JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA VIZIANAGARAM

JNTU-GV COLLEGE OF ENGINEERING VIZIANAGARAM (Autonomous)

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

COURSE STRUCTURE & SYLLABUS M. Tech ECE

VLSI Design and Embedded Systems Programme

(Applicable for batches admitted from 2024-2025)

M. Tech I- Semester

S.No	Course Type/Code	Course Name	Teaching Scheme			C
			L	T	P	
1	Core 1	Digital System Design	3	0	0	3
2	Core 2	Embedded Real Time Operating Systems	3	0	0	3
3	Program Specific Elective	**Elective-I** 1. Embedded-C 2. Image and Video Processing 3. Communication Busses and Interfaces	3	0	0	3
4	Program Specific Elective	**Elective-II** 1. Design for Testability 2. Hardware Software Co-Design 3. CMOS Analog and Digital IC Design	3	0	0	3
5	Lab1	Digital System Design Lab	0	0	4	2
6	Lab2	Embedded Real Time Operating Systems Lab	0	0	4	2
7	MC	Research Methodology and IPR	2	0	0	2
8	Audit Course-1		2	0	0	0
		Total	**16**	**0**	**8**	**18**

M. Tech II- Semester

S.No	Course Type/Code	Course Name	Teaching Scheme			C
			L	T	P	
1	Core-3	Low Power VLSI Design	3	0	0	3
2	Core-4	Embedded System Design	3	0	0	3
3	Program Specific Elective	**Elective-III** 1. System on Chip Design 2. Advanced Processors and Controllers 3. Embedded Networking	3	0	0	3
4	Program Specific Elective	**Elective-IV** 1. Micro Electromechanical System Design 2. Semiconductor Memory Design and Testing 3. VLSI Signal Processing	3	0	0	3
5	Lab1	VLSI Laboratory	0	0	4	2
6	Lab2	Embedded Systems Laboratory	0	0	4	2
7	MC	Mini Project (Seminar)	0	0	4	2
8	Audit Course-2		2	0	0	0
		Total	**14**	**0**	**12**	**18**

M. Tech III-Semester

S.No	Course Type/Code	Course Name	Teaching Scheme			C
			L	T	P	
1	Program Specific Elective	**Elective-V** 1. CMOS Mixed Signal Circuit Design 2. Artificial Intelligence & Machine Learning 3. Internet Of Things	3	0	0	3
2	Open Elective		3	0	0	3
3	Dissertation	Dissertation Phase – I	0	0	20	10
		Total	**6**	**0**	**20**	**16**

M. Tech IV Semester

S.No	Course Type/Code	Course Name	Teaching Scheme			C
			L	T	P	
1	Dissertation	Dissertation Phase – II	--	--	32	16
		Total	**--**	**--**	**32**	**16**

Open Elective:

1. Business Analytics
2. Industrial Safety
3. Operations Research
4. Waste To Energy

Audit Course 1 & 2:

1. English For Research Paper Writing
2. Disaster Management
3. Sanskrit For Technical Knowledge
4. Value Education
5. Constitution Of India
6. Pedagogy Studies
7. Stress Management by Yoga
8. Personality Development Through Life Enlightenment Skills.

	L	T	P	C
M. Tech I- Semester	3	0	0	3

Digital System Design

Course Objectives:

- To provide extended knowledge of digital logic circuits in the form of state model approach.
- To provide an overview of system design approach using programmable logic devices.
- To provide and understand of fault models and test methods.
- To get exposed to the various architectural features of CPLDS.
- To learn the methods and techniques of CPLD design with EDA tools

UNIT-I:

Minimization Procedures and CAMP Algorithm: Review on minimization of switching functions using tabular methods, k-map, QM algorithm, CAMP-I algorithm, Phase-I: Determination of Adjacencies, DA, CSC, SSMs and EPCs,, CAMP-I algorithm, Phase-II: Passport checking, Determination of SPC, CAMP-II algorithm: Determination of solution cube, Cube based operations, determination of selected cubes are wholly within the given switching function or not, Introduction to cube based algorithms.

UNIT-II:

PLA Design, Minimization and Folding Algorithms: Introduction to PLDs, basic configurations and advantages of PLDs, PLA-Introduction, Block diagram of PLA, size of PLA, PLA design aspects, PLA minimization algorithm (IISc algorithm), PLA folding algorithm (COMPACT algorithm)-Illustration of algorithms with suitable examples.

UNIT -III:

Design of Large-Scale Digital Systems: Algorithmic state machine charts-Introduction, Derivation of SM Charts, Realization of SM Chart, control implementation, control unit design, data processor design, ROM design, PAL design aspects, digital system design approaches using CPLDs, FPGAs and ASICs.

UNIT-IV:

Fault Diagnosis in Combinational Circuits: Faults classes and models, fault diagnosis and testing, fault detection test, test generation, testing process, obtaining a minimal complete test set, circuit under test methods- Path sensitization method, Boolean difference method, properties of Boolean differences, Kohavi algorithm, faults in PLAs, DFT schemes, built in self-test.

UNIT-V:

Fault Diagnosis in Sequential Circuits: Fault detection and location in sequential circuits, circuit test approach, initial state identification, Haming experiments, synchronizing experiments, machine identification, distinguishing experiment, adaptive distinguishing experiments.

Textbooks:

1. Logic Design Theory-N. N. Biswas, PHI
2. Switching and Finite Automata Theory-Z. Kohavi, 2nd Edition, 2001, TMH
3. Digital system Design using PLDd-Lala

Reference Books:

1. Fundamentals of Logic Design – Charles H. Roth, 5th Ed., Cengage Learning.
2. Digital Systems Testing and Testable Design – Monobaraminic, Melvin A. Breuer and Arthur D. Friedman- John Wiley & Sons Inc.

Course Outcomes:

- To provide in depth understanding of Fault models.
- To understands test pattern generation techniques for fault detection.
- To design fault diagnosis in sequential circuits.
- To provide understanding in the design of flow using case studies.

	L	T	P	C
M. Tech I- Semester	3	0	0	3

Embedded Real Time Operating Systems

Course Objectives:

- Understand UNIX programming language.
- Create scheduling of tasks in RTOS.
- Develop case studies for real time applications.

UNIT – I: Introduction

Introduction to UNIX/LINUX, Overview of Commands, File I/O, (open, create, close, lseek, read, write), Process Control (fork, vfork, exit, wait, waitpid, exec).

UNIT - II: Real Time Operating Systems

Brief History of OS, Defining RTOS, The Scheduler, Objects, Services, Characteristics of RTOS, defining a Task, asks States and Scheduling, Task Operations, Structure, Synchronization, Communication and Concurrency. Defining Semaphores, Operations and Use, Defining Message Queue, States, Content, Storage, Operations and Use

UNIT - III: Objects, Services and I/O

Pipes, Event Registers, Signals, Other Building Blocks, Component Configuration, Basic I/O Concepts, I/ O Subsystem

UNIT - IV: Exceptions, Interrupts and Timers

Exceptions, Interrupts, Applications, Processing of Exceptions and Spurious Interrupts, Real Time Clocks, Programmable Timers, Timer Interrupt Service Routines (ISR), Soft Timers, Operations.

UNIT - V: Case Studies of RTOS

RT Linux, MicroC/OS-II, Vx Works, Embedded Linux, Tiny OS, and Basic Concepts of Android OS.

Textbook:

1. Real Time Concepts for Embedded Systems – Qing Li, Elsevier, 2011.

Reference Books:

1. Embedded Systems- Architecture, Programming and Design by Rajkamal, 2007, TMH.
2. Advanced UNIX Programming, Richard Stevens.
3. Embedded Linux: Hardware, Software and Interfacing – Dr. Craig Hollabaugh.

Course Outcomes:

- Write an UNIX programming language.
- Create scheduling of tasks in RTOS.
- Develop case studies for real time applications

	L	T	P	C
M. Tech I- Semester	3	0	0	3

Embedded-C

(Elective-I)

Course Objectives:

- Introduce the fundamental programming concepts relevant to embedded system design.
- Explain the features, syntax, and semantics of embedded programming languages.
- Describe the structure, architecture, and operation of microcontroller-based embedded systems.
- Develop the ability to design, code, and debug simple programs for embedded hardware.

UNIT – I:

Programming Embedded Systems in C: Introduction, what is an embedded system, Which processor should you use, Which programming language should you use, Which operating system should you use, how do you develop embedded software, Conclusions. Introducing the 8051 Microcontroller Family Introduction, what's in a name, the external interface of the Standard 8051, Reset requirements, Clock frequency and performance, Memory issues, I/O pins, Timers, Interrupts, Serial interface, Power consumption, Conclusions.

UNIT – II:

Reading Switches: Introduction, Basic techniques for reading from port pins, Example: Reading and writing bytes, Example: Reading and writing bits (simple version), Example: Reading and writing bits (generic version), The need for pull-up resistors, dealing with switch bounce, Example: Reading switch inputs (basic code), Example: Counting goats, Conclusions.

UNIT – III:

Adding Structure to the Code: Introduction, Object-oriented programming with C, The Project Header (MAIN.H), The Port Header (PORT.H), Example: Restructuring the 'Hello Embedded World' example, Example: Restructuring the goat-counting example, Further examples, Conclusions.

UNIT – IV:

Meeting Real-Time Constraints: Introduction, Creating 'hardware delays' using Timer 0 and Timer 1, Example: Generating a precise 50ms delay, Example: Creating a portable hardware delay, Why not use Timer 2?, The need for 'timeout' mechanisms, Creating loop timeouts, Example: Testing loop timeouts, Example: A more reliable switch interface, Creating hardware timeouts, Example: Testing a hardware timeout, Conclusions.

UNIT – V:

Case Study: Intruder Alarm System Introduction, the software architecture, Key software components used in this example, running the program, the software, Conclusions.

Textbook:

1. Embedded C by Michael J. Pont, A Pearson Education.

Reference Books:

2. PIC micro MCU C-An introduction to programming, The Microchip PIC in CCS C By Nigel Gardner.

Course Outcomes:

- Know about programming concepts in embedded system design
- Understand features and concepts of embedded programming languages
- Able to describe how microcontroller based embedded systems are programmed and implemented in real time applications.
- Write simple programs and implement the same embedded hardware

	L	T	P	C
M. Tech I- Semester	3	0	0	3

Image and Video Processing

(Elective-I)

Course objectives:

- To study the image fundamentals and mathematical transforms necessary for image processing.
- To study the image enhancement techniques
- To study image restoration procedures.
- To study the image compression procedures.

UNIT –I:

Fundamentals of Image Processing and Image Transforms: Introduction, Image sampling, Quantization, Resolution, Image file formats, Elements of image processing system, Applications of Digital image processing.

Introduction, need for transform, image transforms, Fourier transform, 2 D Discrete Fourier transform and its transforms, Importance of phase, Walsh transform, Hadamard transform, Haar transform, slant transform Discrete cosine transform, KL transform, singular value decomposition, Radon transform, comparison of different image transforms.

UNIT –II:

Image Enhancement: Spatial domain methods: Histogram processing, Fundamentals of Spatial filtering, smoothing spatial filters, Sharpening spatial filters. Frequency domain methods: Basics of filtering in frequency domain, image smoothing, image sharpening, Selective filtering.

Image Restoration: Introduction to Image restoration, Image degradation, Types of image blur, Classification of image restoration techniques, Image restoration model, Linear and Nonlinear image restoration techniques, Blind deconvolution

UNIT –III:

Image Segmentation: Introduction to image segmentation, Point, Line and Edge Detection, Region based segmentation, Classification of segmentation techniques, Region approach to image segmentation, clustering techniques, Image segmentation based on thresholding, Edge based segmentation, Edge detection and linking, Hough transform, Active contour

Image Compression: Introduction, need for image compression, Redundancy in images, Classification of redundancy in images, image compression scheme, Classification of image compression schemes, Fundamentals of information theory, Run length coding, Shannon – Fano coding, Huffman coding, Arithmetic coding, Predictive coding, Transformed based

compression, Image compression standard, Wavelet-based image compression, JPEG Standards.

UNIT -IV:

Basic Steps of Video Processing: Analog Video, Digital Video. Time-Varying Image Formation models: Three-Dimensional Motion Models, Geometric Image Formation, Photometric Image Formation, Sampling of Video signals, Filtering operations.

UNIT –V:

2-D Motion Estimation: Optical flow, General Methodologies, Pixel Based Motion Estimation, Block-Matching Algorithm, Mesh based Motion Estimation, Global Motion Estimation, Region based Motion Estimation, Multi resolution motion estimation, Waveform based coding, Block based transform coding, Predictive coding, Application of motion estimation in Video coding.

Textbooks:

1. Digital Image Processing – Gonzaleze and Woods, 3rd Ed., Pearson.
2. Video Processing and Communication – Yao Wang, Joem Ostermann and Ya–quin Zhang. 1st Ed., PH Int.
3. S. Jayaraman, S. Esakkirajan and T. Veera Kumar, "Digital Image processing, Tata McGraw Hill publishers, 2009.

Reference Books:

1. Digital Image Processing and Analysis-Human and Computer Vision Application with CVIP Tools – Scotte Umbaugh, 2nd Ed, CRC Press, 2011.
2. Digital Video Processing – M. Tekalp, Prentice Hall International.
3. Multi-dimensional Signal, Image and Video Processing and Coding – John Woods, 2nd Ed, Elsevier.
4. Digital Image Processing with MATLAB and Labview – Vipula Singh, Elsevier.

Course Outcomes

- Review the fundamental concepts of a digital image processing system.
- Analyze images in the frequency domain using various transforms.
- Evaluate the techniques for image enhancement and image restoration.
- Categorize various compression techniques and Interpret Image compression standards
- Interpret image segmentation and representation techniques.

	L	T	P	C
M. Tech I- Semester	3	0	0	3

Communication Busses and Interfaces

(Elective-I)

Course Objectives:

- Understand the basics of serial buses and compare them with parallel communication.
- Study protocols like RS232, RS485, I2C, and SPI with focus on features and limitations.
- Explore CAN bus architecture, layers, frame formats, and real-time applications.
- Learn PCIe and USB protocols, including configuration, transfer types, and descriptors.
- Understand serial data streaming using SFPDP and its transmission techniques.

UNIT I

Serial Busses- Cables, Serial busses, serial versus parallel, Data and Control Signal- data frame, data rate, features Limitations and applications of RS232, RS485, I2C, SPI.

UNIT II

CAN: Architecture- ISO 11898-2, ISO 11898-3, Data Transmission- ID allocation, Bit timing, Layers- Application layers, Object layer, Transfer layer, Physical layer, Frame Formats-Data frame, Remote frame, Error frame, Overload frame, Ack slot, Inter frame spacing, Bit spacing, Applications.

UNIT III

PCIe: Revision, Configuration space- configuration mechanism, Standardized registers, Bus enumeration, Hardware and Software implementation, Hardware protocols, Applications.

UNIT IV

USB: Transfer Types- Control transfers, Bulk transfer, Interrupt transfer, Isochronous transfer. Enumeration- Device detection, Default state, addressed state, Configured state, enumeration sequencing. Descriptor types and contents- Device descriptor, configuration descriptor, Interface descriptor, Endpoint descriptor, String descriptor. Device driver.

UNIT V

Data streaming Serial Communication Protocol- Serial Front Panel Data Port (SFPDP) configurations, Flow control, serial FPDP transmission frames, fibre frames and copper cable.

Textbooks:

1. A Comprehensive Guide to controller Area Network – Wilfried Voss, Copperhill Media Corporation, 2nd Ed., 2005.
2. Serial Port Complete-COM Ports, USB Virtual Com Ports and Ports for Embedded Systems-Jan Axelson, Lakeview Research, 2nd Ed.

Reference Books:

1. USB Complete – Jan Axelson, Penram Publications.
2. PCI Express Technology – Mike Jackson, Ravi Budruk, Mindshare Press.

Course Outcomes:

- Identify and compare different serial and parallel communication protocols.
- Explain working and applications of RS232, RS485, I2C, and SPI.
- Describe CAN architecture, layers, and frame formats used in communication.
- Demonstrate knowledge of PCIe and USB protocol operations and configurations.
- Apply serial data streaming methods using SFPDP for high-speed communication.

	L	T	P	C
M. Tech I- Semester	3	0	0	3

Design for Testability

(Elective-II)

Course Objectives:

- Introduce fault models and basic faults in digital systems.
- Explain stuck-at fault testing and design for testability techniques.
- Develop skills to analyze testing issues in digital circuit design.
- Enable modeling and simulation of faults for reliable circuit performance.
- Encourage research on advanced testing methods for digital and mixed-signal systems.

UNIT -I

Testing Philosophy, Role of Testing, Digital and Analog VLSI Testing, VLSI Technology Trends affecting Testing, Types of Testing, Fault Modelling: Defects, Errors and Faults, Functional Versus Structural Testing, Levels of Fault Models, Single Stuck-at Fault.

UNIT -II:

Simulation for Design Verification and Test Evaluation, Modelling Circuits for Simulation, Algorithms for True-value Simulation, Algorithms for Fault Simulation.

UNIT -III:

SCOAP Controllability and Observability, High Level Testability Measures, Digital DFT and Scan Design: Ad-Hoc DFT Methods, Scan Design, Partial-Scan Design, Variations of Scan.

UNIT -IV:

The Economic Case for BIST, Random Logic BIST: Definitions, BIST Process, Pattern Generation, Response Compaction, Built-In Logic Block Observers, Test-Per-Clock, Test-Per Scan BIST Systems, Circular Self-Test Path System, Memory BIST, Delay Fault BIST.

UNIT -V:

Motivation, System Configuration with Boundary Scan: TAP Controller and Port, Boundary Scan Test Instructions, Pin Constraints of the Standard, Boundary Scan Description Language: BDSL Description Components, Pin Descriptions.

Textbooks:

1. Essentials of Electronic Testing for Digital, Memory and Mixed Signal VLSI Circuits -M.L. Bushnell, V. D. Agrawal, Kluwer Academic Publishers.

Reference Books:

1. Digital Systems and Testable Design - M. Abramovici, M.A.Breuer and A.D Friedman, Jaico Publishing House.
2. Digital Circuits Testing and Testability - P.K. Lala, Academic Press.

Course Outcomes:

- ❖ Demonstrate advanced knowledge in the basic faults that occur in digital systems, testing of stuck at faults for digital circuits, Design for testability.
- ❖ Analyse testing issues in the field of digital system design critically for conducting research.
- ❖ Solve engineering problems by modelling different faults for fault free simulation in digital circuits.
- ❖ Apply appropriate research methodologies and techniques to develop new testing strategies for digital and mixed signal circuits and systems.

	L	T	P	C
M. Tech I- Semester	3	0	0	3

Hardware Software Co-Design

(Elective-II)

Course Objectives:

- Understand co-design models, architectures, and partitioning methods.
- Learn prototyping, emulation techniques, and system communication architectures.
- Explore modern embedded architectures and compilation tools.
- Study specification and verification methods in system design.
- Gain knowledge of system-level design languages and co-simulation tools.

UNIT-I:

Co- Design Issues: Co- Design Models, Architectures, Languages, A Generic Co-design Methodology.

Co- Synthesis Algorithms: Hardware software synthesis algorithms: hardware – software partitioning distributed system co-synthesis.

UNIT-II:

Prototyping and Emulation: Prototyping and emulation techniques, prototyping and emulation environments, future developments in emulation and prototyping architecture specialization techniques, system communication infrastructure

Target Architectures: Architecture Specialization techniques, System Communication infrastructure, Target Architecture and Application System classes, Architecture for control dominated systems (8051-Architectures for Highperformance control), Architecture for Data dominated systems (ADSP21060, TMS320C60), Mixed Systems.

UNIT-III:

Compilation Techniques and Tools for Embedded Processor Architectures: Modern embedded architectures, embedded software development needs, compilation technologies, practical consideration in a compiler development environment.

UNIT-IV:

Design Specification and Verification: Design, co-design, the co-design computational model, concurrency coordinating concurrent computations, interfacing components, design verification, implementation verification, verification tools, Interface verification.

UNIT-V:

Languages for System-Level Specification and Design-I: System-level specification, design representation for system level synthesis, system level specification languages.

Languages for System-Level Specification and Design-II: Heterogeneous specifications and multi-language co-simulation, the cosyma system and Lycos system.

Text Books:

1. Hardware / Software Co- Design Principles and Practice – Jorgen Staunstrup, Wayne Wolf – 2009, Springer.
2. Hardware / Software Co- Design - Giovanni De Micheli, Mariagiovanna Sami, 2002, Kluwer Academic Publishers.

Course Outcomes:

- Explain co-design models, synthesis algorithms, and HW/SW partitioning.
- Describe prototyping and emulation methods for system design.
- Identify tools and techniques used for compiling embedded software.
- Apply design and verification concepts in embedded system development.
- Use system-level specification languages and simulate multi-language designs.

	L	T	P	C
M. Tech I- Semester	3	0	0	3

CMOS Analog and Digital IC Design
(Elective-II)

UNIT-I:

MOS Devices and Modelling : The MOS Transistor, Passive Components- Capacitor & Resistor, Integrated circuit Layout, CMOS Device Modelling - Simple MOS Large-Signal Model, Other Model Parameters, Small-Signal Model for the MOS Transistor, Computer Simulation Models, Sub-threshold MOS Model.

MOS Design: Pseudo NMOS Logic – Inverter, Inverter threshold voltage, output high voltage, Output Low voltage, Gain at gate threshold voltage, Transient response, Rise time, Fall time, Pseudo NMOS logic gates, Transistor equivalency, CMOS Inverter logic.

UNIT-II:

Combinational MOS Logic Circuits: MOS logic circuits with NMOS loads, Primitive CMOS logic gates – NOR & NAND gate, Complex Logic circuits design – Realizing Boolean expressions using NMOS gates and CMOS gates , AOI and OIA gates, CMOS full adder, CMOS transmission gates, Designing with Transmission gates.

Sequential MOS Logic Circuits: Behaviour of bistable elements, SR Latch, Clocked latch and flip flop circuits, CMOS D latch and edge triggered flip-flop.

UNIT -III:

Dynamic Logic Circuits: Basic principle, Voltage Bootstrapping, Synchronous dynamic pass transistor circuits, Dynamic CMOS transmission gate logic, High performance Dynamic CMOS circuits.

Semiconductor Memories: Types, RAM array organization, DRAM – Types, Operation, Leakage currents in DRAM cell and refresh operation, SRAM operation Leakage currents in SRAM cells, Flash Memory- NOR flash and NAND flash.

UNIT -IV:

Analog CMOS Sub-Circuits: MOS Switch, MOS Diode, MOS Active Resistor, Current Sinks and Sources, Current Mirrors-Current mirror with Beta Helper, Degeneration, Cascode current Mirror and Wilson Current Mirror, Current and Voltage References, Band gap Reference.

UNIT-V:

CMOS Amplifiers: Inverters, Differential Amplifiers, Cascode Amplifiers, Current Amplifiers, Output Amplifiers, High Gain Amplifiers Architectures.

CMOS Operational Amplifiers: Design of CMOS Op Amps, Compensation of Op Amps, Design of Two-Stage Op Amps, Power- Supply Rejection Ratio of Two-Stage Op Amps, Cascode Op Amps, Measurement Techniques of OP Amp.

Textbooks:

1. Digital Integrated Circuit Design – Ken Martin, Oxford University Press, 2011.
2. CMOS Digital Integrated Circuits Analysis and Design – Sung-Mo Kang, Yusuf Leblebici, TMH,3rd Ed., 2011.
3. CMOS Analog Circuit Design - Philip E. Allen and Douglas R. Holberg, Oxford University Press, International Second Edition/Indian Edition, 2010.
4. Analysis and Design of Analog Integrated Circuits- Paul R. Gray, Paul J. Hurst, S. Lewis and R.G. Meyer, Wiley India, Fifth Edition, 2010.

Reference Books:

1. Analog Integrated Circuit Design- David A. Johns, Ken Martin, Wiley Student Edn, 2016.
2. Design of Analog CMOS Integrated Circuits- Behzad Razavi, TMH Edition.
3. CMOS: Circuit Design, Layout and Simulation- Baker, Li and Boyce, PHI.
4. Digital Integrated Circuits – A Design Perspective, Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, 2nd Ed., PHI.

Course Outcomes:

- Analyze, design, optimize and simulate analog and digital circuits using CMOS constrained by the design metrics.
- Connect the individual gates to form the building blocks of a system.
- Use EDA tools like Cadence, Mentor Graphics and other open-source software tools like Ngspice.

	L	T	P	C
M. Tech I- Semester	0	0	4	2

Digital System Design Laboratory

Course Objectives:

- Introduce key algorithms for logic minimization and circuit optimization.
- Familiarize students with ROM and PLA design techniques.
- Develop understanding of control unit and data path design.
- Provide hands-on experience with FPGA-based digital system design.
- Explore fault detection and correction using algorithms like Kohavi and Hamming.

Systems Design experiments:

- The students are required to design the logic to perform the following experiments using necessary Industry standard simulator to verify the logical /functional operation, perform the analysis with appropriate synthesizer and to verify the implemented logic with different hardware modules/kits (CPLD/FPGA kits).
- Consider the suitable switching function and data to implement the required logic if required.

A student has to do at least 10 Experiments.

List of Experiments:

1. Determination of EPCs using CAMP-I Algorithm.
2. Determination of SPCs using CAMP-I Algorithm.
3. Determination of SCs using CAMP-II Algorithm.
4. PLA minimization algorithm (IISc algorithm)
5. PLA folding algorithm (COMPACT algorithm)
6. ROM design.
7. Control unit and data processor logic design
8. Digital system design using FPGA.
9. Kohavi algorithm.
10. Hamming experiments.

Course Outcomes:

- Apply CAMP-I and CAMP-II algorithms to determine EPCs, SPCs, and SCs.
- Implement PLA minimization and folding using IISc and COMPACT algorithms.
- Design ROMs and analyze their role in digital systems.
- Design and simulate control units and data processors.
- Use FPGA tools and implement error detection using Kohavi and Hamming codes.

	L	T	P	C
M. Tech I- Semester	0	0	4	2

Embedded Real Time Operating Systems Laboratory

Course Objectives:

- To develop applications using task scheduling, timers, and event-driven programming in embedded systems.
- To implement and analyze inter-task communication mechanisms such as message queues, mailboxes, and interrupts.
- To demonstrate task synchronization, time slicing, and priority-based scheduling.
- To interface and control peripherals like LEDs, LCDs, serial ports, and audio processing units.
- To enhance practical understanding of real-time operating systems (RTOS) concepts through hands-on experiments.

Note: The following programs to understand the use of RTOS with ARM Processor on IDE Environment using ARM Tool chain and Library:

1. Create an application that creates two tasks that wait on a timer whilst the main task loops.
2. Write an application that creates a task which is scheduled when a button is pressed, which illustrates the use of an event set between an ISR and a task.
3. Write an application that Demonstrates the interruptible ISRs(Requires timer to have
4. higher priority than external interrupt button)
   a). Write an application to Test message queues and memory blocks.
   b). Write an application to Test byte queues.
5. Write an application that creates two tasks of the same priority and sets the time slice period to illustrate time slicing.

Interfacing Programs:

6. Write an application that creates a two task to Blinking two different LEDs at different Timings
7. Write an application that creates a two-task displaying two different messages in LCD display in two lines.
8. Sending messages to mailbox by one task and reading the message from mailbox by another task.
9. Sending message to PC through serial port by three different tasks on priority Basis.
10. Basic Audio Processing on IDE environment.

Course Outcomes:

- Apply inter-task communication techniques such as message queues, mailboxes, and interrupts for efficient data exchange.
- Demonstrate task synchronization and scheduling through time slicing and priority-based execution.
- Develop and interface embedded applications using peripherals like LEDs, LCDs, serial communication, and audio processing.
- Analyze and evaluate real-time operating system (RTOS) concepts through practical hands-on experiments.

	L	T	P	C
M. Tech I- Semester	2	0	0	2

Research Methodology and IPR

Course Objectives:

- Understand the basics of research and its types.
- Learn how to define research problems and hypotheses.
- Study data collection, analysis, and interpretation methods.
- Gain knowledge of intellectual property rights and types.
- Understand the process of patent filing and copyright protection.

Unit I:

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:

Effective literature studies approach, analysis Plagiarism, Research ethics. 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 III:

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. 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 IV:

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

Unit V:

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Textbooks:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students""
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step-by-Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.

Course Outcomes:

- Identify research problems and formulate research questions.
- Apply suitable methods for data collection and analysis.
- Write and present effective research reports.
- Explain various forms of IPR and their importance.
- Describe procedures for patent and copyright applications.

	L	T	P	C
M. Tech II- Semester	3	0	0	3

Low Power VLSI Design

Course Objectives:

- To understand the different leakage power reduction techniques.
- To impart knowledge on different abstraction levels in VLSI Design and the impact of power minimization methods at higher levels
- To explain technology independent and technology-dependent techniques for power reduction in CMOS circuits
- To introduce various software power estimation and optimization techniques for low power VLSI system design

UNIT –I:

Fundamentals: Need for Low Power Circuit Design, Sources of Power Dissipation – Switching Power Dissipation, Short Circuit Power Dissipation, Leakage Power Dissipation, Glitching Power Dissipation, Short Channel Effects –Drain Induced Barrier Lowering and Punch Through, Surface Scattering, Velocity Saturation, Impact Ionization, Hot Electron Effect.

UNIT –II:

Low-Power Design Approaches: Low-Power Design through Voltage Scaling – VTCMOS circuits, MTCMOS circuits, Architectural Level Approach –Pipelining and Parallel Processing Approaches. Switched Capacitance Minimization Approaches: System Level Measures, Circuit Level Measures, Mask level Measures.

UNIT –III:

Low-Voltage Low-Power Adders: Introduction, Standard Adder Cells, CMOS Adder's Architectures – Ripple Carry Adders, Carry Look-Ahead Adders, Carry Select Adders, Carry Save Adders, Low-Voltage Low-Power Design Techniques –Trends of Technology and Power Supply Voltage, Low-Voltage Low-Power Logic Styles.

UNIT –IV:

Low-Voltage Low-Power Multipliers: Introduction, Overview of Multiplication, Types of Multiplier Architectures, Braun Multiplier, Baugh-Wooley Multiplier, Booth Multiplier, Introduction to Wallace Tree Multiplier.

UNIT –V:

Low-Voltage Low-Power Memories: Basics of ROM, Low-Power ROM Technology, Future Trend and Development of ROMs, Basics of SRAM, Memory Cell, Precharge and Equalization Circuit, Low-Power SRAM Technologies, Basics of DRAM, Self Refresh Circuit, Future Trend and Development of DRAM.

Text Books:

1. CMOS Digital Integrated Circuits – Analysis and Design – Sung-Mo Kang, Yusuf Leblebici, TMH, 2011.
2. Low-Voltage, Low-Power VLSI Subsystems – Kiat-Seng Yeo, Kaushik Roy, TMH Professional Engineering.

Reference Books:

1. Introduction to VLSI Systems: A Logic, Circuit and System Perspective – Ming-BO Lin, CRC Press, 2011.
2. Low Power CMOS Design – Anantha Chandrakasan, IEEE Press/Wiley International, 1998.
3. Low Power CMOS VLSI Circuit Design – Kaushik Roy, Sharat C. Prasad, John Wiley & Sons, 2000.
4. Practical Low Power Digital VLSI Design – Gary K. Yeap, Kluwer Academic Press, 2002.
5. Low Power CMOS VLSI Circuit Design – A. Bellamour, M. I. Elamasri, Kluwer Academic Press, 1995.
6. Leakage in Nanometer CMOS Technologies – Siva G. Narendran, Anatha Chandrakasan, Springer, 2005.

Course Outcomes:

- Demonstrate knowledge on different sources of power dissipation, power minimization techniques, switched capacitance minimization and working principle of adiabatic logic circuits
- Designing low voltage CMOS circuits to reduce power consumption and low energy circuits.
- Analyze and minimize dynamic and static power consumption in VLSI circuits.
- Discover different ways to minimize leakage power and to achieve low power using voltage scaling, software design.

	L	T	P	C
M. Tech II- Semester	3	0	0	3

Embedded System Design

Course Objectives:

- To understand the lifecycle of embedded systems
- To analyze and design hardware and software components
- To explore real-time operating systems, drivers, and middleware
- To implement and test real embedded applications
- To gain hands-on exposure to industry-relevant platforms

UNIT-I

The Embedded System Design Life Cycle:

Introduction, product specification, embedded systems architecture, embedded system design flow, embedded systems model, hardware/software partitioning, iteration and implementation, detailed hardware and software design, hardware/software integration, product testing and release. the golden rules of architectural embedded systems design: engineering approach.

UNIT-II

Embedded Hardware Design:

Embedded hardware building blocks, Embedded processors: ISA architecture models, internal processor design, processor performance, Board Memory: ROM, RAM, auxiliary memory, memory management of external memory, board memory and performance, Embedded board Input / output: serial versus parallel I/O, interfacing the I/O components, I/O components and performance, Board buses: Bus arbitration and timing, Integrating the bus with other board components, bus performance.

UNIT-III

Embedded Software Design:

Device drivers: Device drivers for interrupt handling, memory device drivers, on-board bus

device drivers, Board I/O driver examples, Embedded operating systems: Multitasking and process management, memory management, I/O and file system management, OS standards example, OS performance guidelines, selecting the right embedded OS and BSPs, Middleware and application software: Middle ware, middleware examples, application layer software examples.

UNIT-IV

Embedded System Design Development, Implementation and Testing:

The development environment: The execution environment, memory organization, system start-up, creating an embedded system architecture, special software techniques: manipulating the hardware, interrupts and ISRs, watchdog timers, flash memory, design methodology,

getting embedded software into the target system, the ICE, Implementing the design: The main software utility tool, CAD and the hardware, Testing: choosing test cases, testing embedded hardware, performance and testing, maintenance and testing.

UNIT-V

Embedded System Design - Case Studies:

Case studies- Processor design approach of an embedded system –Power PC processor based and Micro Blaze processor based embedded system design on Xilinx platform, NiosII Processor based Embedded system design on Altera Platform- respective processor architectural issues are required to be consider while an embedded system design.

Textbooks:

1. Embedded Systems Architecture: A Comprehensive Guide for Engineers and Programmers - Tammy Noergaard, Second Edition, Elsevier (Singapore) Private Limited Publications, 2005.
2. Embedded Systems Design: An Introduction to Processes, Tools & Techniques - Arnold S.Berger, Elsevier CMP Books, 2010.

Reference Books:

1. Embedded system Design: A Unified Hardware/Software Introduction - J Frank Vahid, Tony D. Givargis, John Wily & Sons Inc.2002.
2. Embedded Systems: Architecture, Programming and Design - Rajkamal, TMH, Second Edition, 2008.

Course Outcomes:

- Develop embedded systems from specification to deployment
- Use modern tools (hardware/software) for embedded design
- Design efficient systems with proper hardware/software balance
- Test, debug, and optimize embedded systems
- Apply knowledge in platform-based designs using Xilinx or Altera

	L	T	P	C
M. Tech II- Semester	3	0	0	3

System On Chip Design
(Elective -III)

Course Objectives:

- To understand the concepts of SOC Testing.
- To understand the concepts of System on Chip Design Validation.
- To understand the concepts of System on Chip Design methodology for Logic and Analog Cores.

UNIT I

System Architecture: Overview: Components of the system – Processor architectures – Memory and addressing – system level interconnection – SoC design requirements and specifications – design iteration – System Architecture & complexity – Product Economics for SOC-Dealing with Design Complexity

UNIT II

Processor Selection for SOC: Overview – soft processors, processor core selection. Basic concepts – instruction set, branches, interrupts and exceptions. Basic elements in instruction handling – Minimizing pipeline delays – reducing the cost of branches – Robust processors – Vector processors, VLIW processors, Superscalar processors.

UNIT III

Memory Design: SoC external memory, SoC internal memory, Scratch pads and cache memory – cache organization and write policies – strategies for line replacement at miss time – split I- and Dcaches – multilevel caches – SoC memory systems – board-based memory systems – simple processor/memory interaction.

UNIT IV

Interconnect Architectures and SOC Customization: Bus architectures – SoC standard buses – AMBA, Core Connect – Bus Interface Units: Bus Sockets and Bus Wrappers– Contention and Shared Bus-SOC Customization: An Overview-Processor Customization Approaches -Reconfigurable Technologies

UNIT V

Application Studies: SOC Design Approach, AES: Algorithm and Requirements, AES: Design and Evaluation, 3-D Graphics Processors-Analysis: Processing-Analysis: Interconnection-Prototyping, JPEG Compression, Example JPEG System for Digital Still Camera.

Textbooks

1. Flynn, Michael J., and Wayne Luk. *Computer system design: system-on-chip*. John Wiley & Sons, 2011.
2. Wayne Wolf, "Modern VLSI Design – System – on – Chip Design", Prentice Hall, 3rd Edition, 2008.
3. Wayne Wolf, "Modern VLSI Design – IP based Design", Prentice Hall, 4th Edition, 2008.

Course Outcomes:

- Upon successful completion of the program the students shall
- Explain all important components of a System-on-Chip
- Understanding the Processor selection for SOC Design
- Outline the major Memory Design Challenges.
- Discuss about SOC Customization Explore Different SOC Applications

	L	T	P	C
M. Tech II- Semester	3	0	0	3

Advanced Processors and Controllers

(Elective -III)

Course Objective:

- To introduce students with the architecture and operation of typical microprocessors and microcontrollers.
- To familiarize the students with the programming and interfacing of microprocessors and microcontrollers.
- To provide strong foundation for designing real world applications using microprocessors and microcontrollers

UNIT-I:

INTEL 8086/8088: Architecture, its register organization, pin diagram, minimum and maximum mode system and timings, machine language instruction formats, addressing modes, instruction set, assembler directives and operators.

UNIT-II:

ALP and Special Architecture Features: ALP, Programming with an assembler, stack structure, interrupts, and service subroutines and interrupt programming and Macros.

UNIT-III:

Multiprocessor Systems: Inter connection topologies, numeric processor 8087, I/O processor 8089.Bus arbitration and control design of PC based multiprocessor systems, virtual memory, paging, segmentation.

UNIT-IV:

Advanced Processors: Architectural features of 80836,486 and Pentium processors their memory management, introduction to Pentium pro processors their features, RISC Vs CISC processors, RISC properties, evaluation, architectural features of DEC alpha AXP, power PC family and sun SPARC family systems.

UNIT-V:

Microcontroller: Microcontrollers – 8051 architectures, hardware, interrupts, addressing modes, instruction set –programming-applications.

Textbooks:

1. Intel microprocessors, architecture, programming and interfacing 8086/8088, 80186,80836 and 80846- BARRY b.Brey.PHI-5th edition-2001.
2. Advanced microprocessors-TABAK-McGraw-Hill Inc 2ns edition.
3. Advanced microprocessors and peripherals A.K. Ray and K M Bhurchandani TMH.
4. Microprocessors, Nilesh B. Bahadure, PHI Learning PVT. Ltd.

Reference Books:

1. 8051 microcontroller – architecture programming & applications-K.J.Ayala-penram Intl.
2. Programming & customizing the 8051 microcontroller – Myke Pretko – TMH,1st edition ,1999.
3. The 8088 and 8086 microprocessor-W.A.Triebel &Avtar singh-PHI,4th edition 2002.

Course Outcomes:

- Compare accepted standards and guidelines to select appropriate Microprocessor (8086 & 8088) and Microcontroller to meet specified performance requirements.
- Analyze assembly language programs; select appropriate assemble into machine a cross-assembler utility of a microprocessor and microcontroller.
- Design electrical circuitry to the Microprocessor I/O ports in order to interface the processor to external devices.
- Evaluate assembly language programs and download the machine code that will provide solutions real-world control problems.

	L	T	P	C
M. Tech II- Semester	3	0	0	3

Embedded Networking

(Elective -III)

Course Objectives:

- To introduce the Building Blocks of Embedded System.
- To Educate in Various Embedded Development Strategies.
- To Introduce Bus Communication in processors, Input/output interfacing.
- To impart knowledge in various processor scheduling algorithms.
- To introduce Basics of Real time operating system and example tutorials to discuss on one real time operating system tool.

UNIT –I:

Embedded Communication Protocols: Embedded Networking: Introduction – Serial/Parallel Communication – Serial communication protocols - RS232 standard – RS485 – Synchronous Serial Protocols -Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I2C) – PC Parallel port programming - ISA/PCI Bus protocols – Firewire.

UNIT –II:

USB and CAN Bus: USB bus – Introduction – Speed Identification on the bus – USB States – USB bus communication: Packets –Data flow types –Enumeration –Descriptors –PIC 18 Microcontroller USB Interface – C Programs –CAN Bus – Introduction - Frames –Bit stuffing –Types of errors –Nominal Bit Timing – PIC microcontroller CAN Interface –A simple application with CAN.

UNIT –III:

Ethernet Basics: Elements of a network – Inside Ethernet – Building a Network: Hardware options – Cables, Connections and network speed – Design choices: Selecting components – Ethernet Controllers – Using the internet in local and internet communications – Inside the Internet protocol. UNIT –IV: Embedded Ethernet: Exchanging messages using UDP and TCP – Serving web pages with Dynamic Data – Serving web pages that respond to user Input – Email for Embedded Systems – Using FTP – Keeping Devices and Network secure.

UNIT –V:

Wireless Embedded Networking: Wireless sensor networks – Introduction – Applications – Network Topology – Localization –Time Synchronization - Energy efficient MAC protocols –SMAC – Energy efficient and robust routing – Data Centric routing.

Textbooks:

1. Embedded Systems Design: A Unified Hardware/Software Introduction - Frank Vahid, Tony Givargis, John & Wiley Publications, 2002.
2. Parallel Port Complete: Programming, interfacing and using the PCs parallel printer port - Jan Axelson, Penram Publications, 1996.

Reference Books:

1. Advanced PIC microcontroller projects in C: from USB to RTOS with the PIC18F series - Dogan Ibrahim, Elsevier 2008.
2. Embedded Ethernet and Internet Complete - Jan Axelson, Penram publications, 2003.
3. Networking Wireless Sensors - Bhaskar Krishnamachari?, Cambridge press 2005.

Course Outcomes:

- Acquire a basic knowledge about fundamentals of microcontrollers
- Acquire a basic knowledge about programming and system control to perform a specific task.
- Acquire knowledge about devices and buses used in embedded networking
- Develop programming skills in embedded systems for various applications.
- Acquire knowledge about basic concepts of circuit emulators.

	L	T	P	C
M. Tech II- Semester	3	0	0	3

Micro Electromechanical System Design

(Elective-IV)

Course Objectives:

- Introduce the basic principles and structure of Micro Electromechanical Systems (MEMS).
- Explain standard microfabrication processes used in MEMS development.
- Understand the mechanical and electrical behavior of MEMS components.
- Explore various sensing and actuation methods in MEMS systems.
- Highlight real-world applications and integration of MEMS in practical systems.

UNIT- I

Introduction to MEMS: Overview of MEMS, new trends in engineering and science, micro and nano scale systems, intrinsic characteristics of MEMS, elements of MEMS: micro sensors and micro actuators, microelectronics fabrication process, energy domains, materials for MEMS: silicon, polymers, metals; Packaging and integration: glass encapsulation, MEMS process integration strategies, applications of micro and nano electromechanical systems.

UNIT- II

Fabrication Technologies: Surface micromachining: Sacrificial layer processes, micro motors; Bulk micromachining: micro needles, micro nozzles; Etching: dry etching, plasma etching; Wet etching: principle and process architect; High Aspect-Ratio Processes: LIGA process, Deep Reactive Ion Etching (DRIE); Thin film deposition: Chemical Vapor Deposition (CVD), Physical Vapor Deposition (PVD); Evaporation and sputtering.

UNIT- III

Mechanical concepts: Crystal planes and orientation, Internal force analysis, mechanical properties of silicon and related thin films, flexural beam bending analysis under simple loading conditions, torsional deflections, spring constant and resonant frequency.

Electrical concepts: semiconductor materials, calculation of charge carrier concentration, conductivity and resistivity of semiconductor.

UNIT- IV

Sensing and Actuation Techniques: Micro sensors: Electrostatic sensor, principle of parallel plate capacitors and its applications, Thermal sensor: Fundamentals of thermal transfer, thermal bimorph principle, Piezo-resistive sensor: Materials, piezo-resistivity, Piezoelectric sensor: Materials and Piezoelectric effect, Micro actuators: Actuation using thermal forces, Actuation using shape memory alloys, Actuation using piezoelectric crystals,

Actuation using electrostatic forces (Parallel plate, torsion bar), Actuation using electrostatic forces (Comb drive actuators), Micromechanical motors and pumps.

UNIT- V

Case Studies of MEMS: MEMS inertial sensors in automobiles: airbag deployment, automobile navigation; MEMS vibratory gyroscope, MEMS accelerometer. MEMS devices in commercial applications: Inkjet printers, digital micromirror devices (DMD), radio frequency MEMS switches, scanning tunneling microscopes (STM)

Textbooks:

1. Chang Liu,"Foundation of MEMS", 2 nd edition, Pearson Education Inc.,2012.
2. Tai Ran Hsu, "MEMS and Microsystems Design and Manufacture", 2 nd edition, Tata McGraw Hill, 2008.

Reference Books:

1. Reza Ghodssi, Pinyen, "MEMS Materials and Processes Handbook", Springer Science Business Media, 2011.
2. Rai-Choudhury P., "MEMS and MOEMS Technology and Applications", Prentice Hall of India Learning Private Limited, 2009.

Course Outcomes:

- Describe The Fundamentals of Micro Electromechanical Systems (MEMS).
- Explain Standard Micro Fabrication Techniques.
- Discuss The Mechanical and Electrical Behaviours Of MEMS.
- Discuss Sensing and Actuation Techniques of MEMS System.
- Summarize The Applications of MEMS In Real-World Systems.

	L	T	P	C
M. Tech II- Semester	3	0	0	3

Semiconductor Memory Design and Testing

(ELECTIVE -IV)

Course Objectives:

- To acquire knowledge about different types of semiconductor memories.
- To study about architecture and operations of different semiconductor memories.
- To comprehend the low power design techniques and methodologies.

UNIT -I:

Random Access Memory Technologies: SRAM – SRAM Cell structures, MOS SRAM Architecture, MOS SRAM cell and peripheral circuit operation, Bipolar SRAM technologies, SOI technology, Advanced SRAM architectures and technologies, Application specific SRAMs, DRAM – DRAM technology development, CMOS DRAM, DRAM cell theory and advanced cell structures, BICMOS DRAM, soft error failure in DRAM, Advanced DRAM design and architecture, Application specific DRAM.

UNIT -II:

Non-volatile Memories: Masked ROMs, High density ROM, PROM, Bipolar ROM, CMOS PROMS, EPROM, Floating gate EPROM cell, One-time programmable EPROM, EEPROM, EEPROM technology and architecture, Non-volatile SRAM, Flash Memories (EPROM or EEPROM), advanced Flash memory architecture. UNIT -III: Memory Fault Modelling Testing and Memory Design for Testability and Fault Tolerance: RAM fault modelling, Electrical testing, Pseudo Random testing, Megabit DRAM Testing, non-volatile memory modelling and testing, IDDQ fault modelling and testing, Application specific memory testing, RAM fault modelling, BIST techniques for memory.

UNIT -IV:

Semiconductor Memory Reliability and Radiation Effects: General reliability issues RAM failure modes and mechanism, Non-volatile memory reliability, reliability modelling and failure rate prediction, Design for Reliability, Reliability Test Structures, Reliability Screening and qualification, Radiation effects, Single Event Phenomenon (SEP), Radiation Hardening techniques, Radiation Hardening Process and Design Issues, Radiation Hardened Memory characteristics, Radiation Hardness Assurance and Testing, Radiation Dosimetry, Water Level Radiation Testing and Test structures.

UNIT -V:

Advanced Memory Technologies and High-density Memory Packing Technologies: Ferroelectric RAMs (FRAMs), GaAs FRAMs, Analog memories, magneto resistive RAMs (MRAMs), Experimental memory devices, Memory Hybrids and MCMs (2D), Memory

Stacks and MCMs (3D), Memory MCM testing and reliability issues, Memory cards, High Density Memory Packaging Future Directions.

Textbooks:

1. Semiconductor Memories Technology – Ashok K. Sharma, 2002, Wiley.
2. Advanced Semiconductor Memories – Architecture, Design and Applications - Ashok K. Sharma2002, Wiley.
3. Modern Semiconductor Devices for Integrated Circuits – Chenming C Hu, 1st Ed., Prentice Hall.

Course Outcomes:

- Analysis the different types of RAM, ROM designs.
- Analysis the different RAM and ROM architecture and interconnects.
- Analysis about design and characterization technique.
- Analysis of different memory testing and design for testability.
- Identification of new developments in semiconductor memory design

	L	T	P	C
M. Tech II- Semester	3	0	0	3

VLSI Signal Processing

(Elective -IV)

Course Objective:

- To introduce techniques for altering the existing DSP structures to suit VLSI implementations.
- To introduce efficient design of DSP architectures suitable for VLSI.

UNIT -I

Introduction to DSP: Typical DSP algorithms, DSP algorithms benefits, Representation of DSP algorithms Pipelining and Parallel Processing Introduction, Pipelining of FIR Digital filters, Parallel Processing, Pipelining and Parallel Processing for Low Power Retiming Introduction, Definitions and Properties, Solving System of Inequalities, Retiming Techniques

UNIT –II

Folding and Unfolding: Folding- Introduction, Folding Transform, Register minimization Techniques, Register minimization in folded architectures, folding of Multi rate systems Unfolding- Introduction, An Algorithm for Unfolding, Properties of Unfolding, critical Path, Unfolding and Retiming, Applications of Unfolding

UNIT -III

Systolic Architecture Design: Introduction, Systolic Array Design Methodology, FIR Systolic Arrays, Selection of Scheduling Vector, Matrix Multiplication and 2D Systolic Array Design, Systolic Design for Space Representations contain Delays.

UNIT -IV

Fast Convolution: Introduction – Cook-Toom Algorithm – Winogard algorithm – Iterated Convolution – Cyclic Convolution – Design of Fast Convolution algorithm by Inspection

UNIT -V

Digital lattice filter structures, bit level arithmetic, architecture, redundant arithmetic. Numerical strength reduction, synchronous, wave and asynchronous pipelines, low power design. Low Power Design: Scaling Vs Power Consumption, Power Analysis, Power Reduction techniques, Power Estimation Approaches

Textbooks:

1. Keshab K. Parthi[A1], VLSI Digital signal processing systems, design and implementation[A2], Wiley, Inter Science, 1999.
2. Mohammad Isamail and Terri Fiez, Analog VLSI signal and information processing, McGraw Hill, 1994 3. S.Y. Kung, H.J. White House, T. Kailath, VLSI and Modern Signal Processing, Prentice Hall, 1985.

Course Outcomes:

- Ability to modify the existing or new DSP architectures suitable for VLSI.
- Understand the concepts of folding and unfolding algorithms and applications.
- Ability to implement fast convolution algorithms.
- Low power design aspects of processors for signal processing and wireless applications.

	L	T	P	C
M. Tech II- Semester	0	0	4	2

VLSI Laboratory

Course Objectives:

- Provide hands-on experience in designing, simulating, and analyzing CMOS-based digital and analog circuits using industry-standard EDA tools.
- Develop the ability to implement combinational and sequential logic circuits at the transistor level using schematic and layout design methodologies.
- Enhance understanding of the full-custom VLSI design flow, including schematic entry, layout generation, DRC, LVS, and post-layout simulation.
- Foster the ability to analyze power, delay, and area trade-offs in CMOS circuits and optimize designs accordingly.

List of Experiments

1. Design and Simulation of Basic Logic Gates using CMOS Logic (AND, OR, NOT, NAND, NOR, XOR, XNOR)
2. Design and Implementation of Half Adder and Full Adder using CMOS
3. Design and Implementation of Half Subtractor and Full Subtractor using CMOS
4. Low-Power Design of 4:1 Multiplexer and 1:4 De-Multiplexer Using 6T Logic
5. Design of 4:2 Encoder using CMOS Logic
6. Design of 2:4 Decoder using CMOS Logic
7. Design of a 2-Bit Comparator using CMOS Logic
8. Implementation of Boolean Expressions Using CMOS Logic circuit
9. Design and Simulation of Flip-Flops using CMOS Logic (SR, JK, D, and T Flip-Flops)
10. Design and Analysis of SRAM Using CMOS Technology
11. Design and Analysis of DRAM Using CMOS Technology
12. Design of a CMOS Ring Oscillator for On-Chip Frequency and Delay Characterization

Course Outcomes:

- Design and implement basic logic gates using CMOS technology.
- Develop and simulate combinational and sequential digital circuits at the transistor level.
- Design and analyze sequential circuits such as latches and flip-flops using CMOS logic.
- Create transistor-level schematics and basic layouts for CMOS circuits using EDA tools like Cadence Virtuoso.
- Understand the fundamentals of layout design and gain introductory experience in drawing layouts of MOS transistors and basic CMOS circuits.

	L	T	P	C
M. Tech II- Semester	0	0	4	2

Embedded Systems Laboratory

Course Objectives:

- To acquire working knowledge of various embedded development tools.
- To develop and implement sample programs on ARM-based processors or equivalent.
- To create applications using the ARM processor in an IDE environment with RAM tool chain and libraries.
- To design and implement embedded applications with peripheral interfacing.
- To develop advanced embedded system applications using ARM processors.

Note:

- The following programs are to be implemented on ARM based Processors/Equivalent.
- Minimum of 10 programs are to be conducted.

The following Programs are to be implemented on ARM Processor:

1. Simple Assembly Program for
   a. Addition | Subtraction | Multiplication | Division
   b. Operating Modes, System Calls and Interrupts
   c. Loops, Branches.
2. Write an Assembly programs to configure and control General Purpose Input/ Output (GPIO) port pins
3. Write an Assembly programs to read digital values from external peripherals and execute them with the Target board.
4. Program for reading and writing of a file.
5. Program to demonstrate Time delay program using built in Timer / Counter feature on IDE environment.
6. Program to demonstrate a simple interrupt handler and setting up a timer.
7. Program demonstrates setting up interrupt handlers. Press button to generate an interrupt and trace the program flow with debug terminal.
8. Program to Interface 8 Bit LED and Switch Interface.
9. Program to implement Buzzer Interface on IDE environment.
10. Program to Displaying a message in a 2 line x 16 Characters LCD display and verify the result in debug terminal.
11. Program to demonstrate I2C Interface on IDE environment.
12. Program to demonstrate I2C Interface – Serial EEPROM.
13. Demonstration of Serial communication. Transmission from Kit and reception from PC using Serial Port on IDE environment use debug terminal to trace the program.
14. Generation of PWM Signal.
15. Program to demonstrate SD-MMC Card Interface.

Course Outcomes:

- To gain the working knowledge of various embedded tools.
- To develop sample programs to be implemented on ARM based Processors or equivalent.
- Create applications for using the ARM Processor on IDE Environment using RAM Tool chain & Library.
- Develop applications using the concept of Interfacing.
- Design advanced embedded applications using ARM Processor.

	L	T	P	C
M. Tech III- Semester	3	0	0	3

CMOS Mixed Signal Circuit Design

(Elective -V)

Course objectives:

- To know mixed signal circuits like DAC, ADC, PLL etc.
- To gain knowledge on filter design in mixed signal mode.
- To acquire knowledge on design different architectures in mixed signal mode.

UNIT- I:

Phase Locked Loop Characterization of a comparator, basic CMOS comparator design, analog multiplier design, PLL - simple PLL, charge-pump PLL, applications of PLL.

UNIT -II:

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

UNIT- III:

D/A Converter Architectures Input/output characteristics of an ideal D/A converter, , performance metrics of D/A converter, D/A converter in terms of voltage, current, and charge division or multiplication, , switching functions to generate an analog output corresponding to a digital input. Resistor-Ladder architectures, Current steering architectures

UNIT -IV:

A/D Converter Architectures Input/output characteristics and quantization error of an A/D converter, performance metrics of pipelined architectures, Successive approximation architectures, interleaved architectures.

Unit -V:

Integrator Based Filters Low Pass filters, active RC integrators, MOSFET-C integrators, transconductance-c integrator, and discrete time integrators. Filtering topologies - bilinear transfer function and biquadratic transfer function.

Textbooks:

1. Razavi, "Design of analog CMOS integrated circuits", McGraw Hill, Edition 2002.
2. Razavi, "Principles of data conversion system design", Wiley IEEE Press, 1st Edition, 1994.
3. Jacob Baker, "CMOS Mixed-Signal circuit design", IEEE Press, 2009.

Reference Books:

1. Gregorian, Temes, "Analog MOS Integrated Circuit for signal processing", John Wiley & Sons, 1986.
2. Baker, Li, Boyce, "CMOS: Circuit Design, layout and Simulation", PHI, 2000.

Course Objectives:

- Understand mixed-signal ICs, their features, and application benefits.
- Learn analog circuit design using CMOS for amplifiers and filters.
- Study CMOS digital design basics like logic gates and memory units.
- Develop skills to design interfaces between analog and digital circuits.

	L	T	P	C
M. Tech III- Semester	**3**	**0**	**0**	**3**

Artificial Intelligence & Machine Learning

(Elective -V)

Course Objectives:

- Gain a historical perspective of Artificial Intelligence (AI) and its foundations.
- Become familiar with basic principles of AI toward problem solving, inference, perception, knowledge representation, and learning.
- Develop an appreciation for what is involved in learning from data.
- Demonstrate a wide variety of learning algorithms.
- Demonstrate how to apply a variety of learning algorithms to data.

UNIT-I:

Introduction to artificial intelligence: Introduction, history, intelligent systems, foundations of AI, applications, tic-tac-tie game playing, development of AI languages, current trends in AI, Problem solving state-space search and control strategies: Introduction, general problem solving, characteristics of problem, exhaustive searches, heuristic search techniques, iterative deepening a*, constraint satisfaction

UNIT-II:

Problem reduction and game playing: Introduction, problem reduction, game playing, alpha beta pruning, two-player perfect information games, Logic concepts: Introduction, propositional calculus, proportional logic, natural deduction system, axiomatic system, semantic tableau system in proportional logic, resolution refutation in proportional logic, predicate logic

Knowledge representation: Introduction, approaches to knowledge representation, knowledge representation using semantic network, extended semantic networks for KR, knowledge representation using frames, advanced knowledge representation techniques: Introduction, conceptual dependency theory, script structure, cyc theory, case grammars, semantic web.

UNIT-III:

Fuzzy sets and fuzzy logic: Introduction, fuzzy sets, fuzzy set operations, types of membership functions, multi valued logic, fuzzy logic, linguistic variables and hedges, fuzzy propositions, inference rules for fuzzy propositions, fuzzy systems.

Introduction to Machine Learning: Introduction-Towards Intelligent Machines, Well posed Problems, Example of Applications in diverse fields, Data Representation, Domain Knowledge for Productive use of Machine Learning, Diversity of Data: Structured / Unstructured, Forms of Learning, Machine Learning and Data Mining, Basic Linear Algebra in Machine Learning Techniques.

UNIT-IV:

Supervised Learning- Rationale and Basics: Learning from Observations, Bias and Why Learning Works: Computational Learning Theory, Occam's Razor Principle and Overfitting Avoidance Heuristic Search in inductive Learning, Estimating Generalization Errors, Metrics for assessing regression, Metris for assessing classification.

UNIT-V:

Statistical Learning- Machine Learning and Inferential Statistical Analysis, Descriptive Statistics in learning techniques, Bayesian Reasoning: A probabilistic approach to inference, K-Nearest Neighbor Classifier. Discriminant functions and regression functions, Linear Regression with Least Square Error Criterion, Logistic Regression for Classification Tasks, Fisher's Linear Discriminant and Thresholding for Classification, Minimum Description Length Principle.

Textbooks:

1. Artificial intelligence, A modern Approach, 2nded, Stuart Russel, Peter Norvig, Prentice Hall
2. Artificial Intelligence, SarojKaushik, 1st Edition, CENGAGE Learning, 2011.
3. Applied Machine Learning, M.Gopal, McGraw Hill Education, 2019.
4. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press,2012.

Reference Books:

1. Artificial intelligence, structures and Strategies for Complex problem solving, 5th Edition, George F Lugar, PEA
2. Introduction to Artificial Intelligence, Ertel, Wolf Gang, Springer, 2017
3. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009 (freely available online)
4. Christopher Bishop, Pattern Recognition and Machine Learning, Springer,2007.

Course Outcomes:

- Demonstrate knowledge of the building blocks of AI as presented in terms of intelligent agents.
- Analyze and formalize the problem as a state space, graph, design heuristics and select amongst different search or game-based techniques to solve them.
- Domain Knowledge for Productive use of Machine Learning and Diversity of Data.
- Demonstrate on Supervised and Computational Learning
- Analyze on Statistics in learning techniques and Logistic Regression

	L	T	P	C
M. Tech III- Semester	**3**	**0**	**0**	**3**

Internet of Things

(Elective -V)

Course Objectives:

- To Understand Smart Objects and IoT Architectures.
- To learn about various IOT-related protocols
- To build simple IoT Systems using Arduino and Raspberry Pi.
- To understand data analytics and cloud in the context of IoT
- To develop IoT infrastructure for popular applications.

UNIT I:

Fundamentals Of IOT: Evolution of Internet of Things, Enabling Technologies, IoT Architectures, oneM2M, IoT World Forum (IoTWF) and Alternative IoT models, Simplified IoT Architecture and Core IoT Functional Stack, Fog, Edge and Cloud in IoT, Functional blocks of an IoT ecosystem, Sensors, Actuators, Smart Objects and Connecting Smart Objects.

UNIT II:

IOT Protocols: IT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and Lora WAN, Network Layer: IP versions, Constrained Nodes and Constrained Networks, Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks, Application Transport Methods: Supervisory Control and Data Acquisition, Application Layer Protocols: CoAP and MQTT.

UNIT III:

Design And Development: Design Methodology, Embedded computing logic, Microcontroller, System on Chips, IoT system building blocks, Arduino, Board details, IDE programming, Raspberry Pi, Interfaces and Raspberry Pi with Python Programming.

UNIT IV:

Data Analytics and Supporting Services: Structured Vs Unstructured Data and Data in Motion Vs Data in Rest, Role of Machine Learning – No SQL Databases, Hadoop Ecosystem, Apache Kafka, Apache Spark, Edge Streaming Analytics and Network Analytics, Xively Cloud for IoT, Python Web Application Framework, Django, AWS for IoT, System Management with NETCONF-YANG.

UNIT V:

Case Studies/Industrial Applications: Cisco IoT system, IBM Watson IoT platform, Manufacturing, Converged Plant wide Ethernet Model (CPwE), Power Utility Industry, Grid Blocks Reference Model, Smart and Connected Cities: Layered architecture, Smart Lighting, Smart Parking Architecture and Smart Traffic Control.

Textbooks:

1. IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, Cisco Press, 2017.

Reference Books:

1. Internet of Things – A hands-on approach, Arshdeep Bahga, Vijay Madisetti, Universities Press, 2015
2. The Internet of Things – Key applications and Protocols, Olivier Hersent, David Boswarthick, Omar Elloumi and Wiley, 2012 (for Unit 2).
3. "From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence", Jan Ho¨ ller, Vlasios Tsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand. David Boyle and Elsevier, 2014.
4. Architecting the Internet of Things, Dieter Uckelmann, Mark Harrison, Michahelles and Florian (Eds), Springer, 2011.
5. Recipes to Begin, Expand, and Enhance Your Projects, 2nd Edition, Michael Margolis, Arduino Cookbook and O'Reilly Media, 2011.

Course Outcomes:

- Summarize on the term 'internet of things' in different contexts.
- Analyze various protocols for IoT.
- Design a PoC of an IoT system using Rasperry Pi/Arduino
- Apply data analytics and use cloud offerings related to IoT.
- Analyze applications of IoT in real time scenario

	L	T	P	C
M. Tech III- Semester	**3**	**0**	**0**	**3**

Business Analytics

(Open Elective)

Course Objectives

- To introduce students to the fundamentals of data analytics, including data types, data sources, and basic analytical techniques.
- To develop students' critical thinking and analytical reasoning skills for evaluating data and drawing informed conclusions.
- To train students in the use of statistical, machine learning, and optimization tools for predictive and prescriptive analytics.
- To equip students with the skills to interpret complex datasets and effectively communicate findings using data visualization and storytelling techniques.
- To enable students to apply data analytics tools and frameworks in real-world business scenarios for strategic and operational decision-making.

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 without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.

Textbooks:

1. Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Business Analytics: Principles, Concepts, and Applications, Pearson FT Press.
2. James Evans, Business Analytics, Pearson Education.

Course Outcomes:

- Students will demonstrate knowledge of data analytics.
- Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.
- Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.
- Students will demonstrate the ability to translate data into clear, actionable insights.

	L	T	P	C
M. Tech III- Semester	**3**	**0**	**0**	**3**

Industrial Safety
(Open Elective)

Course Objectives

- To provide knowledge of industrial safety measures, accident prevention, and relevant legal standards such as the Factories Act 1948.
- To introduce the principles and practices of maintenance engineering, including various types of maintenance and cost considerations.
- To explain the causes, effects, and prevention techniques of wear and corrosion, and the application of different lubrication methods.
- To develop the ability to perform fault tracing using decision trees across mechanical, thermal, hydraulic, and electrical systems.
- To equip students with practical skills in periodic and preventive maintenance procedures and scheduling for various industrial equipment.

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, washrooms, 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

Textbooks:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.

Reference Books:

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

Course Outcomes:

- Students will be able to explain accident causes and industrial safety practices and apply safety codes and fire-fighting methods in industrial contexts.
- Students will be able to identify the roles and responsibilities in maintenance engineering and evaluate maintenance strategies based on cost and equipment life.
- Students will be able to analyze wear and corrosion mechanisms and recommend appropriate prevention and lubrication techniques.
- Students will be able to trace faults systematically using decision trees for various mechanical and electrical systems.
- Students will be able to plan and execute periodic and preventive maintenance tasks for industrial machinery and equipment.

	L	T	P	C
M. Tech III- Semester	**3**	**0**	**0**	**3**

Operations Research
(Open Elective)

Unit I:

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models.

Unit II:

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming.

Unit III:

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Unit IV:

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Unit V:

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

Textbooks:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008

Reference Books:

1. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
2. Pannerselvam, Operations Research: Prentice Hall of India 2010
3. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

Course Outcomes:

- Students should be able to apply dynamic programming to solve problems of discreet and continuous variables.
- Students should be able to apply the concept of non-linear programming
- Students should be able to carry out sensitivity analysis
- Students should be able to model the real-world problem and simulate it.

	L	T	P	C
M. Tech III- Semester	**3**	**0**	**0**	**3**

Waste To Energy
(Open Elective)

Course Objectives:

- To impart knowledge on the classification and potential of various waste materials for energy production, along with an overview of energy conversion technologies.
- To enable students to understand the principles, methods, and applications of biomass pyrolysis, including the production of charcoal, oils, and gases.
- To develop technical understanding of biomass gasification technologies, including design, construction, and operational aspects of various gasifiers.
- To familiarize students with different types of biomass combustion systems and their design, operation, and improvements for efficient energy recovery.
- To provide comprehensive insight into biogas production, plant design, and biomass energy programs in India, covering thermo-chemical and biochemical processes.

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:

Biomass 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 – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNIT-IV:

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Unit-V:

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct

combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

Textbooks:

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

Reference Books:

1. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
2. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

Course Outcomes:

- Classify different types of waste and identify appropriate energy conversion devices for each type.
- Understanding of pyrolysis processes and be able to analyze yields and applications of products derived from biomass.
- Explain the construction, working principles, and performance characteristics of various biomass gasifiers.
- Evaluate different biomass combustion systems and suggest improvements for enhanced energy efficiency.
- Assess the potential of biogas and biofuels and describe the key technologies and programs used for biomass-to-energy conversion in India.

	Audit Course	L	T	P	C
M. Tech		2	0	0	0

English For Research Paper Writing

Course objectives:

- Understand how to improve your writing skills and level of readability Learn about what to write in each section.
- Understand the skills needed when writing a Title Ensure the good quality of paper at very first- time submission.

UNIT – I:

Planning And Preparation: Planning and Preparation, Word Order, breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

UNIT – II:

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

UNIT – III:

Discussion And Conclusions: Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check. Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.

UNIT – IV:

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Co

UNIT – V:

Quality And Time Maintenance: Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

Textbooks:

1. Goldbart R, “Writing for Science”, Yale University Press. 2011.
2. Adrian Wallwork, “English for Writing Research Papers”, Springer New York Dordrecht Heidelberg London, 2011.

Reference Books:

1. Highman N, "Handbook of Writing for the Mathematical Sciences", SIAM Highman's Book.

Web References:

1. http://saba.kntu.ac.ir/eecd/ecourses/Seminar90/2011%20English%20for%20Writing%20Research%20P apers.pdf

Course Outcomes:

- Interpret the technique of determining a research problem for a crucial part of the research study
- Examine the way of methods for avoiding plagiarism in research
- Apply the feasibility and practicality of research methodology for a proposed project.
- Make use of the legal procedure and document for claiming patent of invention.
- Identify different types of intellectual properties, the right of ownership, scope of protection to create and extract value from IP

	Audit Course	L	T	P	C
M. Tech		2	0	0	0

Disaster Management

Course Objectives:

- How to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- How critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- The understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- The strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

UNIT I:

Introduction: Disaster: Definition, Factors and Significance; Difference Between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT II:

Repercussions of Disasters and Hazards: Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

UNIT III:

Disaster Prone Areas in India: Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone To Cyclonic and Coastal Hazards With Special Reference to Tsunami; Post-Disaster Diseases and Epidemics

UNIT IV:

Disaster Preparedness and Management: Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental And Community Preparedness.

UNIT V: **Risk Assessment & Disaster Mitigation**:

Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global and National

Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.

Disaster Mitigation: Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.

Textbooks:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies", New Royal Book Company.

Reference Books:

1. Sahni, Pardeep Et.Al, "Disaster Mitigation Experiences and Reflections", Prentice Hall Of India, New Delhi.
2. Goel S. L. "Disaster Administration and Management Text and Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi.

Web Reference:

1. http://nptel.ac.in/courses/105101010/downloads/Lecture37.pdf

Course Outcomes:

- Understand to describe the basic types of Environmental hazards and disasters. Understand how to react effectively to natural, manmade, and technological threats.
- Understand how to react effectively to natural, manmade, and planetary hazards
- Explore the history of the field and comprehend how past events are earthquake, landslides, and volcanic hazards.
- Describe the basic concepts of the emergency management cycle mitigation, preparedness, response, and recovery
- Recognizes the stakeholders in disaster management system, their jurisdiction and responsibilities

	Audit Course	L	T	P	C
M. Tech		2	0	0	0

Sanskrit for Technical Knowledge

Course Objectives

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world
- Learning Sanskrit to improve brain functioning
- Learning Sanskrit to develop logic in mathematics, science & other subjects enhancing memory power
- The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature

UNIT-I

Introduction Alphabets in Sanskrit, Past/Present/Future Tense.

UNIT-II:

Sentences: Simple Sentences

UNIT-III:

Roots: Order, Introduction of roots

UNIT-IV:

Sanskrit Literature: Technical information about Sanskrit Literature

UNIT-V:

Technical Concepts: Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

Textbooks:

1. Suresh Soni, “India’s Glorious Scientific Tradition”, Ocean books (P) Ltd., New Delhi.

Reference Books:

1. Dr.Vishwas, “Abhyaspustakam”, Samskrita-Bharti Publication, New Delhi.

Web References:

1. http://learnsanskritonline.com/

Course Outcomes:

- Understand the basic Sanskrit grammar Understand
- Formulate simple sentences
- Apply order and roots
- Understand Ancient Sanskrit literature about science & technology
- Developing logical thinking being a logical language in technical concepts

	Audit Course	L	T	P	C
M. Tech		2	0	0	0

Value Education

Course Objectives

- The value of education and self- development
- Imbibe good values in students
- Importance of character

UNIT-I:

Values And Self-Development: Values and self-development. Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgments.

UNIT-II:

Cultivation of Values: Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline.

UNIT-III:

Personality and behaviour Development: Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labor. Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature.

UNIT-IV:

Character And Competence: Character and Competence –Holy books vs Blind faith. Self-management and good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women.

UNIT-V:

Self-Control: All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively.

Textbooks:

1. Chakraborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford

Web References:

1. http://www.best-personal-development-books.com/personal-value-development.html
2. http://nptel.ac.in/courses/109104068/

Course outcomes

- ❖ Knowledge of self-development
- ❖ Learn the importance of Human values
- ❖ Developing the overall personality

	Audit Course	L	T	P	C
M. Tech		2	0	0	0

Constitution of India

Course Objectives:

- The premises informing the twin themes of liberty and freedom from a civil right perspective.
- The growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
- The role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

UNIT-I:

History of Making of the Indian Constitution & Philosophy of the Indian Constitution: History of Making of the Indian Constitution: History, Drafting Committee, (Composition & Working) Philosophy of the Indian Constitution: Preamble, Salient Features.

UNIT-II:

Contours of Constitutional Rights & Duties: Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT-III:

Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive President, Governor, Council of Minister. Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions

UNIT-IV:

Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.

UNIT-V:

Election Commission: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

Textbooks:

1. Dr. S. N. Busi, "Dr. B. R. Ambedkar framing of Indian Constitution", 1st Edition, 2015.
2. M. P. Jain, "Indian Constitution Law", Lexis Nexis, 7th Edition, 2014.

Reference Books:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. D.D. Basu, "Introduction to the Constitution of India", Lexis Nexis, 2015.

Web References:

1. http://www.constitution.org/cons/india/p18.html

Course Outcomes:

- Describe historical background of the constitution making and its importance for building a democratic India.
- Understand the Constitutional Rights and duties
- Explain the functioning of three wings of the government i.e., executive, legislative and judiciary.
- Analyse the decentralization of power between central, state and local self-government.
- Apply the knowledge in strengthening of the constitutional institutions like CAG, Election Commission and UPSC for sustaining democracy

	Audit Course	L	T	P	C
M. Tech		2	0	0	0

Pedagogy Studies

Course Objectives:

- Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
- Critical evidence gaps to guide the development.

UNIT-I:

Introduction: Introduction And Methodology: Aims and rationale, Policy background, Conceptual framework and terminology. Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions**.** Overview of methodology and searching.

UNIT-II:

Thematic Overview: Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

UNIT-III:

Pedagogical Practices: Evidence on the effectiveness of pedagogical practices. Methodology for the in-depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change.

Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT-IV:

Professional Development: Professional Development: alignment with classroom practices and follows up Support. Peer support. Support from the head teacher and the community. Curriculum and assessment Barriers to learning limited resources and large class sizes.

UNIT-V:

Research Gaps: Research gaps and future directions, Research design**,** Contexts**,** Pedagogy**.** Teacher education**.** Curriculum and assessment**.** Dissemination and research impact.

Textbooks:

1. Ackers J, Hardman F, "Classroom interaction in Kenyan primary schools", Compare, 31 (2), 245-261.

2. Agrawal M, "Curricular reform in schools: The importance of evaluation", Journal of Curriculum Studies, 36 (3): 361-379.

Reference Books:

1. AkyeampongK, "Teacher training in Ghana - does it count?" Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
2. Akyeampong K, Lussier K, Pryor J, Westbrook J, "Improving Teaching and Learning of Basic Maths and Reading in Africa: Does teacher preparation count?" International Journal Educational Development, 33 (3): 272–282.

Course Outcomes:

- Identify the Methodology and conceptual framework of teachers education
- Understand pedagogical practices are being used by teachers in formal and informal classrooms in developing countries
- Interpret the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners
- Classify the importance of class room practice, curriculum and learning in Professional Development.
- Summarize teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy

	Audit Course	L	T	P	C
M. Tech		2	0	0	0

Stress Management By Yoga

Course Objectives:

- ❖ To achieve overall health of body and mind
- ❖ To overcome stress

UNIT– I:

Introduction: Definitions of Eight parts of yoga. (Ashtanga)

UNIT– II:

Yam and Niyam: Yam and Niyam. Do`s and Don't's in life. Ahinsa, satya, astheya, bramhacharya and aparigraha.

UNIT– III:

Shaucha: Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

UNIT– IV:

Asan and Pranayama: Asan and Pranayama. Various yoga poses and their benefits for mind & body

UNIT– V

Breathing Techniques: Regularization of breathing techniques and its effects-Types of pranayama

Textbooks:

1. Swami Vivekananda, "Rajayoga or conquering the Internal Nature", Advaita Ashrama (Publication Department), Kolkata.

Reference Books:

1. Janardan Swami, "Yogic Asanas for Group Tarining-Part-I", Yogabhyasi Mandal, Nagpur.

Web References:

1. https://americanyoga.school/course/anatomy-for-asana/
2. https://www.yogaasanasonline.com/

Course Outcomes:

- ❖ Develop a healthy mind in a healthy body thus improving social health also
- ❖ Improve efficiency

Audit Course	L	T	P	C
M. Tech	2	0	0	0

Personality Development Through Life Enlightenment Skills

Course Objectives

- ❖ To learn to achieve the highest goal happily.
- ❖ To become a person with stable mind, pleasing personality and determination.
- ❖ To awaken wisdom in students

UNIT– I:

Holistic Development: Neetisatakam-Holistic development of personality, Verses-19,20,21,22 (wisdom), Verses- 29,31,32 (pride & heroism), Verses- 26,28,63,65 (virtue),Verses- 52,53,59 (dont's),Verses- 71,73,75,78 (do's)

UNIT– II:

Bhagwad Geeta: Approach to day to day work and duties. Shrimad BhagwadGeeta: Chapter 2-Verses 41, 47,48. Chapter 3- Verses 13, 21, 27, 35.

UNIT– III:

Bhagwad Geeta: Shrimad BhagwadGeeta: Chapter 6-Verses 5, 13, 17, 23, 35, Chapter 18-Verses 45, 46, 48.

UNIT– IV:

Basic Knowledge: Statements of basic knowledge. Shrimad BhagwadGeeta: Chapter2-Verses 56, 62, 68. Chapter 12 -Verses 13, 14, 15, 16,17, 18

UNIT– V:

Role Model: Personality of Role model. Shrimad BhagwadGeeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42 Chapter 4-Verses 18, 38,39. Chapter18 – Verses 37,38,63

Textbooks:

1. P.Gopinath, "Bhartrihari's Three Satakam (Niti-sringar-vairagya)", Rashtriya Sanskrit Sansthanam, New Delhi.

Reference Books:

1. Swami Swarupananda, "Srimad Bhagavad Gita", Advaita Ashram (Publication Department), Kolkata.

Course Outcomes

- Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life.
- The person who has studied Geeta will lead the nation and mankind to peace and prosperity.
- Study of Neetishatakam will help in developing versatile personality of students.