SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY::PUTTUR
(AUTONOMOUS)
M. Tech. (Electronics & Communication Engineering)
Specialization: VLSI

I M.Tech - I Sem

S. No	Course Code	Course Name	L	T	P	Credits
1	19HS0823	Research Methodology and IPR	2	-	-	2
2	19EC4201	VLSI Technology	3	-	-	3
3	19EC4202	Digital IC Design	3	-	-	3
Programme Elective - I						
4	19EC4203	ASIC Design	3	-	-	3
	19EC4204	System Modeling & Simulation				
	19EC4101	Embedded System Design				
Programme Elective - II						
5	19EC4205	Verilog HDL	3	-	-	3
	19EC4206	Analog IC Design				
	19EC4015	Image & Video Processing				
6	19EC4207	Digital Electronic Circuits Lab (Virtual Lab)	-	-	4	2
7	19EC4208	Digital IC Design Lab	-	-	4	2
Audit Course - I						
8	19HS0818	English for Research Paper Writing	2	-	-	-
Contact Periods/ Week			16	-	8	**18**
			Total/ Week:24			

I M.Tech - II Sem

S. No	Course Code	Course Name	L	T	P	Credits
1	19EC4209	FPGA Architectures & Applications	3	-	-	3
2	19EC4210	Low Power VLSI Design	3	-	-	3
Programme Elective - III						
3	19EC4211	Nano Electronics	3	-	-	3
	19EC4212	Algorithms for VLSI Design Automation				
	19EC4001	Advanced Digital System Design				
Programme Elective - IV						
4	19EC4213	Testing & Testability	3	-	-	3
	19EC4104	Real Time Operating System				
	19EC4214	Solid State Device Modeling and Simulation				
5	19EC4215	Mixed Signal Lab	-	-	4	2
6	19EC4216	Digital VLSI Design Lab (Virtual Lab)	-	-	4	2
7	19EC4217	Mini Project	-	-	4	2
Audit Course - II						
8	19HS0829	Constitution of India	2	-	-	-
Contact Periods/ Week			14	-	12	**18**
			Total/ Week:26			

II M.Tech – ISem

S. No	Course Code	Course Name	L	T	P	Credits
Programme Elective - V						
1	19EC4218	Scripting Language for VLSI Design Automation	3	-	-	3
	19EC4219	Nano Materials and Nanotechnology				
	19EC4008	Wireless Sensor Networks				
Open Elective						
2	19HS0824	Business Analytics	3	-	-	3
	19CE1028	Cost Management of Engineering Projects				
	19EE2128	Waste to Energy				
	19ME3121	Industrial Safety				
	19ME3021	Advances in Operations Research				
	19ME3022	Composite Materials				
3	19EC4220	Dissertation Phase- I	-	-	20	10
Contact Periods/ Week			6	-	20	**16**
			Total/ Week:26			

II M.Tech - II Sem

S. No	Course Code	Course Name	L	T	P	Credits
1	19EC4221	DissertationPhase- II	-	-	32	16
			Total/ Week:32			

NOTE: L- Lecture, T- Theory, P-Practical

LIST OF SUBJECTS

S No.	Subject Code	Subject Name
1.	19EC4201	VLSI Technology
2.	19EC4202	Digital IC Design
3.	19EC4203	ASIC Design
4.	19EC4204	System Modeling & Simulation
5.	19EC4101	Embedded System Design
6.	19EC4205	Verilog HDL
7.	19EC4206	Analog IC Design
8.	19EC4015	Image & Video Processing
9.	19EC4207	Digital Electronic Circuits Lab (Virtual Lab)
10.	19EC4208	Digital IC Design Lab
11.	19HS0823	Research Methodology and IPR
12.	19HS0818	English for Research Paper Writing
13.	19CE1029	Disaster Management
14.	19HS0825	Sanskrit for Technical Knowledge
15.	19HS0826	Value Education
16.	19EC4209	FPGA Architectures & Applications
17.	19EC4210	Low Power VLSI Design
18.	19EC4211	Nano Electronics
19.	19EC4212	Algorithms for VLSI Design Automation
20.	19EC4001	Advanced Digital System Design
21.	19EC4213	Testing & Testability
22.	19EC4104	Real Time Operating Systems
23.	19EC4214	Solid State Device Modeling and Simulation
24.	19EC4215	Mixed Signal Lab
25.	19EC4216	Digital VLSI Design Lab (Virtual Lab)
26.	19EC4217	Mini Project
27.	19HS0829	Constitution of India
28.	19HS0827	Pedagogy Studies
29.	19HS0828	Stress Management by Yoga
30.	19HS0819	Personality Development Through Life Enlightenment Skills.
31.	19EC4218	Scripting Language for VLSI Design Automation
32.	19EC4219	Nano Materials and Nanotechnology
33.	19EC4008	Wireless Sensor Networks
34.	19HS0824	Business Analytics
35.	19CE1028	Cost Management of Engineering Projects
36.	19EE2128	Waste to Energy
37.	19ME3121	Industrial Safety
38.	19ME3021	Advances in Operations Research
39.	19ME3022	Composite Materials
40.	19EC4220	Dissertation Phase - I
41.	19EC4221	DissertationPhase - II

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(19HS0823) RESEARCH METHODOLOGYAND IPR

COURSE OBJECTIVES

The objectives of this course:

1. *Understand some basic concepts of research and its methodologies*
2. *Identify appropriate research topics*
3. *Enrich knowledge to their research field*
4. *Process for filing Patent*

COURSE OUTCOMES (COs)

On successful completion of course, the student will be able to

1. *Recognize appropriate research problem, errors in selecting a research problem, Scope and objectives of research*
2. *Critically assess research methods pertinent to technology innovation research*
3. *Identify, explain, compare, and prepare the key elements of a research proposal/report*
4. *Skill to understand the need of intellectual property rights, IPR protection to inventors*
5. *Develop procedural knowledge to Legal System and solving the problem relating to intellectual property rights for further research work and investment in R & D*

UNIT – I

Research: Meaning of research problem - Sources of research problem - Criteria - Characteristics of a good research problem - Errors in selecting a research problem - Scope and objectives of research problem - Approaches of investigation of solutions for research problem - data collection, analysis, interpretation - Necessary instrumentations

UNIT – II

Literature survey in Research: Effective literature studies approaches - analysis - Plagiarism - Research ethics

UNIT – III

Project Report: Effective technical writing - how to write report – Paper - Developing a Research Proposal - Format of research proposal -A presentation and assessment by a review committee

UNIT – IV

Intellectual Property Rights: Nature of Intellectual Property – Patents, Designs, Trade and Copyrights - Process of Patenting and Development - Technological research, innovation, patenting, development - International Scenario - International cooperation on Intellectual Property - Procedure for grants of patents - Patenting under PCT

UNIT – V

Patent Rights: Scope of Patent Rights - Licensing and transfer of technology –Patentinformation and databases - Geographical Indications - New Developments in IPR - Administration of Patent System - New developments inIPR - IPR of Biological Systems, Computer Software - Traditional knowledge, Case Studies - IPR and IITs

TEXTBOOKS

1. CR Kothari, "*Research Methodology: Methods and Techniques*" 3rd Edition, New Age International(P) Limited, Publishers, 2013
2. NeerajPandey&KhushdeepDharani, "*Intellectual Property Rights*" Eastern Economy Edition, PHI Learning Private Limited.

REFERENCES

1. John W. Creswell, "Research Design – Qualitative, Quantitative and Mixed Methods Approaches" 4th Edition, SAGE Publications, New Delhi 2014
2. Ranjit Kumar, 4thEdition, "*Research Methodology: A Step by Step Guide for beginners*" SAGE Publications, New Delhi, 2014.
3. Ramakrishna B & Anil Kumar H.S "*Fundamentals of Intellectual Property Rights- for students, Industrialist and Patent Lawyers*", First Published, Notion Press, Chennai, 2017.
4. Ahuja VK, "*Intellectual Property Rights in India*", Second Edition, Mittal Books India, 2015.
5. KC Kankanala, AK Narasani& V Radhakrishnan, "*Indian Patent Law and Practice*", Oxford India Paperbacks, Edition, 2012.

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(18EC4201) VLSI TECHNOLOGY
(Common to VLSI & ES)

COURSE OBJECTIVES
The objectives of this course:

1. Understand the electrical properties of MOS, CMOS and BICMOS.
2. Design and Analysis of logic gates and Layouts.
3. Conceptual view of VLSI design flow.

COURSE OUTCOMES (COs)
On successful completion of course, the student will be able to

1. *Understands various parameters of MOSFET based logic circuit.*
2. *Draw layout of a given circuit.*
3. *Design and Analyze Combinational and sequential Circuits.*
4. *Floor Planning and Physical Design Flows.*
5. *Familiar with basics of Chip Design.*

UNIT – I

Review of Microelectronics and Introduction to Mos Technologies: (MOS, CMOS, Bi-CMOS) Technology Trends and Projections.

Basic Electrical Properties of MOS, CMOS &BiCMOS Circuits: I_{ds} -V_{ds} Relationships, Threshold Voltage V_t, gm, g_{ds} & ω_o - Pass Transistor - MOS, CMOS, Bi-CMOS Inverters & $Z_{p.u}/Z_{p.d}$ - MOS Transistor Circuit Model - Latch-Up in CMOS Circuits.

UNIT – II

Layout Design And Tools: Transistor Structures - wires and vias - Scalable Design Rules - Layout Design Tools.

Logic Gates & Layouts: Static Complementary Gates - Switch Logic - Alternative Gate Circuits - Low Power Gates - Resistive and Inductive Interconnect Delays.

UNIT – III

Combinational Logic Networks: Layouts, Simulation, Network delay, Interconnect Design & Power Optimization - Switch Logic Networks, Gate and Network Testing.

Sequential Systems: Memory Cells and Arrays - Clocking Disciplines, Design - Power Optimization - Design Validation and Testing.

UNIT – IV

Floor Planning & Architecture Design: Floor Planning Methods, Off-Chip Connections, High Level Synthesis, Architecture for Low Power, SOCs and Embedded CPUs, Architecture Testing.

UNIT – V

Introduction To Cad Systems (Algorithms) And Chip Design:

Layout Synthesis and Analysis - Scheduling and Printing - Hardware-Software Co-design, Chip Design Methodologies- A Simple Design Example.

TEXT BOOKS

1. Wayne Wolf, *Modern VLSI Design*, 3rd Edition, Pearson Education, fifth Indian Reprint, 2005.
2. K. Eshraghian et.al (3 authors), *Essentials of VLSI Circuits and Systems*, PHI of India Ltd., 2005.

REFERENCES

1. N.H. E Weste, K. Eshraghian, *Principals of CMOS Design*, Adison Wesley, 2ndEdition.
2. Fabricius, *Introduction to VLSI Design*, MGH International Edition, 1990.
3. Neil H E West and Kamran Eshranghian, *Principles of CMOS VLSI Design - A System Perspective*, Addision-Wesley 2nd Edition, 2002.

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(18EC4202) DIGITAL IC DESIGN
(Common to VLSI & ES)

COURSE OBJECTIVES
The objectives of this course:

1. *Able to Understand the Static & Dynamic Behavior of CMOS &BiCMOS circuits.*
2. *Able to design CMOS based Subsystems.*
3. *Able to design BiCMOS based subsystems.*

COURSE OUTCOMES (COs)
On Successful Completion of this Course, the Student will be able to

1. *Understand Static and dynamic power consumption in Integrated Chips.*
2. *Design CMOS based Combinational circuits and Memory modules.*
3. *Demonstrate the delay and power consumption in BiCMOS circuits.*
4. *Design and Analyze Layout of given circuit in terms of various parameters.*
5. *Able to mimic and implement simple subsystems design.*

UNIT– I
CMOS Inverters -Static and Dynamic Characteristics, Static and Dynamic CMOS Design- Domino and NORA Logic - Combinational and Sequential Circuits.

UNIT – II
Method of Logical Effort for Transistor Sizing -Power Consumption in CMOS gates- Low Power CMOS Design, Arithmetic Circuits in CMOS VLSI - Adders- Multipliers- Shifter - CMOS Memory Design - SRAM and DRAM

UNIT– III
Bipolar Gate Design- BiCMOS Logic - Static and Dynamic Behavior -Delay and Power Consumption in BiCMOS Logic.

UNIT– IV
Layout Design Rules: Need for Design Rules - Mead Conway Design Rules for the Silicon Gate NMOS Process, CMOS Based Design Rules & Simple Layout Examples, Sheet Resistance - Area Capacitance - Wire Capacitance - Drive Large Capacitive Load**.**

UNIT– V
Subsystem Design Process: General arrangement of 4-bit Arithmetic Processor- Design of 4-bit shifter - Design of ALU Sub-System - Implementing ALU Functions with an Adder, Carry-look-ahead Adders, Multipliers, Serial Parallel Multipliers, Pipeline Multiplier Array & Modified Booth's Algorithm.

TEXT BOOKS

1. Sung-Mo Kang & Yusuf Leblebici, *CMOS Digital Integrated Circuits - Analysis & Design*, MGH, Second Ed.,1999.
2. Jan M Rabaey, *Digital Integrated Circuits - A Design Perspective*, Prentice Hall, 1997.
3. Eugene D Fabricus, *Introduction to VLSI Design*, McGraw Hill InternationalEdition.1990.

REFERENCES

1. Ken Martin, *Digital Integrated Circuit Design,* Oxford University Press, 2000.
2. Neil H E West and Kamran Eshranghian, *Principles of CMOS VLSI Design - A System Perspective*, Addision-Wesley 2nd Edition, 2002.
3. R. J. Baker, H. W. Li, and D. E. Boyce, *CMOS circuit design, layout, and simulation*, New York: IEEE Press, 1998.
4. David A. Hodges, Horace G. Jackson and Resve A. Saleh, *Analysis and Design of Digital Integrated Circuits*, Third Edition, McGraw-Hill, 2004.

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(19EC4203) ASIC DESIGN
(Programme Elective -I)

COURSE OBJECTIVES
The objectives of this course:

1.*To prepare the student to be an entry-level industrial standard ASIC or FPGA designer.*
2.*To develop the skill and tools related to ASIC/FPGA design and implementation.*
3.*To improve the skills to understanding of basics of System on Chip and Platform based design.*

COURSE OUTCOMES (COs)
On Successful Completion of this Course, the Student will be able to

1. *Demonstrate VLSI tool-flow and appreciate FPGA architecture.*
2. *Understand the issues involved in ASIC design, including technology choice, design management, tool-flow, verification, debug and test, as well as the impact of technology scaling on ASIC design.*
3. *Understand the algorithms used for ASIC construction*
4. *Understand the basics of System on Chip, On chip communication architectures like AMBA,AXI an utilizing Platform based design.*
5. *Appreciate high performance algorithms available for ASICs.*

UNIT-I
ASIC Design Styles: Introduction – Categories – Gate Arrays – Standard Cells – Cell Based ASICs – Mixed Mode and Analogue ASICs – PLDs.
ASICS Programmable Logic Devices: Overview – PAL Based PLDs - Structures – PAL Characteristics – FPGAs– Introduction – Selected Families – Design Outline.

UNIT-II
ASICS Design Issues: Design Methodologies – Design Tools – Design for Testability – Economies.
ASIC Characteristics and Performance: Design Styles – Gate Arrays – Standard Cell – Based Asics – Mixed Mode and Analogue ASICs.

UNIT-III
ASICS Design Techniques: Overview – Design Flow – Methodology – Hardware Description Languages – Simulation and Checking – Commercial Design Tools – FPGA Design Tools-XILINX, ALTERA.

UNIT-IV

Logic Synthesis, Simulation and Testing: Verilog and Logic Synthesis – VHDL and Logic Synthesis – Types of Simulation – Boundary Scan Test – Fault Simulation – Automatic Test Pattern Generation.

UNIT-V

ASIC Construction: Floor Planning – Placement and Routing System Partition.

FPGA Partitioning: Partitioning Methods – Floor Planning – Placement – Physical Design Flow – Global Routing – Detailed Routing – Special Routing – Circuit Extraction – DRC.

TEXT BOOKS

1. *Integrated circuit engineering,* L.J.Herbst, Oxford Science Publications, 1996.
2. Michael John Sebastin Smith, - "*Application - Specific Integrated Circuits*" – Pearson Education,

REFERENCES

1. *Application -Specific integrated circuits*, M.J.S.Smith, Addison-Wesley Longman Inc 1997.
2. S.D. Brown, R.J. Francis, J. Rox, Z.G. Uranesic, "*Field Programmable Gate Arrays*"- Kluwer Academic Publishers, 1992.
3. 3.J.S.Smith, " *Application – Specific Integrated Circuits*", Pearson,2003

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(19EC4204) SYSTEM MODELLING & SIMULATION

COURSE OBJECTIVES

The objectives of this course:

1. *The aim of this course is to introduce various system modeling and simulation Techniques and highlight their applications in different areas*
2. *The course includes modeling, design, simulation, planning, verification and validation.*
3. *After learning the simulation techniques, we can be able to solve real world problems*
4. *This course begins by demonstrating the usefulness of simulation as a tool for problem solving in business, industry, government, and society.*

COURSE OUTCOMES (COs)

On Successful Completion of this Course, the Student will be able to

1. *Understand the topics in digital logic design.*
2. *Understand modeling and verification with Hardware Description Language.*
3. *Understand the tunning filtering.*
4. *Understand the signals and events.*
5. *Understand the simulation software.*

UNIT – I

Basic Simulation Modeling, Systems, Models and Simulation, Discrete Event Simulation, Simulation of Single Server Queuing System, Simulation of Inventory System, Alternative Approach to Modeling and Simulation.

Simulation Software: Comparison of Simulation Packages with Programming Languages, Classification of Software, Desirable Software Features, General Purpose Simulation Packages – Arena, Extend and Others, Object Oriented Simulation, Examples of Application Oriented Simulation Packages.

UNIT – II

Building Simulation Models: Guidelines for Determining Levels of Model Detail, Techniques for Increasing Model Validity and Credibility.

Modeling Time Driven Systems: Modeling Input Signals, Delays, System Integration, Linear Systems, Motion Control Models, Numerical Experimentation.

UNIT – III

Exogenous Signals And Events: Disturbance Signals, State Machines, Petri Nets & Analysis, System Encapsulation.

Markov Process: Probabilistic Systems, Discrete Time Markov Processes, Random Walks, Poisson Processes, the Exponential Distribution, Simulating a Poison Process, Continuous-Time Markov Processes.

UNIT – IV

Event Driven Models: Simulation Diagrams, Queuing Theory, Simulating Queuing Systems, Types of Queues, Multiple Servers.

UNIT – V

System Optimization: System Identification, Searches, Alpha/Beta Trackers,Multidimensional Optimization, Modeling and Simulation Mythology.

TEXTBOOKS

1. John Wiley & Sons , *System Modeling & Simulation, an Introduction,* 2001.
2. Averill M.Law, W.David Kelton, *Simulation Modeling and Analysis*, TMH, 3rdEdition,2003.

REFERENCES

1. Jerry Banks and John, Carson, *Discrete Event System Simulation*, Fourth Edition, PHI, 2005.
2. Geoffrey Gordon, *System Simulation*, Second Edition, PHI, 2006 .
3. Frank L. Severance, *System Modeling and Simulation*, Wiley, 2001.
4. Averill M. Law and W. David Kelton, *Simulation Modeling and Analysis*, Third Edition, McGraw Hill, 2006.

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(19EC4101) EMBEDDED SYSTEM DESIGN

COURSE OBJECTIVES

The objectives of this course:

1. *Able to understand fundamentals of embedded systems.*
2. *Able to familiarize students with Embedded Computing Platform.*
3. *Able to learn various tools for design & development of embedded systems.*
4. *Able to understand the instruction set of various processors in embedded systems.*

COURSE OUTCOMES (COs)

On Successful Completion of this Course, the Student will be able to

1. *Apply and analyse the applications in various processors and domains of embedded system*
2. *To Analyse and develop embedded hardware and software development cycles and tools.*
3. *To Analyseand understand a microprocessor and core of the embedded system.*
4. *To Analyse to understand different concepts of a RTOS, sensors, memory interface, and communication interface.*
5. *To solve real world problems by doing projects using embedded systems.*

UNIT – I

Introduction: Embedded System Overview - Embedded Hardware Units - Embedded Software in a System - Embedded System on Chip (SoC) - Design Process - Classification of Embedded Systems.

UNIT – II

Embedded Computing Platform: CPU Bus - Memory Devices - Component Interfacing- Networks for Embedded Systems - Communication Interfacings: RS232/UART(a), RS422/RS485(b) &IEEE 488 Bus(c).

Survey of Software Architecture: Round Robin, Round Robin with Interrupts, Function Queue Scheduling Architecture, Selecting an Architecture Saving Memory Space.

UNIT – III

Embedded Software Development Tools: Host and Target Machines – Linkers - Locations for Embedded Software - Getting Embedded Software into Target System - Debugging Technique.

RTOS Concepts: Architecture of the kernel - Interrupt Service Routines - Semaphores, Message Queues - Pipes.

UNIT – IV

Instruction Sets: Introduction – Preliminaries - ARM Processor - SHARC Processor - System Design Techniques: Design Methodologies(a), Requirement Analysis(b), Specifications(c) & System Analysis and Architecture Design(d).

UNIT – V

Design Examples: Telephone PBX - Ink Jet Printer - Water Tank Monitoring System – GPRS - Personal Digital Assistants - Set Top Boxes.

TEXTBOOKS

1. Wayne Wolf,*Computers as a component: principles of embedded computing system design,*The Morgan Kaufmann publications,1st Edition, 2001.
2. David E.Simon,*Mechatronics,*Addison-Wesley Professional, 1st s Edition, 1999.

REFERENCES

1. Sri Ram V Iyer, Pankajgupta, *Embedded real time systems programming,* Tata McGraw-Hill,1st Edition, 2004.
2. Frank Vahid, Ton D. Givargis, *Embedded system design a unified hardware/software introduction,* John Willey, 3rd Edition, 2009.
3. KVKK Prasad, *Embedded / real time systems,* Dreamtech press,1st Edition, 2005.

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(19EC4205) VERILOG HDL

COURSE OBJECTIVES

The objectives of this course:

1. *Basic Constructs of Verilog HDL like Verilog primitives, Descriptive Styles, Structural Connections and Design Methodology.*
2. *Combinational and sequential user defined primitives, data types and operators for modeling in Verilog HDL.*
3. *Simulation process and delay concepts of Verilog HDL.*
4. *Synthesis methodology of combinational and sequential logic.*
5. *Switch level models of MOS and CMOS circuits, Design examples in Verilog.*

COURSE OUTCOMES (COs)

On Successful Completion of this Course, the Student will be able to

1. *Understand the basic concepts of Verilog HDL and write simple programs.*
2. *Design of Combinational and sequential logic circuits using user defined primitives, data types and operators.*
3. *Design and Simulate circuits using test vectors and to write the programs more effectively to reduce delay using Verilog tasks and directives.*
4. *Analyze Synthesis methodology of combinational and sequential logic and Finite State Machines.*
5. *Analyze MOS and CMOS circuits.*

UNIT – I

Hardware Modeling with the Verilog HDL: Hardware Encapsulation -The Verilog Module, Hardware Modeling Verilog Primitives, Descriptive Styles, Structural Connections, Behavioral Description in Verilog, Hierarchical Descriptions of Hardware, Structured (Top Down) Design Methodology, Arrays of Instances, Using Verilog for Synthesis, Language Conventions, Representation of Numbers.

UNIT – II

Logic System, Data Types and Operators for Modeling in Verilog HDL: User Defined Primitives – Combinational Behavior User-Defined Primitives –Sequential Behavior, Initialization of Sequential Primitives. Verilog Variables, Logic Value Set, Data Types, Strings, Constants, Operators, Expressions and Operands, Operator Precedence Models of Propagation Delay: Built-In Constructs for Delay, Signal Transitions, Verilog Models for Gate Propagation Delay (Inertial Delay), Time Scales for Simulation, Verilog Models for Net Delay (Transport Delay), Module Paths and Delays, Path Delays and Simulation, Inertial Delay Effects and Pulse Rejection.

UNIT – III

Behavioral Descriptions In Verilog HDL: Verilog Behaviors, Behavioral Statements, Procedural Assignment, Procedural Continuous Assignments, Procedural Timing Controls and Synchronization, Intra-Assignment, Delay-Blocked Assignments, Non- Blocking Assignment, Intra-Assignment Delay: Non-Blocking Assignment, Simulation of Simultaneous Procedural Assignments, Repeated Intra Assignment Delay, Indeterminate Assignments and Ambiguity, Constructs for Activity Flow Control, Tasks and Functions, Summary of Delay Constructs in Verilog, System Tasks for Timing Checks, Variable Scope Revisited, Module Contents, Behavioral Models of Finite State Machines.

UNIT – IV

Synthesis of Combinational Logic: HDL-Based Synthesis, Technology- Independent Design, Benefits of Synthesis, Synthesis Methodology, Vendor Support, Styles for Synthesis of Combinational Logic, Technology Mapping and Shared Resources, Three State Buffers, Synthesis of Sequential Logic: Synthesis of Sequential UDPs, Synthesis of Latches, Synthesis of Edge-Triggered Flip Flops, Registered Combinational Logic, Shift Registers and Counters, Synthesis of Finite State Machines.

Synthesis of Language Constructs: Synthesis of Nets, Synthesis of Register Variables, Restrictions on Synthesis of "X" and "Z", Synthesis of Expressions and Operators, Synthesis of Assignments, Synthesis of Case and Conditional Statement, Synthesis of Resets, Timings Controls in Synthesis, Synthesis of Multi-Cycle Operations, Synthesis of Loops, Synthesis if Fork Join Blocks, Synthesis of The Disable Statement Synthesis of User-Defined Tasks, Synthesis of User-Defined Functions, Synthesis of Specify Blocks, Synthesis of Compiler Directives.

UNIT – V

Switch-Level Models in Verilog: MOS Transistor Technology, Switch Level Models of MOS Transistors, Switch Level Models of Static CMOS Circuits, Alternative Loads and Pull Gates, CMOS Transmission Gates, Bio-Directional Gates (Switches), Signal Strengths, Ambiguous Signals, Strength Reduction by Primitives, Combination and Resolution of Signal Strengths, Signal Strengths and Wired Logic, Design Examples in Verilog.

TEXT BOOKS

1. M.D. Ciletti,*Modeling, Synthesis and Rapid Prototyping with the Verilog HDL*,Prentice-Hall, 1999.
2. Z. Nawabi, *VHDL Analysis and Modeling of Digital Systems*, (2/E), McGraw Hill, 1998.

REFERENCES

1. M.G. Arnold, *Verilog Digital – Computer Design*, Prentice-Hall (PTR), 1999.
2. Perry, *Vhdl*, (3/E), McGraw Hill.

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(19EC4206) ANALOG IC DESIGN
(Programme Elective -II)

COURSE OBJECTIVES

The objectives of this course:

1. *To develop the ability to design and analyze MOS based analog VLSI circuits.*
2. *To develop the skills to design analog VLSI circuits for a given specification.*
3. *To learn how to use and where to use data converters and Sampling Converters.*

COURSE OUTCOMES (COs)

On Successful Completion of this Course, the Student will be able to

1. *Analyze the Advanced MOS Modeling concept and also learn the behavior of Current Mirrors.*
2. *Develop mathematical modeling of op-amps.*
3. *Analyze the design of MOS based sample and hold circuits.*
4. *Learn the design of data converters (ADC/DAC).*
5. *Analyze the concept of Over Sampling Converters.*

UNIT–I

Integrated Devices and Modeling and Current Mirror:

MOS Transistors - Modeling in Linear, Saturation & Cut Off High Frequency Equivalent Circuit – Advanced MOS Modeling - Large Signal, Small Signal Modeling for BJT – Basic Current Mirrors - Single Stage Amplifiers – Simple CMOS Current Mirror – High Output Impedance Current Mirrors – Bipolar Gain Stages – Frequency Response.

UNIT–II

Operational Amplifier Design and Compensation: Two Stage CMOS Operational Amplifier – Feedback and Operational Amplifier Compensation – Advanced Current Mirror – Common Mode Feedback Circuits – Current Feedback Operational Amplifier – Comparator – Charge Injection Error – Latched Comparator and Bi-CMOS Comparators.

UNIT–III

Sample and Hold Switched Capacitor Circuits-I: MOS – CMOS – Bi-CMOS – Sample and Hold Circuits – Switched Capacitor Circuits-Basic Operation and Analysis –First Order – Biquard Filters.

Sample and Hold Switched Capacitor Circuits-II: Charge Injection – Switched Capacitor Gain Circuit – Correlated – Double Sampling Techniques –Other Switched Capacitor Circuits.

UNIT– IV

Data Converters: Ideal D/A, A/D Converters - Quantization Noise, Performance &Limitations –Nyquist Rate D/A Converters - Decoders Based Converters, Binary Scaled Converters & Hybrid Converters – Nyquist Rate A/D Converters - Integrating, Successive Approximation, Cyclic Flash Type, Two Step, Interpolating, Folding & Pipelined A/D Converters.

UNIT –V

Over Sampling Converters and Filters: Over Sampling with and without Noise –Shaping – Digital Decimation Filter – High Order Modulators – Band Pass Over Sampling Converter – Practical Considerations – Continuous Time Filters.

TEXTBOOKS

1. D.A. John & Ken Martin, John Wiley,*Analog Integrated Circuit Design,* 1997.
2. Behzad Razavi, Tata-Mc Graw Hill, *Design of Analog CMOS Integrated Circuit, 2002.*

REFERENCES

1. Philip Allen & Douglas Holberg, *CMOS Analog Circuit Design*, Oxford University Press,2002.
2. John Wiley, *Analog MOS Integrated Circuits,* 1986.
3. Paul R Gray Robert G Meyer, *"Analysis and Design of Analog Integrated Circuits"*,4th edition, 2009.

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(19EC4015) IMAGE & VIDEO PROCESSING
(Common to DECS & VLSI)
(Programme Elective – II)

COURSE OBJECTIVES

The objectives of this course:

1. *Develop an overview of the field of image processing.*
2. *Understand the fundamental algorithms and how to implement them.*
3. *Prepare to read the current image processing research literate.*

COURSE OUTCOMES (COs)

On Successful Completion of this Course, the Student will be able to

1. *Describe and use the principles of digital image and video processing to develop image processing algorithms.*
2. *Implement (for example with MATLAB) and assess the developed image processing algorithms.*
3. *Explain algorithm design choices using the principles of digital image/video processing.*
4. *Develop image processing algorithms for a given practical image/video processing problem.*
5. *Solve more advanced problems in all areas mentioned above*
6. *Identify and explain the challenges, propose possible solutions, and explain the chosen algorithm design.*

UNIT – I

Image Representation: Gray Scale And Color Images– Image Sampling And Quantization– Two Dimensional Orthogonal Transforms: DFT, WT, HAAR Transform, KLT, And DCT.

UNIT – II

Image Enhancement: Filters In Spatial And Frequency Domains– HistogramBased Processing, And Homomorphic Filtering– Edge Detection, Non-Parametric And Model Based Approaches– LOG Filters– Localization Problem.

UNIT – III

Image Restoration: Degradation Models, PSF, Circulant And Block Circulant Matrices – De-Convolution – Restoration Using Inverse Filtering: Wiener Filtering And Maximum Entropy Based Methods – Morphological Operations.

Image Segmentation: Pixel Classification – Bi-Level Thresholding – Multi-Level Thresholding: P-Tile Method, Adaptive Thresholding – Spectral & Spatial Classification – Hough Transform – Region Growing.

UNIT – IV

Image Compression: Compression Models – Information Theoretic Perspective – Fundamental Coding Theorem.

Lossless Compression: Huffman Coding – Arithmetic Coding – Bit Plane Coding – Run Length Coding – Lossy Compression: Transform Coding, Image Compression Standards.

UNIT – V

Video Processing: Representation Of Digital Video – SpatioTemporal Sampling – Motion Estimation – Motion Compensation – Video Filtering, Video Compression – Video Coding Standards.

TEXTBOOKS

1. R. C. Gonzalez, R. E. Woods, *Digital Image Processing*, Pearson Education. 2nd edition, 2002.
2. W. K. Pratt, *Digital Image Processing*, Prentice Hall, 1989.

REFERENCES

1. Rosenfold and A. C. Kak, *Digital Image Processing*, Vols. 1 And 2, PHI, 1986.
2. H. C. Andrew and B. R. Hunt,*Digital Image Restoration*, PrenticeHall,1977
3. R. Jain, R.Kasturi and B.G.Schunck, *Machine Vision*,Mgh International Edition, 1995.

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(19EC4207) DIGITAL ELECTRONIC CIRCUITS LAB (Virtual Lab)

COURSE OBJECTIVES

The objectives of this course:

1. *To acquire the basic knowledge of digital logic levels.*
2. *To understand the digital electronics circuits.*
3. *To impart how to design Digital Circuits.*

COURSE OUTCOMES (COs)

On Successful Completion of this Course , the Student will be able to

1. *Convert different type of codes and number systems which are used in digital communication and computer systems.*
2. *Employ the codes and number systems converting circuits and Compare different types of logic families.*
3. *Analyse different types of digital electronic circuit using various mapping and logical tools.*
4. *simplified circuit using various mapping and mathematical methods.*
5. *Design different types of with and without memory element digital electronic circuits for particular operation.*

LIST OF EXPERIMENTS:

1. Analysis of Functions of BCD-TO-7-segment Decoder / Driver and Operation of 7- Segment LED Display.
2. Characterization of Digital Logic Families.
3. Analysis and Synthesis of Boolean Expressions using Basic Logic Gates.
4. Analysis and Synthesis of Logic Functions using Multiplexers.
5. Analysis and Synthesis of Logic Functions using Decoders.
6. Analysis and Synthesis of Boolean Relations using Digital Comparators.
7. Analysis and Synthesis of Arithmetic Expressions using Adders /Subtractors.
8. Analysis and Synthesis of Sequential Circuits using Basic Flip-Flops.
9. Analysis and Synthesis of Multi-bit Sequential Circuits using Shift Registers.
10. Design of Arithmetic Logic Unit (ALU)

REQUIRED SOFTWARE TOOLS:

1. Mentor Graphic tools / Cadance tools/ Synophysis tools. (220 nm Technology andabove).
2. NgSpiceSoftwaretool.

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(19EC4208) DIGITAL IC DESIGN LAB

COURSE OBJECTIVES

The objectives of this course:

1. *Understand concept of various components.*
2. *Understand concepts that underpin the disciplines of Digital electronic logic circuits.*
3. *Describe Various Number system and Boolean algebra.*

COURSE OUTCOMES (COs)

On successful completion of course, the student will be able to

1. *Achieve Knowledge and Awareness of various components to design stable analog circuits.*
2. *Minimize the Boolean expression using Boolean algebra and design it using logic gates*
3. *Analyse and design combinational circuit.*
4. *Design and develop sequential circuits*
5. *Translate real world problems into digital logic formulations using VHDL.*

LIST OF EXPERIMENTS:

1. Digital Circuits Description using Verilog and VHDL.
2. Verification of the Functionality of Designed Circuits using Function Simulator.
3. Timing Simulation for Critical Path Time Calculation.
4. Synthesis of Digital circuits.
5. Place and Route Techniques for Major FPGA Vendors such as Xilinx, Altera and Acteletc.
6. Implementation of Designed Digital Circuits using FPGA and CPLD devices.

REQUIRED SOFTWARE TOOLS:

1. Mentor Graphic tools / Cadance tools/ Synophysis tools. (220 nm Technology andAbove)
2. Xilinx 11.1i and Above for FPGA/CPLDS / FPGAAdvantage

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(19HS0818) ENGLISH FOR RESEARCH PAPER WRITING

COURSE OBJECTIVES

The objectives of this course:

1. *To understand that how to improve writing skills and level of readability.*
2. *To learn about what to write in each section.*
3. *To understand the skills needed when writing a Title.*
4. *To ensure the good quality of paper at very first-time submission.*
5. *To know the strategies and techniques for preparing academic projects.*

COURSE OUTCOMES (COs)

On Successful Completion of this Course, the Student will be able to

1. *To recognize and demonstrate the style and conventions of research writing.*
2. *To improve the clarity and coherence of their written proposal.*
3. *Able to use a variety of sentence patterns.*
4. *To enhance their revision and proofreading skills.*
5. *To use effective strategies and techniques to construct their academic projects*.

UNIT-I

Planning and Preparation- Word Order- Breaking up long sentences- StructuringParagraphs and Sentences- Being Concise and Removing Redundancy, AvoidingAmbiguity and Vagueness.

UNIT-II

Clarifying Who Did What- Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism- Sections of a Paper, Abstracts and Introduction.

UNIT-III

Review of the Literature,-Methods, Results, Discussion, Conclusions and The Final Check.

UNIT-IV

Key skills needed when writing Title- Key skills needed when writing abstract- Key skillsneeded when writing an Introduction- Skills whenwriting a Review of the Literature.

UNIT-V

Skills needed when writing the Methods- Skills needed when writing the Results- Skills needed when writing the Discussion- Skills needed when writing the Conclusions.

TEXT BOOKS

1. Adrian Wallwork, *English for Writing Research Papers*, Springer New York Dordrecht.Heidelberg London, 2011.
2. Adrian Wallwork, *English for Academic Correspondence and Socializing*, Kindle edition, 2011

REFERENCES

1. Day R *How to Write and Publish a Scientific Paper*, Cambridge University Press, 2006.
2. Highman N *Handbook of Writing for the Mathematical Sciences*, SIAM, Highman's Books,1998.
3. Goldbort R *Writing for Science*, Yale University Press,2006.

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(19EC4209) FPGA ARCHITECTURES & APPLICATIONS

COURSE OBJECTIVES

The objectives of this course:

1. *Know FPGA Architecture, Interconnect and Technologies.*
2. *Know Different FPGA's and Implementation Methodologies.*
3. *Understand Configuring and Implementing Digital Embedded System, Microcontrollers, Microprocessors, FSM Systems on FPGA.*

COURSE OUTCOMES (COs)

On Successful Completion of this Course, the Student will be able to

1. *Acquire Knowledge about Various Architectures and Device Technologies Of PLD's*
2. *Comprehend FPGA Architectures.*
3. *Describe FSM and Different FSM Techniques like Petrinets& Different Case Studies.*
4. *Acquire Knowledge on Hot Design Method*
5. *Analyze System Level Design and Their Application for Combinational and Sequential Circuits*

UNIT – I

Programmable Logic: ROM, PLA, PAL, PLD, PGA – Features, Programming and Applications using Complex Programmable Logic Devices Altera Series – Max 5000/7000 Series and Altera FLEX Logic – 10000 Series CPLD, AMD's – CPLD (Mach 1 To 5); Cypres FLASH 370 Device Technology, Lattice PLSI's Architectures – 3000 Series – Speed Performance and in System Programmability.

UNIT – II

FPGA: Field Programmable Gate Arrays – Programming Technologies, Logic Blocks, Routing Architecture, Design Flow, Technology Mapping for FPGAs.

Case Studies: Xilinx XC4000 & ALTERA's FLEX 8000/10000 FPGAs: AT & T–ORCA's (Optimized Reconfigurable Cell Array): ACTEL's – ACT-1,2,3 and Their Speed Performance.

UNIT – III

Finite State Machines (FSM): Top Down Design – State Transition Table, State Assignments for FPGAs, Problem of Initial State Assignment for One Hot Encoding, Derivations of State Machine Charges.

Realization Of State Machine: Charts with a PAL, Alternative Realization for State Machine Chart using Microprogramming, Linked State Machines. One – Hot State Machine, Petrinets for State Machines – Basic Concepts, Properties, Extended Petrinets for Parallel Controllers. Finite State Machine Case study, Meta Stability, Synchronization.

UNIT – IV

FSM Architectures and Systems Level Design: Architectures Centered around Non-Registered PLDs. State Machine Designs Centered around Shift Registers, one – Hot Design Method, Use of ASMs in One – Hot Design, Application of One – Hot Method, System Level Design – Controller, Data Path and Functional Partition.

UNIT – V

Case Studies: Combinational Logic Circuits - Parallel Adder Cell, Parallel Adder Sequential Circuits - Decade Counters, Multipliers, Parallel Controller design

TEXTBOOKS

1. P.K.Chan& S. Mourad, Prentice Hall (Pte), *Digital Design Using Field Programmable Gate Array*, 1994.
2. S.Brown, R.Francis, J.Rose, Z.Vransic, "Field Programmable Gate Array", Kluwer
3. Publications, 1992.

REFERENCES

1. J. Old Field, R.Dorf, "Field Programmable Gate Arrays", John Wiley & Sons, New York, 1995.
2. S.Trimberger, Edr. "Field Programmable Gate Array Technology", Kluwer, Academic Publications, 1994.
3. Bob Zeidman, "Designing with FPGAs & CPLDs", CMP Books, 2002.

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(19EC4210) LOW POWER VLSI DESIGN

COURSE OBJECTIVES

The objectives of this course:

1. *To develop the Skills to Effectively Analyze the Technique of Low Power MOS VLSI Design.*
2. *To develop the ability to Effectively Design and analyze the Low Power CMOS/BiCMOS Circuits.*
3. *To develop the ability to Effectively Design and analyze Low Power MOS based Flipflops.*

COURSE OUTCOMES (COs)

On Successful Completion of this Course, the Student will be able to

1. *Analyze the low power MOSFET Device Behavior.*
2. *Analyze Low- Voltage Low Power CMOS /BiCMOS Logic Circuits.*
3. *Analyze and Design the Low Power Latches/Flipflops.*
4. *Learn Special Techniques for Low Power Clocks and Memories.*
5. *Analyze the Advanced Bi- CMOS Digital Circuits at low power.*

UNIT– I

Low Power Design, An Over View: Introduction to Low Voltage Low Power Design – Limitations – Silicon On Insulator.

MOS/BiCMOS Processes: Bi CMOS Processes – Integration and Isolation Considerations – Integrated Analog/Digital CMOS Process.

UNIT– II

Low-Voltage/Low Power CMOS/ BiCMOS Processes: Deep Submicron Processes – SOI CMOS –Lateral BJT on SOI – Future Trends and Directions of CMOS/Bi- CMOS Processes.

Device Behavior and Modeling: Advanced MOSFET Models – Limitations of MOSFET Models – Bipolar Models – Analytical and Experimental Characterization of Sub- Half Micron MOS Devices – MOSFET in A Hybrid Mode Environment.

UNIT–III

Cmos and BiCMOS Logic Gates: Conventional CMOS – Bi-CMOS Logic gates – Performance Evaluation.

Low-Voltage Low Power Logic Circuits: Comparison of Advanced Bi- CMOS Digital Circuits – ESD Free Bi-CMOS – Digital Circuit Operation, Comparative Evaluation.

UNIT– IV

Low Power Latches and Flip Flops: Evolution of Latches and Flip Flops – Quality Measures for Latches, Flip Flops – Design Perspective.

UNIT V

Special Techniques: Power Reduction in Clock Networks – CMOS Floating Node – Low Power Bus – Delay Balancing – Low Power Techniques for SRAM.

TEXTBOOKS

1. Yeo Rofail/ Gohl (3 Authors),*CMOS/BiCMOS ULSI low voltage, low power*, Pearson Education Asia 1st Indian reprint, 2002.
2. Gary K. Yeap, KAP,*Practical Low Power Digital VLSI Design*, 2002.

REFERENCES

1. Douglas A.Pucknell & Kamran Eshraghian,*Basic VLSI Design*, 3rd edition PHI.
2. *Digital Integrated circuits*, J.Rabaey,PHI,1996.
3. Sung-mo Kang and yusufleblebici, *CMOS Digital ICs*, 3rd edition TMH2003.

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(19EC4211) NANO ELECTRONICS

COURSE OBJECTIVES
The objectives of this course:

1. *Able to understand Transistor and band structure models.*
2. *Nano capacitors, single electron, transistor and Nano photonics.*
3. *Able to design different mass storage devices.*

COURSE OUTCOMES (COs)
On Successful Completion of this Course, the Student will be able to

1. *Able to understand nanoelectronics holds the capacity for mass production of high-Quality nanodevices.*
2. *Able to analyze the scaling of transistors and other devices to smaller and smaller sizes, which has provided the basis for this exponential growth.*
3. *Able to analyze and design different types random access memories.*
4. *Able to analyze different mass storage devices which are useful in electronic gadgets.*
5. *Able to know in the near future from photonics, molecular electronics or revolutionary engineering solutions.*

UNIT – I
Technology And Analysis: Film Deposition Methods-Lithography-Material Removing Technologies-Etching and Chemical-Mechanical Processing-Scanning Probe Techniques.
CARBON NANO STRUCTURES: Carbon Clusters- Carbon Nano tubes- Fabrication-Electrical-Mechanical and Vibrational Properties-Applications of Carbon Nano Tubes.

UNIT – II
Logic Devices: Silicon MOSFETS- Novel Materials and Alternative Concepts- Ferro Electric Filed Effect Transistors- Super Conductor Digital Electronics-Carbon Nano Tubes for Data Processing.

UNIT – III
Radom Acess Memories: High Permittivity Materials for DRAMs- Ferro Electric Random Access Memories-Magneto-Resistive RAM.

UNIT – IV
Mass Storage Devices: Hard Disk Drives-Magneto Optical Disks-Rewriteable DVDs based on Phase Change Materials-Holographic Data Storage.

UNIT – V
Data Transimission, Interfaces And Displays: Photonic Networks-Microwave Communication Systems-Liquid Crystal Displays-Organic Light Emitting Diodes.

TEXT BOOKS

1. Rainer Waser, *Nano Electronics and Information Technology*, Wiley VCH,3rdEdition, April 2003.
2. Charles Poole, *Introduction to Nano Technology,* Wiley Interscience, 2nd Edition **,** May2003

REFERENCES

1. Anupama B Kaul, *Microelectronics to Nanoelectronics:Materials, Devices and Manufacturability.*
2. Rainer Waser,*Nano Electronics and Information Technology,*Wiley VCH,3rd Edition, April 2003
3. A.N.Banarjee,K.K.Chattopadhyay, Introduction to NanoscienceTechnology,PHI.

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(19EC4212) ALGORITHMS FOR VLSI DESIGN AUTOMATION
(Programme Elective -III)

COURSE OBJECTIVES
The objectives of this course:

1. *To impart the knowledge about Design Methodologies, Design Automation Tools,*
2. *To impart the knowledge about modeling, simulation, logic synthesis, verification and high-level synthesis.*
3. *To impart the knowledge about physical design automation of FPGA's and physical design automation of MCM's.*

COURSE OUTCOMES (COs)
On Successful Completion of this Course, the Student will be able to

1. *To analyze&design Methodologies, Design Automation Tools and general-purpose methods for combinational optimization.*
2. *Toanalyzemodeling and simulation of digital systems.*
3. *Toanalyzelogic synthesis and verification of digital system's*
4. *Toanalyze high-level synthesis of digital systems.*
5. *To impartthe knowledge about physical design automation of FPGA's and MCM's.*

UNIT – I
Preliminaries: Introduction to Design Methodologies- Design Automation Tools- Algorithmic Graph Theory - Computational Complexity - Tractable and Intractable problems.

General Purpose Methods for Combinational Optimization: Backtracking - Branch and Bound - Dynamic Programming – Integer Linear Programming - Local Search - Simulated Annealing - Tabu Search - Genetic Algorithms.

UNIT – II
Layout Compaction – Placement - Floor Planning and Routing Problems - Concepts and Algorithms.
Modelling and Simulation: Gate Level Modeling and Simulation - Switch level Modeling and Simulation.

UNIT – III
Logic Synthesis and Verification: Basic issues and Terminology -Binary Decision Diagrams - Two-Level logic Synthesis.

UNIT – IV

High-Level Synthesis: Hardware Models - Internal Representation of the Input Algorithm – Allocation - Assignment and Scheduling - Some Scheduling Algorithms - Some Aspects of Assignment problem - High-level Transformations**.**

UNIT – V

Physical Design Automation of FPGA's: FPGA Technologies - Physical Design Cycle for FPGA's - Partitioning and Routing for Segmented and Staggered Models.

Physical Design Automation of MCM's: MCM Technologies - MCM Physical Design Cycle - Partitioning, Placement - Chip Array Based and Full Custom Approaches- Routing - Maze Routing - Multiple Stage Routing - Topologic Routing - Integrated Pin – Distribution and Routing - Routing and Programmable MCM's.

TEXT BOOKS

1. S.H. Gerez, *Algorithms for VLSI Design Automation,* Wiley Student Edition, John wiley & Son (Asia) Pvt. Ltd., 1999.
2. Naveed Sherwani, *Algorithms for VLSI Physical Design Automation*, 3rd edition, Springer International Edition,2005.

REFERENCES

1. Hill & Peterson, *Computer Aided Logical Design with Emphasis on VLSI*, Wiley,1993.
2. Wayne Wolf, *Modern VLSI Design: Systems on silicon*, Pearson Education Asia, 2nd Edition, 1998.
3. Andreas Burg, *Algorithms to Circuits and System-On-Chip Design*, Springer.

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(19EC4001) ADVANCED DIGITAL SYSTEM DESIGN

(Common to VLSI & DECS)
(Programme Elective -III)

COURSE OBJECTIVES

The objectives of this course:

1. *To make the students to aware of Design of digital systems and sequential circuits.*
2. *To impart the knowledge on D – Algorithm, PODEM, Random testing, Transition Count Testing, Signature Analysis and Testing for bridging fault.*
3. *To impart the knowledge about fault diagnosis, fault models, diagnosis methods & test methods & Test Patten generation.*

COURSE OUTCOMES (COs)

On Successful Completion of this Course, the Student will be able to

1. *To impart the knowledge about Design of digital systems and sequential circuit design*
2. *To impart the knowledge about Fault Modeling, Test Patten generation and different methods for fault diagnosis of Combinational circuits.*
3. *Analyze D – Algorithm, PODEM, Random testing, Transition Count Testing, Signature Analysis and Testing for bridging faults for Test pattern generation of digital system design.*
4. *Analyze the functionality of sequential circuits using different fault diagnosis & test methods.*
5. *Analyze fault models, diagnosis methods of PLA Design and Asynchronous sequential circuits.*

UNIT –I

Design of Digital Systems: ASM charts - Hardware Description Language and Control Sequence Method - Reduction of State Tables - State Assignments.

Sequential Circuit Design: Design of Iterative Circuits –Design of Sequential Circuits Using ROMs, PLAs, CPLD and FPGAs

UNIT – II

Fault Modeling: Fault Classes and Models - Stuck at Faults, Bridging Faults, Transition and Intermittent Faults.

Test Generation: Fault Diagnosis of Combinational Circuits by Conventional Methods - Path Sensitization Technique - Boolean Difference Method - Kohavi Algorithm.

UNIT – III

Test Pattern Generation: D – Algorithm – PODEM - Random Testing-Transition Count Testing - Signature Analysis - Testing for bridging faults.

UNIT –IV

Programming Logic Arrays: Introduction-Design using PLA's, PLA Minimization and PLA Folding.

Fault Diagnosis in Sequential Circuits: State Identification and Fault Detection Experiment - Machine Identification - Design of Fault Detection Experiment.

UNIT – V

PLA Testing: Fault Models - Test generation and Testable PLA design.

Asynchronous Sequential Machine: Fundamental Mode Model- Flow Table - State Reduction - Minimal Closed Covers – Races - Cycles and Hazards.

TEXT BOOKS

1. Z. Kohavi, *Switching & finite Automata Theory,* TMH.
2. N. N. Biswas, *Logic Design Theory,* PHI.
3. Nolman Balabanian, Bradley Calson Wily, *Digital Logic Design Principles,* Student Edition, 2004.

REFERENCES

1. M. Abramovici, M. A. Breues, A. D. Friedman, *Digital System Testing and Testable Design,* Jaico Publications.
2. Charles H. RothJr ,*Fundamentals of Logic Design*,.
3. Frederick. J. Hill & Peterson, *Computer Aided Logic Design,* Wiley 4thEdition.

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(19EC4213) TESTING & TESTABILITY

COURSE OBJECTIVES
The objectives of this course:

1. *Fundamentals of Testing and Testability, different levels of modeling and simulation.*
2. *Fault models and Automatic Test Pattern Generation.*
3. *Testability Trade-Offs, Scan Architectures and Compression Techniques.*
4. *BIST Concepts, Test Pattern Generation and Advanced BIST Concepts.*
5. *Memory Test Architectures, In Circuit Testing (ICT), JTAG Testing Features.*

COURSE OUTCOMES (COs)
On Successful Completion of this Course, the Student will be able to

1. *Understand the elementary concepts of Testing and Testability.*
2. *Understand different types of faults associated with logic circuits and types of testing byemploying fault models to the logic circuits.*
3. *Get complete knowledge about different methods of simulation and algorithms associated withtesting.*
4. *Analyze BIST concepts and design self-test at Board Level.*
5. *Analyze Memory Test Requirements for MBIST and Embedded Core Testing.*

UNIT – I
Introduction to Test and Design for Testability (DFT) Fundamentals: Modeling: Modeling Digital Circuits at Logic Level, Register Level and Structural Models, Levels of Modeling, Logic Simulation: Types of Simulation, Delay Models, Element Evaluation, Hazard Detection, Gate Level Event Driven Simulation.

UNIT – II
Fault Modeling: Logic Fault Models, Fault Detection and Redundancy, Fault Equivalence and Fault Location. Single Stuck and Multiple Stuck – Fault Models. Fault Simulation Applications, General Techniques for Combinational Circuits.

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.

UNIT – III
Design For Testability: Testability Trade-Offs, Techniques, Scan Architectures and Testing – Controllability and Absorbability, Generic Boundary Scan, Full Integrated Scan, Storage Cells for Scan Design, Board Level and System Level DFT Approaches, Boundary Scans Standards, Compression Techniques – Different Techniques, Syndrome Test and Signature Analysis.

UNIT – IV

Built-In Self-Test (BIST): BIST Concepts and Test Pattern Generation. Specific BIST Architectures: CSBL, BEST, RTS, LOCST, STUMPS, CBIST, CEBS, RTD, SST, CATS, CSTP, BILBO. Brief Ideas on Some Advanced BIST Concepts and Design for Self- Test at Board Level

UNIT – V

Memory BIST (MBIST): Memory Test Architectures and Techniques – Introduction to Memory Test, Types of Memories and Integration, Embedded Memory Testing Model. Memory Test Requirements for MBIST

Brief Ideas on Embedded Core Testing: Introduction to Automatic in Circuit Testing (ICT), JTAG Testing Features.

TEXT BOOKS

1. Miron Abramovici, Melvin A. Breur, Arthur D.Friedman, *Digital Systems Testing and Testable Design*,Jaico Publishing House, 2001.
2. Alfred Crouch, *Design for Test for Digital ICs & Embedded Core Systems*, Prentice Hall.

REFERENCES

1. Robert J.Feugate, Jr., Stevenm. Mentyn, *Introduction to VLSI Testing, Prentice Hall*, Englehood Cliffs, 1998.

COURSE OBJECTIVES

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(19EC4104) REAL TIME OPERATING SYSTEM

The objectives of this course:

1. *To deal with issues in real time operating systems,*
2. *To understand the importance of deadlines and concept of task scheduling.*
3. *Student will be able to understand and design real time operating systems which are backbone of embedded industry.*

COURSE OUTCOMES (COs)

On Successful Completion of this Course, the Student will be able to

1. *Student will be able to summarize the issues in real time computing*
2. *Student will be able to explain and give examples of real time operating systems.*
3. *Student will be able to solve scheduling problems and can apply them in real time applications in industry.*
4. *Student can also design an RTOS and will be able to interpret the feasibility of a task set to accomplish or not.*
5. *Analyze the situation of fault occurrence and will be able to apply solutions accordingly.*

UNIT– I

Operating Systems: Overview - Time Services and Scheduling Mechanisms - Other Basic Operating System Function - Processor Reserves and Resource Kernel - Capabilities of Commercial Real Time Operating Systems.

UNIT–II

Introduction to UNIX: Overview of Commands - File I/O: Open, Create, Close, Lseek, Read, and Write - Process Control: Fork, Vfork, Exit, Wait, Waitpid, Exec – Signals - Inter Process Communication: Pipes, FIFOs, Message Queues, Semaphores, Shared Memory.

UNIT– III

Real Time Systems: Typical Real Time Application - Hard Vs Soft Real Time Systems - A Reference Model of Real Time Systems: Processors and Resources - Temporal Parameters of Real Time Workload - Periodic Task Model - Precedence Constraints and Data Dependency Functional Parameters - Resource Parameters of Jobs and Parameters of Resources

UNIT–IV

Approaches to Real Time Scheduling Clock Driven - Weighted Round Robin - Priority Driven - Dynamic Vs. State Systems - Effective Release Times and Dead Lines - Offline Vs Online Scheduling.

Fault Tolerance Techniques Introduction - Fault Causes, Types, Detection, Fault and Error Containment - Redundancy: Hardware, Software, Time - Integrated Failure Handling.

UNIT– V

Case Studies-Vx Works: Memory Managements Task State Transition Diagram - Pre-Emptive Priority, Scheduling, Context Switches – Semaphore – Binary Mutex, Counting: Watch Dugs, I/O System.

RT Linux: Process Management – Scheduling - Interrupt Management - Synchronization.

TEXT BOOKS:

1. Richard Stevens, *Advanced Unix Programming*, Pearson Education 2003.
2. Jane W.S.Liu , *Real Time Systems, Pearson Education*, 2013.

REFERENCES:

1. Vx Works Programmers Guide
2. www.tidp.org
3. www.kernel.org
4. *Real Time Systems, McGraw-Hill*, C.M. Krishna, KANG G.Shin.

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(19EC4214) SOLID STATE DEVICE MODELING AND SIMULATION

COURSE OBJECTIVES

The objectives of this course:

1. *The three areas of circuit design, device modeling and CAD tools are the main pillars based on which all VLSI system designs are carried out*
2. *This course introduces the principles of device modeling and experimentally observed device performance characteristics*
3. *This course introduces mathematical techniques for device simulators*

COURSE OUTCOMES (COs)

On Successful Completion of this Course, the Student will be able to

1. *Able to analyze the principles of basic device modeling*
2. *Able to understand the changes introduced in the device models as well as contribute to the development of appropriate device models*
3. *Able to Analyze General Purpose Circuit Simulators*
4. *Able to Analyze mathematical techniques for device simulations*
5. *Able to Analyze Simulation of Semiconductor Devices*

UNIT – I

MOSFET Device Physics: MOSFET Capacitor-Basic Operation,BasicModeling,Advanced MOSFET Modeling-RF Modeling of MOS Transistors- Equivalent Circuit Representation of MOS Transistor-High Frequency Behavior of MOS Transistor And A.C Small Signal Modeling-Model Parameter Extraction-Modeling Parasitic BJT, Resistors, Capacitors, Inductors.

UNIT – II

Device Modelling: Prime Importance of Circuit and Device Simulations In VLSI-Nodal, Mesh, Modified Nodal and Hybrid Analysis Equations- Solution of Network Equations- Sparse Matrix Techniques- Solution of Nonlinear Networks Through Newton- Raphson Technique-Convergence and Stability.

UNIT – III

Multistep Methods: Solution of Stiff Systems of Equations- Adaptation of Multistep Methods to The Solution of Electrical Networks-General Purpose Circuit Simulators.

UNIT – IV

Mathematical Techniques For Device Simulations: Poisson Equation-Continuity Equation-Drift-Diffusion Equation-Schrodinger Equation-Hydrodynamic Equations- Trap Rate- Finite Difference Solutions to These Equations in 1D and 2D Space-Grid Generation.

UNIT – V

Simulation Of Devices: Computation of Characteristics of Simple Devices Like P-N Junction-MOS Capacitor and MOSFET-Small-Signal Analysis.

TEXT BOOKS

1. Arora.N,MOSFET *Models for VLSI Circuit Simulation,* Springer-Verlag Second Edition,1993.
2. Selberherr. S,*Analysis and Simulation of Semiconductor Devices,* Springer-Verlag, Third Edition, 1984.
3. *Grasser*.T,*Advanced Device Modeling and Simulation* ,World Scientific Publishing Company, Second Edition ,2003.

REFERENCES

1. Chua, L.O and Lin P.M,*Computer-Aided Analysis of Electronic Circuits: Algorithms and computational Techniques,*Prentice-Hall.,1975.
2. Trond Ytterdal, Yuhua Cheng and Tor A. FjeldlyWayne Wolf, John Wiley,*Device*
3. *modeling for Analog and RF CMOS Circuit Design,*SonsLtd,2001.
4. John Wiley, *RFCMOS circuit Design,*SonsLtd,2001

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(19EC4215) MIXED SIGNAL LAB

COURSE OBJECTIVES

The objectives of this course:

1. *To understand fundamental steps in analog VLSI design.*
2. *To learn various techniques ADC and DAC design.*
3. *To study the OP-AMP design.*

COURSE OUTCOMES (COs)

On Successful Completion of this Course, the Student will be able to

1. *Model analog circuit with, simulate, synthesis in Micro wind.*
2. *Understand chip level issues and need of testability.*
3. *Design OP-AMP circuits for specified applications*

LIST OF EXPERIMENTS

1. Analog Circuits Simulation using Spice.
2. Mixed Signal Simulation using Mixed Signal Simulators.
3. Layout Extraction for Analog & Mixed Signal Circuits.
4. Parasitic Values Estimation from Layout.
5. Layout Vs Schematic.
6. Net List Extraction.
7. Design Rule Checks.

REQUIRED SOFTWARE TOOLS

1. Mentor Graphic tools / Cadance tools/ Symphysis tools. (220 nm Technology and Above)
2. Xilinx 9.1i and Above for FPGA/CPLDS.

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(19EC4216) DIGITAL VLSI DESIGN LAB (VIRTUAL LAB)

COURSE OBJECTIVES

The Objectives of this Course:

1. *To design and simulate the various digital circuits.*
2. *To understand fundamental steps in digital VLSI design.*
3. *To design the various IC components.*

COURSE OUTCOMES (COs)

On Successful Completion of this Course the Student will be able to

1. *Design and simulate list of combinational and sequential digital circuits using Modelism&Xilinx–VHDL language.*
2. *Understand the static and dynamic characteristics of CMOS Inverter.*
3. *Design and simulate the brawn array multiplier and ALU using Modelsim and Xilinx-Verilog Language.*
4. *Characterize Combinational circuits using Pass Transistor logic*
5. *Design & Analyse the sequential circuit*
6. *Design RAM and FSM using Questa software.*

LIST OF EXPERIMENTS

1. Plot the Output Characteristics & Transfer Characteristics of an n-channel and p-channel MOSFET.
2. Design and Plot the Static (VTC) and Dynamic Characteristics of a Digital CMOS Inverter.
3. Design and Plot the Output Characteristics of a 3-inverter RingOscillator.
4. Design and Plot the Dynamic Characteristics of 2-input NAND, NOR, XOR and XNOR Logic Gates using CMOSTechnology.
5. Design and Plot the Characteristics of a 4x1 Digital Multiplexer using Pass Transistor Logic.
6. Design and Plot the Characteristics of a Positive and Negative Latch Based on Multiplexers.
7. Design and Plot the Characteristics of a Master-Slave Positive and Negative Edge Triggered Registers Based onMultiplexers.

REQUIRED SOFTWARE TOOLS

1. NgSpice Software tool

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(19EC4216) DIGITAL VLSI DESIGN LAB (Virtual Lab)

COURSE OBJECTIVES

The Objectives of this Course:

1. *To design and simulate the various digital circuits.*
2. *To understand fundamental steps in digital VLSI design.*
3. *To design the various IC components.*

COURSE OUTCOMES (COs)

On Successful Completion of this Course the Student will be able to

1. *Design and simulate list of combinational and sequential digital circuits using Modelism & Xilinx–VHDL language.*
2. *Understand the static and dynamic characteristics of CMOS Inverter.*
3. *Design and simulate the brawn array multiplier and ALU using Modelsim and Xilinx-Verilog Language.*
4. *Characterize Combinational circuits using Pass Transistor logic*
5. *Design & Analyse the sequential circuit*
6. *Design RAM and FSM using Questa software.*

LIST OF EXPERIMENTS

1. Plot the Output Characteristics & Transfer Characteristics of an n-channel and p-channel MOSFET.
2. Design and Plot the Static (VTC) and Dynamic Characteristics of a Digital CMOS Inverter.
3. Design and Plot the Output Characteristics of a 3-inverter RingOscillator.
4. Design and Plot the Dynamic Characteristics of 2-input NAND, NOR, XOR and XNOR Logic Gates using CMOSTechnology.
5. Design and Plot the Characteristics of a 4x1 Digital Multiplexer using Pass Transistor Logic.
6. Design and Plot the Characteristics of a Positive and Negative Latch Based on Multiplexers.
7. Design and Plot the Characteristics of a Master-Slave Positive and Negative Edge Triggered Registers Based onMultiplexers.

REQUIRED SOFTWARE TOOLS

1. NgSpice Software tool

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(19EC4218) SCRIPTING LANGUAGE FOR VLSI DESIGN AUTOMATION
(Programme Elective -V)

COURSE OBJECTIVES
The Objectives of this Course:

1. *To understand the syntax and semantics of the Perl language and their similarity and differences from Java.*
2. *To understand how to develop and implement various types of programs in the Perl language*
3. To u*nderstand various forms of data representation and structures supported by the Perl language*
4. *To understand the appropriate applications of the Perl language*

COURSE OUTCOMES (COs)
On Successful Completion of this Course, the Student will be able to

1. *Develop the basic knowledge on data types of Perl*
2. *Design and revision of Perl scripts*
3. *Develop the knowledge of standard input , output and files in programming*
4. *Develop substantial knowledge on Modules and CGI Programming.*
5. *Debug the techniques appropriate for the Perl language*
6. *Compare and contrast different regular expressions using operators and control structures.*

UNIT – I
JavaScript: Object Models – Design Philosophy – Versions of JavaScript – The Java Script Core Language – Basic Concepts of Python.

Object Oriented Programming Concepts (Qualitative Concepts Only): Objects – Classes – Encapsulation – Data Hierarchy.

UNIT – II
Overview Of Scripting Language: PERL – File Handles – Operators – Control Structures – Regular Expressions – Built in Data Types – Operators – Statements and Declarations, Simple, Compound, Loop Statements, Global and Scoped Declarations.

UNIT – III
Pattern Matching: Regular Expression – Pattern Matching Operators – Character Classes – Positions – Capturing and Clustering.

UNIT-IV
PERL Built-In Functions, Collections of Data, Working with Arrays, Lists and Hashes,

Simple Input and Output, Strings, Patterns and Regular Expressions, Subroutines, Scripts with Arguments.

UNIT-V

Threads: Process Model, Thread Model, Perl Debugger, Using Debugger Commands, Customization, Internals and Externals, Internal Data Types, Extending Perl, Embedding Perl, Exercises for Programming Using Perl.

TEXT BOOKS

1. Learning PERL, Randal L, Schwartz Tom Phoenix, Oreilly Publications, 3rd Edn.,2000
2. Programming PERL, Larry Wall, Tom Christiansen, John Orwant, Oreilly Publications, 3rd Edn.,2000.
3. Java the Complete Reference, Herbert Schildt, 7th Edition,TMH,2006

REFERENCES

1. *The World of Scripting Languages*, David Barron, Wiley Student Edition, 2010

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(19EC4219) NANO MATERIALS AND NANOTECHNOLOGY

(Programme Elective -V)

COURSE OBJECTIVES

The objectives of this course:

1. *To give a comprehensive introduction to the topic of semiconductor nanostructures.*
2. *To study the characteristics of magnetic nanostructures through the use of different apparatus and techniques.*
3. *To summarize the different types of Nano sensors and actuators based on the size, mechanism of response, and synthesis technique.*
4. *To discuss the types of molecular electronics and their uses in nanotechnology.*
5. *To discuss the different types of industrial applications.*

COURSE OUTCOMES (COs)

On Successful Completion of this Course the Student will be able to

1. *Define the basic concepts of semiconductor nanostructures.*
2. *Illustrate the various parameters and explain about the characteristics of the magnetic nanostructures.*
3. *Understand the measurements performed for Nano sensors.*
4. *Analyze the different actuators.*
5. *Design the nanoparticles for different application fields based on molecular electronics.*
6. *Design the different nanostructured and nanomaterials for different applications*

UNIT- I

Semiconductor Nanostructures: Semiconductor Fabrication Techniques - Electronic Structure and Properties of Semiconductor Nanostructures - Principles and Performance of Semiconductor Nanostructures Based Electronic and Electro-Optical Devices.

UNIT- II

Magnetic Nanostructures: Magnetism in Solids-Magnetic Domains, Nano Magnetic Properties of Materials-Nanostructure Relationships, Fabrication and Properties of Nanostructured Magnets - Photo Induced Magnetism and Spintronic - Nano Magnetic Probes - Electronic Magneto Transport and Micro Magnetic Modeling.

UNIT III

Nanosensors And Actuators: Micro and Nano Electromechanical Systems- Fabrication Process, Choice of Materials, Calculations, Performance of Different Nanostructures, Advantages and Limitations of Various Approaches - Applications-Thermal, Radiation Magnetic, Chemical and Mechanical Nano Sensors and Micro Actuators.

UNIT IV

Molecular Electronics: Conducting and Semiconducting Polymers- Hybridization, Conjugation and Excitations. Molecular Crystals- Organic Electroluminescent Displays-Injection, Transport, Excitation Formation and Light Emission - Influence of Supramolecular Order- Excimers, H and J Aggregates - Liquid Crystal Display.

UNIT V

Industrial Applications: Nanomaterials in Bone Substitutes & Dentistry - Antimicrobial Applications of Nanomaterials - Food and Cosmetic Applications of Nanomaterials - Application of Nanomaterials in Textiles, Paints, Catalysis, Lubricants, Fuel Cells and Batteries.

TEXT BOOKS

1. *J. Verdeyen* , Laser Electronics, II Edition, Prentice Hall, 1989
2. *C.W. Turner, T. Van Duzer*, Principles of Superconductive Devices and Circuits, Prentice Hall; 2nd Edition,1999
3. *Reynolds, M.Pomeranty, Skotheim T. Marcel Dekker,* Electro responsive molecules and polymeric systems, New York, 1988.

REFERENCES

1. *Yariv*,Principles of Optical Electronics, John Wiley, New York, 1988
2. M C Petty, M R Bryce, D Bloor (eds.),Edward Arnold, *Introduction to Molecular Electronics*, London, 1995
3. G Hadziioannou, P F van Hutten, *Semiconducting Polymers Chemistry, Physics, and Engineering*, Wiley-VCH, 2000 (ISBN 3-527-29507-0)
4. D. D. C Bradley, Current Opinion in Solid State & Materials Science Vol. 1, 789 ,1996

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(19EC4008) WIRELESS SENSOR NETWORKS
(Common to VLSI, DECS & ES)
(Programme Elective -V)

COURSE OBJECTIVES
The objectives of this course:

1. *To understand the basic WSN technology with basic sensor systems and provide a survey of sensor technology*
2. *To understand the medium access control protocols, routing and transport layer protocols for sensor networks and address physical layer issues*
3. *To understand the Sensor management, sensor network hardware, operating systems.*

COURSE OUTCOMES (COS)
On successful completion of course, the student will be able to

1. *Understand the basic concepts of wireless sensor networks, sensing, computing and communication tasks*
2. *Understand the radio standards and communication protocols adopted in wireless sensor networks*
3. *Describe and explain the hardware, software and communication for wireless sensor network nodes*
4. *Understand the architectures, features, and performance for wireless sensor network systems and platforms*
5. *Describe and analyze the specific requirements of applications in wireless sensor networks for energy efficiency, computing, storage and transmission*
6. *Design and deploy the sensor networks*

UNIT - I
Introduction: Introduction and Overview of Sensor Network Architecture and Its Applications, Sensor Network Comparison with Adhoc Networks, Sensor Node Architecture with Hardware and Software Details.

UNIT - II
Hardware: Examples Like Mica2, Micaz, Telosb, Cricket, Imote2, Tmote, Btnode, and Sun SPOT, Software (Operating Systems): Tinyos, MANTIS, Contiki and Retos. Programming Tools: C, Nesc. Performance Comparison of Wireless Sensor Networks Simulation and Experimental Platforms Like Open Source (Ns-2) and Commercial (QUALNET, OPNET)

UNIT- III
Overview of Sensor Network Protocols (Details of Atleast 2 Important Protocol per Layer): Physical, MAC and Routing/ Network Layer Protocols, Node Discovery Protocols, Multi- Hop and

Cluster-Based Protocols, Fundamentals of 802.15.4, Bluetooth, BLE (Bluetooth Low Energy), UWB.

UNIT - IV

Data Dissemination and Processing: Differences Compared with Other Database Management Systems, Data Storage, and Query Processing.

UNIT - V

Specialized Features: Energy Preservation and Efficiency, Security Challenges, Fault Tolerance, Issues Related to Localization, Connectivity and Topology, Sensor Deployment Mechanisms, Coverage Issues, Sensor Web, Sensor Grid, Open Issues for Future Research, and Enabling Technologies in Wireless Sensor Network.

TEXT BOOKS

1. H. Karl and A. Willig, *Protocols and Architectures for Wireless Sensor Networks*, John Wiley & Sons, India,2012.
2. C. S. Raghavendra, K. M. Sivalingam, and T. Znati, Editors, *Wireless Sensor Networks*, Springer Verlag, 1st Indian reprint,2010.

REFERENCES

1. F. Zhao and L. Guibas, Morgan Kaufmann, *Wireless Sensor Networks, An Information Processing Approach* 1st Indian reprint,2013.
2. YingshuLi, MyT. Thai, Weili Wu, *Wireless sensor Network and Applications,*Springer series on signals and communication technology,2008.

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(19HS0824) BUSINESS ANALYTICS
(Open Elective)

COURSE OBJECTIVES
The objectives of this course:

1. *Understand the concepts and methods of business analytics.*
2. *To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.*
3. *Identify the management related issues and processes to resolve*
4. *Understand the significance of forecasting models helpful in decision making*
5. *To become familiar with processes needed to develop, report, and analyze business data.*

COURSE OUTCOMES (COS)
On successful completion of course, the student will be able to

1. *Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.*
2. *Design alternatives to solve business problems utilizing quantitative analysis, critical thinking and sound ethical decision making.*
3. *Summarize, process and transform data for obtaining meaningful conclusions*
4. *Interpret data using latest data analytics tools to address organisational problems*
5. *Organize and critically apply the concepts and methods of business analytics*
6. *Assess decision problems and build models for creating solutions using business analytical tools.*

UNIT- I
Business analytics: Overview of Business analytics - Scope of Business analytics - Business Analytics Process - Relationship of Business Analytics Process and organisation - competitive advantages of Business Analytics - Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

UNIT- II
Trendiness and Regression Analysis: Modelling Relationships and Trends in Data - simple Linear Regression - Important Resources - Business Analytics Personnel - Data and models for Business analytics - problem solving - Visualizing and Exploring Data, Business Analytics Technology

UNIT- III
Organization Structures of Business analytics: Team management - Management Issues - Designing Information Policy – Outsourcing - Ensuring Data Quality - Measuring contribution of Business analytics - Managing Changes - Descriptive Analytics - predictive analytics - predicative

Modelling - Predictive analytics analysis - Data Mining - Data Mining Methodologies - Prescriptive analytics and its step in the business analytics Process - Prescriptive Modelling - nonlinear Optimization.

UNIT- IV

Forecasting Techniques: Qualitative and Judgmental Forecasting - Statistical Forecasting Models - Forecasting Models for Stationary Time Series - Forecasting Models for Time Series with a Linear Trend - Forecasting Time Series with Seasonality - Regression Forecasting with Casual Variables - Selecting Appropriate Forecasting Models - Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform - New-Product Development Model - Newsvendor Model - Overbooking Model - Cash Budget Model.

UNIT- V

Decision Analysis: Formulating Decision Problems - Decision Strategies with the Outcome Probabilities - Decision Trees - The Value of Information - Utility and Decision Making - Recent Trends in Embedded and collaborative business intelligence - Visual data recovery - Data Storytelling and Data journalism.

TEXT BOOKS

1. S. Christian Albright & Wayne Winston, *Business Analytics: Data analysis & Decision making*, 6th Edition, Cengage Learning, 2019
2. James Evans, *Business Analytics*, 2nd Edition, Pearson Education, 2013.

REFERENCES

1. Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, *Business analytics Principles, Concepts, and Applications*,1st Edition, Pearson FT Press, 2014.

2. Seema Acharya& RN Prasad, *Fundamentals of Business Analytics*, 2ndEdition,WILEY

3. Galit Shmueli, Peter C. Bruce, Nitin R. Patel, *Data mining for business analytics: Concepts, Techniques and Applications in Microsoft Office Excel with XLMiner*, WILEY, 2008.

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(19CE1028) COST MANAGEMENT OF ENGINEERING PROJECTS

(Open Elective)

COURSE OBJECTIVES

The objectives of this course:

1. *To establish systems to help streamline the transactions between corporate support departments and the operating units.*
2. *To devise transfer pricing systems to coordinate the buyer-supplier interactions between decentralized organizational operating units.*
3. *To use pseudo profit centres to create profit maximizing behaviour in what were formerly cost centres.*

COURSE OUTCOMES (COs)

On successful Completion of this course the student will be able to

1. *Summarise the concept of strategic cost management, strategic cost analysis – target costing, life cycle costing and Kaizen costing and the cost drive concept.*
2. *Describe the decision-making; relevant cost, differential cost, incremental cost and opportunity cost, objectives of a costing system.*
3. *Summarise the meaning and different types of project management and project execution, detailed engineering activities.*
4. *Understand the project contracts,*
5. *Describe the cost behaviour and profit planning types and contents, Bar charts and Network diagram.*
6. *Analyse by using quantitative techniques for cost management like PERT/CPM.*

UNIT – I

Introduction and Overview of the Strategic Cost Management Process.

UNIT-II

Cost Concepts: Cost concepts in decision-making - Relevant cost - Differential cost - Incremental cost and Opportunity cost - Objectives of a Costing System - Inventory valuation - Creation of a Database for operational control - Provision of data for Decision Making.

UNIT – III

Project Management: Project: meaning - Different types - why to manage - cost overruns centers - various stages of project execution: conception to commissioning - Project execution as conglomeration of technical and nontechnical activities - Detailed Engineering activities - Pre project execution main clearances and documents - Project team: Role of each member - Importance Project site: Data required with significance - Project contracts - Types and contents - Project execution Project cost control - Bar charts and Network diagram - Project commissioning: mechanical and process.

UNIT – IV

Cost Behavior and Profit Planning: Cost Behavior and Profit Planning Marginal Costing - Distinction between Marginal Costing and Absorption Costing - Break-even Analysis - Cost-Volume-Profit Analysis - Various decision-making problems - Standard Costing and Variance Analysis - Pricing strategies: Pareto Analysis - Target costing - Life Cycle Costing - Costing of service sector - Just-in-time approach - Material Requirement – Planning - Enterprise Resource Planning -Total Quality Management and Theory of constraints - Activity-Based Cost Management - Bench Marking - Balanced Score Card and Value-Chain Analysis - Budgetary Control - Flexible Budgets - Performance budgets - Zero-based budgets - Measurement of Divisional profitability pricing decisions including transfer pricing.

UNIT-V

Quantitative Techniques: Quantitative techniques for cost management - Linear Programming, PERT/CPM - Transportation Problems - Assignment problems – Simulation - Learning Curve Theory.

TEXT BOOKS

1. Robert S Kaplan Anthony A. Alkinson, *Management & Cost Accounting.*
2. N.D. Vohra, *Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.*

REFERENCES

1. *Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi*.
2. Charles T. Horngren and George Foster *Advanced Management Accounting.*
3. Ashish K. Bhattacharya, *Principles & Practices of Cost Accounting A. H. Wheeler publisher.*

WEB REFERENCES

1. https://nptel.ac.in/courses/110/101/110101132/
2. https://nptel.ac.in/courses/105104161/

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(19EE2128) WASTE TO ENERGY

(Open Elective)

COURSE OBJECTIVES
The objectives of this course:

1. *To learn different types of waste materials available for energy conversion*
2. *To understand Pyrolytic oil and gases*
3. *To introduce gasification methods for biomass*
4. *To learn concepts of biomass resources, combustion types and biogas plant technology*

COURSE OUTCOMES (COs)
On successful completion of this course, the student will be able to

1. *Analyse agro based, forest residue and industrial waste conversion processes.*
2. *Manufacture of Pyrolytic oils and gases*
3. *Manufacture of charcoal, yields and applications*
4. *Understand various types of gasifiers operation*
5. *Understand inclined and fluidized bed combustors operation*
6. *Understand types of biogas plants and biomass energy programme in India*

UNIT- I
Introduction to Energy from waste: Classification of waste as fuel – Agro based- Forest residue- Industrial waste- MSW- conversion devices- Incinerators- Gasifiers-Digestors.

UNIT- II
Bio-mass Pyrolysis: Pyrolysis- Types- Slow-Fast- Manufacture of Charcoal- methods- yields and application. Manufacture of Pyrolytic oils and gases – yields and applications.

UNIT- III
Biomass Gasification: Gasifiers- Fixed bed system- Downdraft and Updraft gasifiers- Fluidized bed gasifiers- construction and operation- Gasifier burner arrangement for thermal heating.

UNIT- IV
Biomass Combustion: Biomass stoves- Types- Inclined combustors- Fluidized bed combustors- construction and operation of above biomass combustors.

UNIT- V
Properties of Biogas: Biogas plant Technology and status – Biomass resources and their classification- Biomass conversion processes- thermo chemical conversion – Direct Combustion-

Biomass gasification- Pyrolysis and liquefaction – bio-chemical conversion- anaerobic digestion-Types of biogas plants- applications-Biomass Energy Programme in India.

TEXT BOOKS

1. Non-Conventional Energy- Desai Ashok V. Wiley Eastern Ltd 1990.
2. Biogas Technology – A Practical Hand Book – Khandelwal K.C. and Mahdi SS, Vol I & II. Tata McGraw Hill Publishing Co Ltd.,1983.

REFERENCES

1. Food, Feed and Fuel from Biomass – Challal D.S., IBH Publishing Co Pvt Ltd.,1991.
2. Non-conventional Energy Sourcrs- GD Roy, Khanna Publishers, 6th Edition
3. Biomass & Bioenergy – Khahid Rehman Hekeem, Mohammad Jawald., Umar Rashid-Springer International Publishing Ltd.

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(19ME3121) INDUSTRIAL SAFETY
(Open Elective)

COURSE OBJECTIVES

The objectives of this course:

1. *To learn about mechanical and electrical hazards.*
2. *To learn about Fundamentals of Maintenance Engineering.*
3. *To learn about Wear and Corrosion and their prevention.*
4. *To know about Fault Tracking*
5. *To learn about Periodic and preventive maintenance.*

COURSE OUTCOMES (COs)

On successful completion of this course, the student will be able to

1. *Explain the Points of factories act 1948 for health and safety.*
2. *Define the term Cost & its relation with replacement economy.*
3. Recognize the Concept of Wear, Corrosion and its Prevention methods
4. Understand the Concept of sequence of fault finding activities and the importance of decision tree
5. *Elaborate the importance of scheduled preventive maintenance of mechanical and electrical equipment.*
6. *Distinguish between Periodic and Preventive maintenance of equipments*

UNIT-I

Industrial Safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT-II

Fundamentals of Maintenance Engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT-III

Wear and Corrosion and their Prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v.

Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT-IV

Fault Tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT-V

Periodic and Preventive Maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

TEXT BOOKS

1. Higgins & Morrow, *Maintenance Engineering Handbook*,McGraw-Hill, 2008
2. H. P. Garg, *Maintenance Engineering*, S. Chand and Company, 1987.

REFERENCES:

1. Audels, *Pump-hydraulic Compressors*, Mcgrew Hill Publication.
2. Winterkorn, *Foundation Engineering Handbook*,Chapman& Hall London.

SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY :: PUTTUR
(AUTONOMOUS)

II M.Tech.- I Sem.

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(19ME3021) ADVANCES IN OPERATIONS RESEARCH
(Open Elective)

COURSE OBJECTIVES
The objectives of this course:

1. *To enumerate the fundamentals of Linear Programming*
2. *To learn classical optimization techniques*
3. *To develop the best strategy of Game and identifying the Queuing theory.*
4. *To understand about sequence and optimum Duration of the Project*
5. *To develop the importance of Replacement models and Inventory control*

COURSE OUTCOMES (COs)
On successful Completion of this course the student will be able to

1. *Create mathematical models of the real time situations.*
2. *Implement Transportation and Assignment problems to solve in real time industry*
3 C*hoose the best strategy of Game and capable of identifying the suitable queuing theory*
4. *Enumerate fundamental techniques and apply it to solve various optimization areas*
5. *Investigate, study, Apply knowledge in Replacement models and*
6. *Understand the Inventory control Models*

UNIT-I
Introduction to OR and Linear Programming-OR definition–Types of Operations Research models; Linear Programming- Problem Formulation, Graphical Method, Simplex Method, Big-M Method, Degeneracy - Problems

UNIT-II
Transportation Problem – Formulation; Initial Basic Feasible Solution-North-West Corner Rule, Least Cost Method, Vogel‘s Approximation Method, Modified Distribution (MODI) Method, Unbalanced Transportation - Problems
Assignment Problem – Formulation, Optimal Solution -Traveling Salesman problem.

UNIT-III
Game Theory - Introduction – Minimax (Maxi mini) Criterion and Optimal Strategy, Saddle Point, Solution of Games with Pure Strategy and Mixed Strategies – 2 X 2 Games – Dominance Principle.
Queuing Theory- Introduction to queuing system–Service Channel, Arrival Pattern, Size of Population, Service Pattern, Queue Discipline, Customer Behavior, Probability Distribution-Birth & Death Process, Simple Problems on Single Service channel only.

UNIT-IV
Sequencing –Terminology - Johnson’s Algorithm for n-jobs x 2 Machines and n-jobs x 3 machines models - Problems

PERT & CPM: Introduction, Difference between PERT and CPM, Terminology- Activities, Events, Predecessor, Early Start, Early Finish, Late Start & Late Finish Times, Earliest Occurrence and Latest Occurrence of the Event, Total Float, Free Float, Independent Float; CPM- Deterministic Model; PERT- Probabilistic Model, Critical Path, Optimal Project Duration, Least Possible Project Duration- Problems.

UNIT-V

Replacement – Failure Mechanism of Items**,** Types of Replacements- Individual Replacement policy, Group Replacement policy, Replacement of items fail suddenly – problems

Inventory - Necessity for maintaining inventory, inventory costs, classification of fixed order quantity inventory models, selective inventory management techniques.

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TEXT BOOKS

1. S D. SHARMA, *Operations Research*,KNRN Publications, 17th edition 2015
2. Hamdy A Taha , *Operations Research*,Pearson Publications, 9th edition 2015

REFERENCES

1. ManoharMahajan,*Operations Research*, DhanpatRai&Co 2016
2. Er. PremkumarGuptha&Dr.D.S.Hira, *Operations Research*, Schand publications 2012.
3. R Panneerselvam, *Operations Research*, PHI, 2nd edition, 2012

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II M.Tech.- I Sem.

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(19ME3022) COMPOSITE MATERIALS
(Open Elective)

COURSE OBJECTIVES
The objectives of this course:

1. *To understand the mechanical behavior of composite materials*
2. *To get an overview of the methods of manufacturing composite materials.*
3. *To know the fundamentals of composite materials.*
4. *To understand the fabrication and process of composites.*
5. *To recognize the applications of composite materials.*

COURSE OUTCOMES (COs)
On successful completion of this course, the student will be able to

1. *Explain the Fundamental concept of composite materials.*
2. *Classify different types of composite materials.*
3. *Describe the Fabrication and processing of composite materials.*
4. *Illustrate the Methods of preparation of Metal matrix Composites and polymer matrix composites*
5. *Discuss about the Mechanical behavior of composite materials.*
6. *Explain the application of composite materials.*

UNIT- I
Introduction To Composites: Fundamentals of composites – need– enhancement of properties – classifications —Introduction to Reinforcement composites–types. Applications.Fiber production techniques for glass, carbon and ceramic fibers –Resin materials-Types.

UNIT- II
Polymer Matrix Composites: Fabrication of PMC's ,Fabrication of Fibers, Plastic Fiber Forms, Pre-pregs, Molding Compounds-Processes, Lay-Ups, Filament Winding, Pultrusion, and Recycling. Matrix – Reinforcement Interface, Wettability.

UNIT-III
MMC & CMC : Fabrication of MMC'S, Liquid Infiltration- Casting, Solid State Processes-Diffusion Bonding &In Situ Technique. Fabrication of CMC's, Hot-Pressing, Infiltration, In Situ Chemical reaction Techniques.CVD& CVI, Sol-gel.

UNIT-IV
Mechanics of Composites: Basic assumptions of laminated anisotropic plates, symmetric laminates, angle ply laminates, cross ply laminates, laminate structural moduli, evaluation of lamina properties, determination of lamina stresses, maximum stress and strain criteria, Von -Mises Yield criterion for isotropic materials, generalized Hill's criterion for anisotropic materials, Tsai-Hill's criterion for composites, prediction of laminate failure, thermal analysis of composite laminates

UNIT-V

Applications Of Composites: Applications of advanced composite materials. Environmental effects in Composites, Green composites, Synthesis and Properties of Nano composites. Surface Composites & Surface metal matrix composites: Need, Synthesis, Properties and applications.

TEXT BOOKS

1. Mathews F. L. and Rawlings R. D., *Composite Materials: Engineering and Science*, 1st Edition, Chapman and Hall, London, England, 1994.
2. Chawla K. K., *Composite materials*, Second Edition, Springer – Verlag, 1998.

REFERENCES

1. Clyne, T. W. and Withers, P. J., *Introduction to Metal Matrix Composites*, Cambridge University Press, 1993.
2. Strong, A.B., *Fundamentals of Composite Manufacturing*, SME, 1989.
3. Sharma, S.C., *Composite materials*, Narosa Publications, 2000.