# SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY:PUTTUR

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## M. Tech. (Electronics & Communication Engineering) Specialization: Embedded Systems

### I M. Tech - I Sem

| S.No | Course Code | Course Name | L | T | P | Credits |
|---|---|---|---|---|---|---|
| 1 | 20HS0823 | Research Methodology and IPR | 2 | - | - | 2 |
| 2 | 20EC4101 | Embedded System Design | 3 | - | - | 3 |
| 3 | 20EC4102 | Sensors and Actuators | 3 | - | - | 3 |
| **Programme Elective - I** | | | | | | |
| 4 | 20EC4103 | Structural Digital System Design | 3 | - | - | 3 |
| | 20EC4209 | FPGA Architectures & Applications | | | | |
| | 20EC4104 | Real Time Operating Systems | | | | |
| **Programme Elective - II** | | | | | | |
| 5 | 20EC4105 | Embedded Networking | 3 | - | - | 3 |
| | 20EC4011 | Wireless Communications | | | | |
| | 20EC4106 | Internet Protocols | | | | |
| 6 | 20EC4107 | Embedded System Design Lab | - | - | 4 | 2 |
| 7 | 20EC4108 | Structural Digital System Design Lab | - | - | 4 | 2 |
| **Audit Course - I** | | | | | | |
| 8 | 20HS0818 | English for Research Paper Writing | 2 | - | - | - |
| Contact Periods / Week | | | 16 | - | 8 | 18 |
| | | | Total/Week: 24 | | | |

### I M. Tech - II Sem

| S.No | Course Code | Course Name | L | T | P | Credits |
|---|---|---|---|---|---|---|
| 1 | 20EC4109 | Introduction to IoT | 3 | - | - | 3 |
| 2 | 20EC4110 | Advanced Microcontrollers | 3 | - | - | 3 |
| **Programme Elective - III** | | | | | | |
| 3 | 20EC4111 | Hardware Software Co-Design | 3 | - | - | 3 |
| | 20EC4213 | Testing & Testability | | | | |
| | 20EC4112 | Micro Electromechanical Systems | | | | |
| **Programme Elective - IV** | | | | | | |
| 4 | 20EC4201 | VLSI Technology | 3 | - | - | 3 |
| | 20EC4202 | Digital IC Design | | | | |
| | 20EC4008 | Wireless Sensor Networks | | | | |
| 5 | 20EC4113 | Internet of Things Lab | - | - | 4 | 2 |
| 6 | 20EC4114 | Microcontrollers & Interfacing Lab | - | - | 4 | 2 |
| 7 | 20EC4115 | Mini Project | - | - | 4 | 2 |
| **Audit Course - II** | | | | | | |
| 8 | 20HS0829 | Constitution of India | 2 | - | - | - |
| Contact periods / Week | | | 14 | - | 12 | 18 |
| | | | Total/Week:26 | | | |

## II M. Tech – I Sem

| S.No | Course Code | Course Name | L | T | P | Credits |
|---|---|---|---|---|---|---|
| **Programme Elective - V** | | | | | | |
| 1 | 20EC4002 | Advanced Digital Signal Processing | 3 | - | - | 3 |
| | 20EC4116 | Radio Frequency Identification | | | | |
| | 20EC4117 | System on Chip Architecture | | | | |
| **Open Elective** | | | | | | |
| 2 | 20HS0824 | Business Analytics | 3 | - | - | 3 |
| | 20CE1028 | Cost Management of Engineering Projects | | | | |
| | 20EE2128 | Waste to Energy | | | | |
| | 20ME3026 | Industrial Safety | | | | |
| | 20ME3027 | Advances in Operations Research | | | | |
| | 20ME3028 | Composite Materials | | | | |
| 3 | 20EC4118 | DissertationPhase-I | - | - | 20 | 10 |
| Contact periods / Week | | | 6 | - | 20 | 16 |
| | | | Total/Week:26 | | | |

## II M. Tech - II Sem

| S.No | Course Code | Course Name | L | T | P | Credits |
|---|---|---|---|---|---|---|
| 1 | 20EC4119 | DissertationPhase-II | - | - | 32 | 16 |
| Contact periods / Week | | | Total/Week:32 | | | 16 |

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

## LIST OF SUBJECTS

| S. No | Course Code | Course Title |
|---|---|---|
| 1. | 20EC4101 | Embedded System Design |
| 2. | 20EC4102 | Sensors and Actuators |
| 3. | 20EC4103 | Structural Digital System Design |
| 4. | 20EC4209 | FPGA Architectures & Applications |
| 5. | 20EC4104 | Real Time Operating Systems |
| 6. | 20EC4105 | Embedded Networking |
| 7. | 20EC4011 | Wireless Communications |
| 8. | 20EC4106 | Internet Protocols |
| 9. | 20EC4107 | Embedded System Design Lab |
| 10. | 20EC4108 | Structural Digital System Design Lab |
| 11. | 20HS0823 | Research Methodology and IPR |
| 12. | 20HS0818 | English for Research Paper Writing |
| 13. | 20CE1029 | Disaster Management |
| 14. | 20HS0825 | Sanskrit for Technical Knowledge |
| 15. | 20HS0826 | Value Education |
| 16. | 20EC4109 | Introduction to IoT |
| 17. | 20EC4110 | Advanced Microcontrollers |
| 18. | 20EC4111 | Hardware Software Co-Design |
| 19. | 20EC4213 | Testing & Testability |
| 20. | 20EC4112 | Micro Electromechanical Systems |
| 21. | 20EC4201 | VLSI Technology |
| 22. | 20EC4202 | Digital IC Design |
| 23. | 20EC4008 | Wireless Sensor Networks |
| 24. | 20EC4113 | Internet of Things Lab |
| 25. | 20EC4114 | Microcontrollers & Interfacing Lab |
| 26. | 20EC4115 | Mini Project |
| 27. | 20HS0829 | Constitution of India |
| 28. | 20HS0827 | Pedagogy Studies |
| 29. | 20HS0828 | Stress Management by Yoga |
| 30. | 20HS0819 | Personality Development Through Life Enlightenment Skills. |
| 31. | 20EC4002 | Advanced Digital Signal Processing |
| 32. | 20EC4116 | Radio Frequency Identification |
| 33. | 20EC4117 | System on Chip Architecture |
| 34. | 20HS0824 | Business Analytics |
| 35. | 20CE1028 | Cost Management of Engineering Projects |
| 36. | 20EE2128 | Waste to Energy |
| 37. | 20ME3026 | Industrial Safety |
| 38. | 20ME3027 | Advances in Operations Research |
| 39. | 20ME3028 | Composite Materials |
| 40. | 20EC4118 | Dissertation Phase-I |
| 41. | 20EC4119 | Dissertation Phase -II |

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## (20HS0823) RESEARCH METHODOLOGY AND IPR

### COURSE OBJECTIVES

The objectives of this course:

1. *Understand some basic concepts of research and its methodologies.*
2. *Identify and discuss appropriate research topics, select appropriate research design, and implement a research project.*
3. *Understand the method of research writing and presenting research report and proposal*
4. *Provide an understanding on the importance of intellectual property rights*
5. *Understand the intricacies of grant of patent, patentability, licensing and revocation at national and international level.*

### COURSE OUTCOMES (COs)

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

1. *Explain the key concepts and issues in research and basic framework of research process.*
2. *Formulate appropriate research problem and implement suitable research design for the research problem.*
3. *Identify various sources of information for literature review and data collection.*
4. *Develop an understanding of ethics in conducting applied research and make use of components of scholarly writing in report preparation.*
5. *Identify different types of Intellectual Properties (IPs), the right of ownership, scope of protection as well as the ways to create and to extract value from IP.*
6. *Recognize the crucial role of IP in organizations of different industrial sectors for the purposes of product and technology development.*

### UNIT- I

**Research Methodology:** Meaning, Objective and importance of research - Types of research - steps involved in research -Motivation in Research, Types of Research -Significance of Research - Research Methods versus Methodology - Importance of Knowing How Research is done - Research Process - Criteria of Good Research defining research problem - Errors in selecting a research problem.

### UNIT- II

**Research Design and Data Collection**: Research design - Different Research Designs - Effective literature studies -Classification of Data - Methods of Data Collection – Sampling - Sampling techniques, procedure and methods - Ethical considerations in research - Responsibility of ethics in research.

**UNIT- III**

**Research Report Writing**: Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

**UNIT-IV**

**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- V**

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

**TEXT BOOKS**

1. Stuart Melville and Wayne Goddard, *Research methodology: An introduction for science & engineering students*
2. Wayne Goddard and Stuart Melville, *Research Methodology: An Introduction*.

**REFERENCES**

1. Ranjit Kumar, *Research Methodology: A Step by Step Guide for beginners*,Halbert, *Resisting Intellectual Property*, 2nd Edition, Taylor & Francis Ltd, 2007.
2. Mayall, “Industrial Design”, McGraw Hill, 1992. Niebel, *Product Design*, McGraw Hill, 197
3. Asimov, “Introduction to Design”, Prentice Hall, 1962.
4. Robert P. Merges, Peter S. Menell, Mark A. Lemley, *Intellectual Property in New Technological Age*, 2016.
5. T. Ramappa, *Intellectual Property Rights Under WTO*, S. Chand, 2008

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## (20EC4101) EMBEDDED SYSTEM DESIGN
## (Common to ES & VLSI)

**COURSE OBJECTIVES**
The objectives of this course:

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

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

1. *Apply and analyze the applications in various processors and domains of embedded system*
2. *Analyse embedded hardware and software development cycles and tools.*
3. *Analyseand understand a microprocessor and core of the embedded system.*
4. *Analyse to understand different concepts of a RTOS, sensors, memory interface, and communication interface.*
5. *Develop solutions for real world problems by doing projects using embedded systems.*
6. *Analyse the design methodologies involved in the examples of embedded systems.*

**UNIT – I**
**Introduction:** Embedded System Overview - Embedded Hardware Units - Embedded Software ina System - Embedded System on Chip (SoC) - Design Process - Classification of Embedded Systems.

**UNIT – II**
**Embedded Computing Platform:** CPU Bus - Memory Devices - Component Interfacing - Networks for Embedded Systems - Communication Interfacings: RS232/UART, RS422/RS485&IEEE 488 Bus.
**Survey of Software Architecture:** Round Robin, Round Robin with Interrupts, Function Queue Scheduling Architecture, Selecting an Architecture Saving Memory Space.

**UNIT – III**
**Embedded Software Development Tools:** Host and Target Machines - Linkers - Locations for Embedded Software - Getting Embedded Software into Target System - Debugging Technique.
**RTOS Concepts:** Architecture of the kernel - Interrupt Service Routines - Semaphores, Message Queues - Pipes.

**UNIT – IV**
**Instruction Sets:** Introduction – Preliminaries - ARM Processor - SHARC Processor - System Design Techniques: Design Methodologies, Requirement Analysis, Specifications & System Analysis and Architecture Design.

**UNIT – V**

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

**TEXTBOOKS**

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

**REFERENCES**

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

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## (20EC4102) SENSORS AND ACTUATORS

### COURSE OBJECTIVES

The objectives of this course:

1. *Understandsensor/transducer Principles, Classification, Parameters, Characteristics, Environmental Parameters (EP), and Characterization.*
2. *Enumerate different types of sensors, actuators, and its principle of operation.*
3. *Able to understand basic laws and phenomena on which operation of sensors and actuators-transformation of energy is based.*

### COURSE OUTCOMES(COs)

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

1. *Describe basic laws and phenomena that define behaviour of sensors and actuator.*
2. *Determine the required sensor and actuator criteria for a mechatronic system.*
3. *Analyse various premises, approaches, procedures and results related to sensors and actuators.*
4. *Create analytical design and development solutions for sensors and actuator.*
5. *Describe development and application of sensors and actuators.*
6. *Analyse and select the most appropriate sensors or actuator for an application.*

### UNIT – I

**Sensors/Transducers:** Classification – Parameters – Characteristics –Environmental Parameters (EP) – Characterization Mechanical and Electromechanical Sensors: Introduction – Resistive Potentiometer – Strain Gauge Resistance – Strain Gauge – Semiconductor StrainGauges.

### UNIT – II

**Thermal Sensors:** Introduction – Gas Thermometric Sensors – Thermal Expansion Type Thermometric Sensors – Acoustic Temperature Sensor – Dielectric Constant and Refractive Index Thermo sensors – Helium Low Temperature Thermometer – Nuclear Thermometer – Magnetic Thermometer – Resistance Change Type Thermometric Sensors –Thermo EMF Sensors– Junction Semiconductor Types– Thermal Radiation Sensors –Quartz Crystal Thermoelectric Sensors – NQR Thermometry – Spectroscopic Thermometry – Noise Thermometry.

### UNIT – III

**Radiation Sensors:** Introduction, Basic Characteristics – Types of Photo sensistors/Photo detectors– X-ray and Nuclear Radiation Sensors– Fiber Optic Sensors Electro Analytical Sensors: Introduction – The Electrochemical Cell – The Cell Potential – Standard Hydrogen Electrode (SHE) – Liquid Junction and Other Potentials – Polarization – Concentration Polarization – Reference Electrodes–Sensor Electrodes – Electro ceramics in Gasmedia.

**UNIT – IV**

**Smart Sensors**: Introduction – Primary Sensors – Excitation – Amplification – Filters – Converters – Compensation– Information Coding/Processing - Data Communication – Standards for Smart Sensor Interface – The Automation Sensors –Applications: Introduction – On-board Automobile Sensors (Automotive Sensors)– Home Appliance Sensors – Aerospace Sensors – Sensors for Manufacturing – Sensors for environmental Monitoring.

**UNIT – V**

**Actuators:** Pneumatic and Hydraulic Actuation Systems– Actuation systems – Pneumatic and Hydraulic systems – Directional Control valves – Pressure control valves – Cylinders–Servo and Proportional control valves – Process control valves – Rotary actuators Mechanical actuation Systems – Types of Motion – Kinematic chains – Cams – Gears – Ratchet and Pawl – Belt and Chain drives – Bearings.

**TEXTBOOKS**

1. D.Patranabis**,** *Sensors and Transducers,* PHI Learning Pvt Ltd,3rd Edition, 2001
2. W.Bolton**,** *Mechatronics,* Pearson Education Limited, 3rd Edition, 2003

**REFERENCES**

1. D.Patranabis**,** *Sensors and Actuators,* PHI Learning Pvt Ltd,3rdEdition, 2013
2. Manfred Kaltenbacher**,** *Numerical Simulation of Mechatronic Sensors and Actuators: Finite Elements for Computational Multiphysics,*Springer,3rd Edition, 2015
3. Evgeni Gusev, Eric Garfunkel, and Arthur Dideikin**,***Advanced Materials and Technologies for Micro/Nano-Devices, Sensors and Actuators,*Springer,1st Edition, 2010

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## (20EC4103) STRUCTURAL DIGITAL SYSTEM DESIGN
**(Programme Elective-I)**

**COURSE OBJECTIVES**
The objectives of this course:

1. *To study about structural functionality of different Digital blocks (Both combinational and Sequential)*
2. *To provide an exposure to ASM charts, their notations and their realizations.*
3. *To provide an exposure to VHDL and different styles of modelling using VHDL.*
4. *To introduce concept of micro programming and study issues related to micro programming*

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

1. *Understand structural functionality of different digital blocks*
2. *Represent their designs in ASM charts*
3. *Realize their designs in ASM charts*
4. *Represent their designs in different modelling styles by using VHDL*
5. *Understand concept of Micro program and issues related to micro programming.*
6. *Analyse the design methodologies in digital systems.*

**UNIT – I**
**Building Blocks for Digital Design**: Multiplexer - De-Multiplexer – Decoder – Encoder – Comparator – Adder – ALU - Carry-Look-Ahead Adder.
**Building Blocks with Memory:** Clocked Building Blocks&Register Building Blocks – RAM – ROM – PLA – PAL - Timing Devices.

**UNIT – II**
**Design Methods:** Elements of Design Style - Top-Down Design - Separation of Controller and Architecture - Refining Architecture and Control Algorithm - Algorithmic State Machines - ASM Chart Notations.

**UNIT – III**
**Realizing ASMs:** Traditional Synthesis from ASM Chart - Multiplexer Controller Method, One- Shot Method&ROM Based Method.
**Asynchronous Inputs and Races:** Asynchronous ASMs - Design for Testability - Test Vectors - Fault Analysis Tools.

**UNIT – IV**

**Micro programed Design:** Classical Microprogramming with Modem Technology - Enhancing the Control Unit - The 2910 Micro program Sequencer - Choosing a Micro Program Memory - A Development System for Microprogramming - Designing a Micro Programmed Minicomputer.

**UNIT – V**

**Modeling with VHDL:** CAD Tools – Simulators - Schematic Entry - Synthesis from VHDL.
**Design Case Studies:** Single Pulse - System Clock - Serial to Parallel Data Conversion - Traffic Light Controller.

**TEXTBOOKS**

1. Franklin P. Prosser and David E. Winkel, *The Art of Digital Design*, Prentice Hall,2nd Edition, 1987.
2. Charles H Roth, *Digital System Design using VHDL*, McGraw Hill, 3rd Edition, 2018.

**REFERENCES**

1. William Fletcher, *An Engineering Approach to Digital Design*, PrenticeHall India, 1stEdition, 1997.
2. William J Dally and John W Poulton,*Digital Systems Engineering*, Cambridge University Press, 5th Edition, 2008
3. Jayaram Bhasker**,** *A VHDL Primer*, PrenticeHall India, 3rd edition,2009.
4. Kevin Skahill,*V HDL for Programmable Logic*, Cypress Semiconductors, 2nd Edition, 2008.

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## (20EC4209) FPGA ARCHITECTURES & APPLICATIONS
## (Programme Elective-I)

**COURSE OBJECTIVES**

The objectives of this course:

:

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

**COURSE OUTCOMES (COs)**

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

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

**UNIT – I**

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

**UNIT – II**

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

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

**UNIT – III**

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

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

**UNIT – IV**

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

**UNIT – V**

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

**TEXTBOOKS**

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

**REFERENCES**

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

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## (20EC4104) REAL TIME OPERATING SYSTEMS
## (Programme Elective-I)

**COURSE OBJECTIVES**

The objectives of this course:

1. *To provide a basic understanding of Real-Time systems requirements.*
2. *To understand the complexities of RTOS scheduling and synchronization.*
3. *To configure, boot, test and deploy real-time embedded systems using various tools.*
4. *To give students the confidence to apply these concepts to their RTOS projects.*

**COURSE OUTCOMES (COs)**

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

1. *Understand the capabilities and functionalities of an real time operation systems*
2. *Analyse the usage of UNIX commands in real time operating systems.*
3. *Describe the concepts of Real-Time systems and modeling.*
4. *Classify and exemplify real time scheduling algorithms.*
5. *Analyse the situation of fault occurrence and will be able to apply solutions accordingly.*
6. *Analyze the use commercial tools to develop RTOS based applications for various applications.*

**UNIT – I**

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

**UNIT – II**

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

**UNIT – III**

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

**UNIT– IV**

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

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

**UNIT – V**

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

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

**TEXT BOOKS**

1. Richard Stevens, *Advanced Unix Programming*, Pearson Education, 2nd Edition, 2008.
2. Jane W.S.Liu, *Real Time Systems*, Pearson Education, 9th Edition, 2013.

**REFERENCES**

1. VxWorks Programmers Guide
2. www.tidp.org
3. www.kernel.org

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## (20EC4105) EMBEDDED NETWORKING
## (Programme Elective-II)

**COURSE OBJECTIVES**

The objectives of this course :

1. *To understand the serial and parallel communication protocol related to embedded networking.*
2. *To familiarize the concepts of USB & CAN bus.*
3. *To learn the principles of Ethernet communication.*
4. *To understand the concepts of Embedded Ethernet.*
5. *To recognize the need for wireless protocols to indulge in Real world interfacing.*

**COURSE OUTCOMES (COs)**

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

1. *Understand the basic principles of embedded networking protocols.*
2. *Differentiate serial and parallel communication protocols related to embedded networking.*
3. *Describe the capabilities of USB & CAN bus protocols.*
4. *Understand the principles of Ethernet communication.*
5. *Describe the concepts of Embedded Ethernet.*
6. *Recognize the need for wireless protocols to indulge in Real world interfacing.*

**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 – Fire wire.

**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.

**TEXT BOOKS**

1. Frank Vahid, Tony Givargis, *Embedded Systems Design: A Unified Hardware/Software Introduction* ,John& Wiley Publications, 3rd Edition, 2009.
2. Jan Axelson, *Parallel Port Complete: Programming, interfacing and using the PCs parallel printer port* ,Lakeview Research, 4th Edition,2000.

**REFERENCES**

1. Dogan Ibrahim, *Advanced PIC microcontroller projects in C: from USB to RTOS with the PIC18F series,* Elsevier, 1st Edition, 2008.
2. Jan Axelson, *Embedded Ethernet and Internet Complete*, Penram publications, 2nd Edition, 2003.

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## (20EC4011) WIRELESS COMMUNICATIONS
## (Programme Elective-II)

**COURSE OBJECTIVES**

The objectives of this course :

1. *To provide an overview of Wireless Communication and its applications in communication engineering.*
2. *To appreciate the contribution of Wireless Communication networks to overall technological growth.*
3. *To understand the various terminology, principles, devices, schemes, concepts, algorithms and different methodologies used in Wireless Communication.*

**COURSE OUTCOMES (COs)**

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

1. *Understand fundamentals of wireless communications and Compare different technologies used for wireless communication systems.*
2. *To understand large-scale and small-scale fading-channel models, and to analyze their influences on a wireless communication system's performance.*
3. *Analyze and design receiver and transmitter diversity techniques.*
4. *Understand various multiple-access techniques for cellular communications, and their advantages and disadvantages*
5. *Understand the principles and theory of spread spectrum communications with emphasis on CDMA*
6. *Calculate the capacity of deterministic and random MIMO channels and fading channels.*

**UNIT – I**

**Introduction to Wireless Communications Systems:** Evolution, Examples of WirelessCommunication Systems, Comparison – Second Generation Cellular Networks, WLL, Bluetooth and Personal Area Networks.

**UNIT – II**

**Mobile Radio Propagation:** Large-Scale Path Loss, Introduction to Radio Wave Propagation, Free Space Propagation Model, Propagation Mechanisms, Reflection, Ground Reflection (Two-Ray) Model, Diffraction, Scattering. Small-Scale Fading and Multipath, Impulse Response Model of a Multipath Channel, Small- Scale Multipath Measurements, Parameters of Mobile Multipath Channels, Types of Small-Scale Fading, Rayleigh and Ricean Distributions, Statistical Models for Multipath Fading Channels, Theory of Multipath Shape Factors for Small-Scale Fading Wireless Channels.

**UNIT– III**

**Diversity Techniques:** Repetition Coding and Time Diversity – Frequency and Space Diversity, Receive Diversity – Concept of Diversity Branches and Signal Paths – Combining Methods – Selective Diversity Combining – Switched Combining – Maximal Ratio Combining – Equal Gain

Combining – Performance Analysis for Rayleigh Fading Channels.

**Cellular Communication:** Cellular Networks, Multiple Access: FDM/TDM/FDMA/TDMA, Spatial Reuse, Co-Channel Interference Analysis, Hand Over Analysis, Erlang Capacity Analysis, Spectral Efficiency and Grade of Service- Improving Capacity – Cell Splitting andSectorization.

**UNIT – IV**

**Spread Spectrum and CDMA:** Motivation – Direct Sequence Spread Spectrum– Frequency Hopping Systems, Time Hopping., Anti-Jamming – Pseudo Random (PN) Sequence, Maximal Length Sequences, Gold Sequences, and Generation of PN Sequences.

**Diversity in DS-SS Systems:** Rake Receiver- Performance Analysis. Spread Spectrum Multiple Access, CDMA Systems – Interference Analysis for Broadcast and Multiple Access Channels, Capacity of Cellular CDMA Networks – Reverse Link Power Control, Hard and Soft Hand Off Strategies.

**UNIT – V**

**Fading Channel Capacity:** Capacity of Wireless Channels – Capacity of Flat and Frequency Selective Fading Channels – Multiple Input Multiple Output (MIMO) Systems,Narrow Band Multiple Antenna System Model, Parallel Decomposition of MIMO Channels – Capacity of MIMO Channels.

**Cellular Wireless Communication Standards:** GSM Specifications and Air Interface, Specifications, IS 95 CDMA- 3G Systems: UMTS & CDMA 2000 Standards and Specifications.

**TEXT BOOKS**

1. Andrea Goldsmith, *Wireless Communications*, Cambridge Universitypress, 1st Edition, 2005.
2. T.S. Rappaport, *Wireless Communications, Principles & Practice*, Pearson, 2nd Edition, 2009.

**REFERENCES**

1. G.L Stuber, *Principles of Mobile Communications*, Kluwer Academic Publishers, 3rd Edition, 1999.
2. A.J.Viterbi, *CDMA- Principles of Spread Spectrum*, Addison Wesley,1st Edition,1995.
3. Simon Haykin and Michael Moher, *Modern Wireless Communications*, Person Education, 1st Edition, 2011.

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## (20EC4106) INTERNET PROTOCOLS
**(Programme Elective-II)**

### COURSE OBJECTIVES

The objectives of this course:

1. *To get familiar with the Internetworking concepts, internet addressing and TCP/IP protocol Suite.*
2. *To Understand Mobile IP and multicasting & unicasting routing protocols.*
3. *To Understand the IP security and the firewalls*

### COURSE OUTCOMES (COs)

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

1. *Explain basic network routing concepts &algorithms and apply them into given topologies.*
2. *Explain how the Internet protocol suite operates and describe the functions of its various protocols.*
3. *Identify the different types of network devices and their functions within a network.*
4. *Examine data packets and compare communication patterns to protocol descriptions.*
5. *Recognize the suitability of an Internet protocol for supporting a given application type.*
6. *Understand the principles of network security.*
7. *Describe the techniques involved in processing multimedia.*

### UNIT – I

**Internetworking Concepts:** Principles of Internetworking - Connectionless Internetworking - Application level Interconnections - Network level Interconnection - Properties of the Internet - Internet Architecture - Wired LANS & Wireless LANs - Point-to-Point WANs &Switched WANs, Connecting Devices, TCP/IP Protocol Suite.

**IP Address: Classful Addressing:** Introduction - Classful Addressing - Other Issues - Sub-netting and Super-netting.

**Classless Addressing:** Variable length Blocks - Sub-Netting - Address Allocation – Delivery - Forwarding - Routing of IP Packets - Delivery, Forwarding, Routing &Structure of Router.

**ARP and RARP:** ARP - ARP Package - RARP.

### UNIT – II

**Internet Protocol (IP):** Datagram – Fragmentation – Options – Checksum - IP V.6.

**Transmission Control Protocol (TCP):** TCP Services - TCP Features –Segment - A TCP Connection - State Transition Diagram - Flow Control, Error Control & Congestion Control - TCP Times.

**Stream Control Transmission Protocol (SCTP):** SCTP Services - SCTP Features - Packet Format - Flow Control, Error Control &Congestion Control.

**Mobile IP:** Addressing – Agents - Three Phases - Inefficiency in Mobile IP.
**Classical TCP Improvements:** Indirect TCP, Snooping TCP & Mobile TCP - Fast Retransmit/ Fast Recovery - Transmission/ Time out Freezing - Selective Retransmission - Transaction OrientedTCP.

**UNIT– III**
**Unicast Routing Protocols (RIP, OSPF, and BGP):** Intra and Inter Domain Routing - Distance Vector Routing – RIP - Link State Routing – OSPF - Path Vector Routing - BGP.
**Multicasting and Multicast Routing Protocols:** Unicast, Multicast & Broadcast - Multicast Applications - Multicast Routing - Multicast Link State Routing: MOSPF - Multicast Distance Vector: DVMRP.

**UNIT– IV**
**Domain Name System (DNS):** Name Space, Domain Name Space & Distribution of Name Space – DNSin the internet.
**Remote Login TELNET:** Concept - Network Virtual Terminal (NVT).
**File Transfer FTP and TFTP:** File Transfer Protocol (FTP).
**Electronic Mail:** SMTP and POP.
**Network Management-SNMP:** Concept - Management Components - World Wide Web- HTTP Architecture.

**UNIT– V**
**Multimedia:** Digitizing Audio and Video - Network Security - Security in The Internet Firewalls - Audio and Video Compression - Streaming Stored Audio/Video, Streaming Live Audio/Video &Real-Time Interactive Audio/ Video - RTP, RTCP & Voice Over IP.

**TEXT BOOKS**

1. Behrouz *A.* Forouzan, *TCP/IP Protocol Suite,*McGraw-Hill Education (India) Pvt Limited, 4th Edition, 2017.
2. Comer, *Internetworking with TCP/IP*,PHI, 3rd Edition,2014

**REFERENCE BOOKS**

1. Mahbub Hassan, Raj Jain, *High performance TCP/IP Networking,* PHI, 3rd Edition,2005.
2. *B.A.* Forouzan, *Data Communications & Networking,* TMH, 4th Edition, 2007.
3. William Stallings, *High Speed Networks and Internets,* Pearson Education, 2nd Edition,2002.
4. William Stallings, *Data and Computer Communications,* PEI, 8th Edition, 2009..
5. Adrin Farrel, *The Internet and Its Protocols,* Elsevier, 2nd Edition2005.

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## (20EC4107) EMBEDDED SYSTEM DESIGN LAB

**COURSE OBJECTIVES**
The objectives of this course:

1. *Understand the structure ARM development board*
2. *Familiar with keil software*
3. *Understand the interfacing of I/O devices with ARM processors.*

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

1. *Familiar with ARM evaluation board.*
2. *Analyze the techniques of writing programs for various applications.*
3. *Develop Embedded C programs for various applications*
4. *Experience with implementing the interfacing of various input and output devices with ARM processor.*
5. *Understand how to Test, debug and deploy programs using keil software.*
6. *Design and develop own microprocessor/microcontroller based solutions for real world problems*

**Note**: Minimum **Ten** Experiments to be conducted

**List of Experiments**

1. Study of ARM evaluation system
2. Interfacing ADC and DAC.
3. Interfacing LED and PWM.
4. Interfacing real time clock and serial port.
5. Interfacing keyboard and LCD.
6. Interfacing EPROM and interrupt.
7. Mailbox
8. Interrupt performance characteristics of ARM and FPGA.
9. Flashing of LEDS.
10. Interfacing stepper motor and temperature sensor.
11. Implementing zigbee protocol with ARM.
12. Mini Project

**Lab Requirements:**
**Software:**

1. KEIL µ VISION 4 SOFTWARE

**Hardware:**

1. ARM(LPC2148) development board

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## (20EC4108) STRUCTURAL DIGITAL SYSTEM DESIGN LAB

**COURSE OBJECTIVES**
The objectives of this course :

1. *To understand about VHDL and Verilog Programming in all available styles.*
2. *To understand differences between Verilog and VHDL.*
3. *To Design digital logic for various systems .*

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

1. *Analyze, design and implement combinational logic circuits.*
2. *Analyze, design and implement sequential logic circuits.*
3. *Analyze, design and implement digital logic for various real time applications.*
4. *Understand different modelling styles available in VHDL and Verilog and difference between them*
5. *Design digital systems logic using finite state machines*
6. *Simulate and implement combinational and sequential circuits using VHDL systems*

### List of Experiments

**Using VHDL or VERILOG do the following experiments**

1. Design of 4-bit adder / subtractor
2. Design of Booth Multiplier
3. Design of 4-bit ALU
4. Design SISO, SIPO, PISO, PIPO Registers
5. Design of Ripple, Johnson and Ring counters
6. Design of MIPS processor
7. Design of Washing machine controller
8. Design of Traffic Light Controller
9. Design “1010” pattern detector using Mealy State Machine
10. Design “1100” recursive pattern detector using Moore state Machine
11. Design simple Security System Using FSM/ASM
12. Mini Project

**Tools Required:**Xilinx ISE Design Suite

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## (20HS0818) ENGLISH FOR RESEARCH PAPER WRITING
**(Audit Course-I)**

### COURSE OBJECTIVES
The objectives of this course:

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

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

1. *Familiarize students with the key concepts of linguistics and develop awareness of the latest trends in language study.*
2. *Lead to a greater understanding of the human communicative action through an objective study of language.*
3. *Know and appreciate the location of literature within humanities.*
4. *Gain knowledge of research methods in literary studies and advanced knowledge of literature in the English language and literary theory.*
5. *Carry out an independent, limited research project under supervision, in accordance with applicable norms, ideals and conditions for literary research.*
6. *Improve common and basic scholarly requirements of logical and empirical rigor.*

**UNIT- I**

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

**UNIT- II**

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

**UNIT- III**

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

**UNIT- IV**

Key Skills Needed When Writing a Title, Key Skills Needed When Writing Abstract, Key Skills Needed When Writing an Introduction, Skills When Writing a Review of the Literature.

**UNIT- V**

Skills Needed When Writing the Methods, Skills Needed When Writing the Results, Skills Needed When Writing the Discussion, Skills Needed When Writing the Conclusions.

**TEXT BOOKS**

1. Goldbort R, *Writing for Science,* Yale University Press. 2006.

2. Day R , *How to Write and Publish a Scientific Paper,* Cambridge University Press. 2006.

**REFERENCES**

1. Highman N, *Handbook of Writing for the Mathematical Sciences,* SIAM. Highman's Books,1998.

2. Adrian Wall, *English for Writing Research Papers,* Springer New York Dordrecht. Heidelberg London, 2011.

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## (20EC4109) INTRODUCTION TO IoT

### COURSE OBJECTIVES

The objectives of this course:

1. *To provide an overview on the ICT ecosystem and enabling environment to foster Internet of Things (including technology, standards, system management and applications) deployments.*
2. *Define the infrastructure for supporting IoT deployments.*
3. *To provide an understanding of the technologies and the standardsrelating to the Internet of Things.*
4. *Understand various case studies related to IoT domain.*

### COURSE OUTCOMES (COs)

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

1. *Understand the technology and standards relating to IoTs.*
2. *Understand where the IoT concept fits within the broader ICT industry and possible future trends.*
3. *Understand the key components that make up an IoT system.*
4. *Differentiate between the levels of the IoT stack and be familiar with the key technologies and protocols employed at each layer of the stack.*
5. *Configure Raspberry Pi, Understand Sensors, Actuators& get started with python on Raspberry Pi.*
6. *Apply the knowledge and skills acquired during the course to design, build and test a complete, working IoT system involving prototyping, programming and data analysis.*

### UNIT – I

**Introduction & Concepts:** Introduction to Internet of Things - Physical Design of IOT - Logical Design of IoT - IoT Enabling Technologies - IoT Levels.

### UNIT – II

**Domain Specific IoTs:** Home Automation – Cities – Environment – Energy – Retail- Logistics – Agriculture – Industry - Health & Life Style.

### UNIT – III

**M2M & System Management with NETCONF-YANG:** M2M - Difference between IoT and M2M - SDN and NFV for IoT - Software defined Networking - Network Function Virtualization - Need for IOT Systems Management - Simple Network Management Protocol - Limitations of SNMP - Network Operator Requirements – NETCONF – YANG - IOT Systems management with NETCONF-YANG.

**UNIT – IV**

**Developing Internet of Things & Logical Design using Python:** Introduction, IoT Design Methodology - Installing Python - Python Data Types & Data Structures - Control Flow - Functions – Modules – Packages - File Handling - Date/ Time Operations – Classes - Python Packages.

**UNIT – V**

**IoT Physical Devices & Endpoints:** What is an IoT Device - Exemplary Device - Board, Linux on Raspberry Pi - Interfaces and Programming IoT Devices.

**TEXTBOOKS**

1. Vijay Madisetti, Arshdeep Bahga**,** *Internet of Things a Hands-on Approach,* University press,,1st Edition, 2014
2. Adrian McEwen**,** *Designing the Internet of Things,* Wiley Publishers, 1st Edition, 2013

**REFERENCES**

1. Daniel Kellmereit, Daniel Obodovski, *The Silent Intelligence: The Internet of Things*, DND Ventures LLC ,1st Edition, 2013
2. Samuel Greenland, *The Internet of Things,* MIT Press,1st Edition, 2015
3. Patrick Grossetete, Gonzalo Salgueiro, David Hanes, *IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things*,Pearson,1st Edition, 2015

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## (20EC4110) ADVANCED MICROCONTROLLERS

### COURSE OBJECTIVES

The objectives of this course :

1. *To understand the fundamentals of embedded systems and its design concepts.*
2. *To learn the fundamentals of ARM Cortex processors.*
3. *To understand and program the peripherals of TM4C Processor.*

### COURSE OUTCOMES (COs)

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

1. *Describe the fundamentals of embedded systems.*
2. *Describe the principles of embedded system design concepts.*
3. *Understand hardware-interfacing concepts to connect digital as well as analog sensors while ensuring low power considerations.*
4. *Review and implement the protocols used by microcontroller to communicate with external sensors and actuators in real world.*
5. *Understand the operation of various peripherals associated with TM4C controller.*
6. *Understand the interfacing and programming of TM4C controller.*
7. *Design of embedded systems leading to 32-bit application development.*

### UNIT– I

**Introduction to Embedded Systems:** Introduction - Classification – Applications – Architecture - Embedded processors and their types – Communication Interfaces - Onboard (I2C, SPI, UART, 1-wire interface, parallel interface), External (RS-232 & RS-485, USB, CAN, IEEE 1394, IrDA, Bluetooth, Wi-Fi, ZigBee, GPRS - Application specific circuitry - Reset, Brownout protection, Oscillator, RTC, Watchdog timer - Embedded firmware – In-Circuit Emulator (ICE).

### UNIT– II

**Embedded Systems design concepts:** Processor architectures – Memory architectures - Processor Selection for anEmbedded System - Embedded SystemDesign and Co-design Issues in System Development Process - Design Cycle in theDevelopment Phase for an Embedded System - Design metrics of embedded systems - Programming languages and tools for embedded design.

### UNIT– III

**Introduction to ARM processors:** Introductionto ARM architecture and Cortex M series - Introduction to the TM4C family viz.TM4C123x & TM4C129x and its targeted applications - TM4C block diagram– Addressspace - on-chip peripherals - Register sets - Addressing modes - Instruction set basics.

**UNIT– IV**

**Overview of TM4C peripherals:** I/O pin multiplexing - Pull up/down registers - GPIO control - Memory Mapped Peripherals– Programming system registers - Watchdog Timer, need of low power for embedded systems -System clocks and control - Hibernation Module on TM4C - Active vs Stand by current consumption - NVIC - Real Time Clock (RTC) - Motion Control Peripherals: PWM Module& Quadrature Encoder Interface (QEI).

**Case Study**: Tiva based embedded system application using the interface protocols for communication with external devices "Sensor Hub BoosterPack".

**UNIT– V**

**Interfacing and Programming Peripherals:** Programming and interfacing – LED, Push buttons, sensors, actuators & serial communication devices - Designing and developing solutions for real world problems.

**Case Study**: Tiva based Embedded Networking Application: "Smart Plug with Remote Disconnect and Wi-Fi Connectivity".

**TEXT BOOKS**

1. Jonathan W Valvano, *Embedded Systems: Introduction to ARM Cortex - M Microcontrollers*, CreateSpace publications,5th Edition, 2014.
2. Raj Kamal, *Embedded Systems*, Tata McGraw-Hill Education, 2nd Edition,2011.

**REFERENCES**

1. Shibu K V, *Introduction to Embedded systems*, Tata McGraw-HillEducation, 1st Edition,2009.
2. http://processors.wiki.ti.com/index.php/HandsOn_Training_for_TI_Embedded_Processors
3. http://www.ti.com/ww/en/simplelink_embedded_wi-fi/home.html

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## (20EC4111) HARDWARE SOFTWARE CO-DESIGN
## (Programme Elective-III)

### COURSE OBJECTIVES

The objectives of this course :

1. *To provide a broad understanding of the specific requirement of Hardware and software integration for embedded system.*
2. *To define a concurrent specification from an algorithm, analyze its behavior and partition the specification into software and hardware components.*
3. *To introduce students to the design issues of embedded systems.*

### COURSE OUTCOMES (COs)

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

1. *Acquire the knowledge on various design models.*
2. *Explore the interrelationship between hardware and software in embedded system.*
3. *Acquire the knowledge of firmware development process and tools*
4. *Evaluate the requirements of programming Embedded Systems, related software architectures and tool chain for Embedded Systems.*
5. *Describe the broad range of system architectures that currently exist and define their fundamental attributes including speed, energy, area, design complexity, design cost, etc.*
6. *Understand languages used for system design.*

### 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 - Prototyping Architecture Specialization Techniques –System Communication Infrastructure.

### UNIT –III

**Target Architectures:** Architecture Specialization Techniques –System Communication Infrastructure –Target Architecture and Application System Classes –Architecture for Control Dominated Systems (8051–Architectures for High Performance Control) –Architecture for Data Dominated Systems (Adsp21060, Tms320c60)–Mixed Systems.

**UNIT –IV**

**Compilation Techniques and Tools for Embedded Processor Architectures:** Modern Embedded Architectures –Embedded Software Development Needs –Compilation Technologies –Practical Consideration in A Compiler Development Environment.

**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**.**

**Design-II:** Heterogeneous Specifications – Multi-Language Co-Simulation –the Cosyma System and Lycos System.

**TEXT BOOKS**

1. Jorgen Staunstrup, Wayne Wolf, *Hardware/software co- design Principles and Practice*, Springer, 1st Edition,2009.
2. Kluwer, *Hardware/Software Co-Design Principles and Practice*, academic publishers, 2nd Edition, 2002.

**REFERENCES**

1. Patrick R.Schaumont, *A Practical Introduction to Hardware/Software Co-design*, Springer, 4th Edition, 2010

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## (20EC4213) TESTING & TESTABILITY
## (Programme Elective-III)

**COURSE OBJECTIVES**
The objectives of the course:

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

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

1. *Understand the elementary concepts of Testing and Testability.*
2. *Understand different types of faults associated with logic circuits and types of testing by employing fault models to the logic circuits.*
3. *Get complete knowledge about different methods of simulation and algorithms associated with testing.*
4. *Analyze BIST concepts and design self-test at Board Level.*
5. *Analyze Memory Test Requirements for MBIST and Embedded Core Testing.*
6. *Apply the concepts in testing which can help them design a better yield in IC design.*

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

**UNIT – II**
**Fault Modeling:** Logic Fault Models, Fault Detection and Redundancy, Fault Equivalence and Fault Location. Single Stuck and Multiple Stuck – Fault Models. Fault Simulation Applications, General Techniques for Combinational Circuits.
**Testing for Single Stuck Faults (SSF):** Automated Test Pattern Generation (ATPG/ATG) for SSFs in Combinational and Sequential Circuits, Functional Testing with Specific Fault Models.

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

**UNIT – IV**

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

**UNIT – V**

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

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

**TEXT BOOKS**

1. Miron Abramovici, Melvin A. Breur, Arthur D.Friedman, *Digital Systems Testing and Testable Design*,Jaico Publishing House, 1st Edition, 2001.
2. Alfred Crouch, *Design for Test for Digital ICs & Embedded Core Systems*, PrenticeHall, 1st Edition, 1999.

**REFERENCES**

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

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## (20EC4112) MICRO ELECTROMECHANICAL SYSTEMS
## (Programme Elective-III)

**COURSE OBJECTIVES**
The objectives of this course:

1. *Become familiar with the operation principles of selected MEMS sensors and actuators*
2. *To examine the MEMS-specific design issues and constraints*
3. *Become familiar with the MEMS fabrication processes*
4. *To describe Dynamics and modelling of microsystems*
5. *To understand the Applications of microsensors and micro actuators*

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

1. *Develop an understanding of microscale physics for use in designing MEMS system applications.*
2. *Understand concepts of basic MEM devices and systems.*
3. *Describe the structures and applications of MEMS*
4. *Understand the two terminal MEMS and its characteristics.*
5. *Design digital and analog applications in various silicon-based MEMS structures.*
6. *Analyse the technologies used for the fabrications of MEMS.*

**UNIT – I**
**Introduction:** Introduction Basic structures of MEM devices – (Canti-Levers, Fixed Beams diaphragms) - Broad Response of Micro electromechanical systems (MEMS) to Mechanical (Force, pressure etc.)(a), Thermal(b),Electrical(c), Optical(d) and Magnetic Stimuli(e), Compatibility of MEMS from the Point of Power Dissipation and Leakage.

**UNIT – II**
**Study of Characteristics:** Review of Mechanical Concepts Like Stress(a), Strain(b), Bending Moment(c) and Deflection Curve(d) - Differential Equations Describing the Deflection Under Concentrated Force(a), Distributed Force(b) - Distributed Force - Deflection Curves for Canti-Levers - Fixed Beam - Electrostatic Excitation – Columbic Force Between the Fixed and Moving Electrodes - Deflection with Voltage in C.L - Deflection Vs Voltage Curve - Critical Fringe Field – Field Calculations Using Laplace Equation - Discussion On the Approximate Solutions – Transient Response of the MEMS.

**UNIT – III**
**MEMS Structures:** Types Two Terminal MEMS - Capacitance Vs Voltage Curve – Variable Capacitor - Applications of Variable Capacitors - Two Terminal MEM Structures - Three Terminal MEM Structures – Controlled Variable Capacitors – MEM as A Switch and Possible Applications.

**UNIT – IV**

**MEM Configurations and Applications:** MEM Circuits & Structures for Simple GATES- AND(a), OR(b), NAND(c), NOR(d) and Exclusive OR(e) - Simple MEM Configurations for Flip -Flops - Triggering Applications to Counters(a) and Converters(b). Applications for Analog Circuits Like Frequency Converters(a), Wave Shaping(b) - RF Switches for Modulation - MEM Transducers for Pressure(a), Force Temperature(b) and Optical MEMS(c).

**UNIT – V**

**MEM Technologies:** MEM Technologies Silicon Based MEMS- Process Flow – Brief Account of Various Processes and Layers Like Fixed Layer(a), Moving Layers(b), Spacers(c) and Etching Technologies - Metal Based MEMS: Thin and Thick Film Technologies for MEMS - Process Flow and Description of the Processes - Status of MEMS in the Current Electronics Scenario.

**TEXTBOOKS**

1. Gabriel M. Rebeiz, *MEMS Theory, Design and Technology,*Wiley Publishers, 1st Edition, 2003
2. Thimo Shenko**,** *Strength of Materials,* CBS publishers &Distributors, 5th Edition, 2000

**REFERENCES**

1. Ristic L *Sensor Technology and Devices,* Artech House, London,1st Edition, 1994.
2. *Survey E.Lyshevski, MEMS and NEMS, Systems Devices and Structures,*CRT Press, 1st Edition, 2002.
3. Stephen D. Senturia, *Microsystem Design,* Springer US,1st Edition, 2001.

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## (20EC4201) VLSI TECHNOLOGY
## (Programme Elective-IV)

**COURSE OBJECTIVES**

The objectives of the course:

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

**COURSE OUTCOMES (COs)**

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

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

**UNIT – I**

**Review Of Microelectronics And Introduction To Mos Technologies**: (MOS, CMOS, Bi-CMOS) Technology Trends and Projections.

**Basic Electrical Properties Of MOS, CMOS & BiCMOS Circuits**: Ids -Vds Relationships, Threshold Voltage Vt, gm, gds & ωo - Pass Transistor - MOS, CMOS, Bi-CMOS Inverters & Zp.u/Zp.d - MOS Transistor Circuit Model - Latch-Up in CMOS Circuits.

**UNIT – II**

**Layout Design and Tools: Logic Gates & Layouts:** Static Complementary Gates - Switch Logic - Alternative Gate Circuits - Low Power Gates - Resistive and Inductive Interconnect Delays.Power Optimization - Design Validation and Testing.

**UNIT – III**

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

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

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

**UNIT – IV**

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

**UNIT – V**

**Introduction To Cad Systems (Algorithms) And Chip Design:**Layout Synthesis and Analysis - Scheduling and Printing - Hardware-Software Co-design, Chip Design Methodologies- A Simple Design Example.

**TEXTBOOKS**

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

**REFERENCES**

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

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## (20EC4202) DIGITAL IC DESIGN
## (Programme Elective-IV)

**COURSE OBJECTIVES**

The objectives of the course :

1. *To Understand the Static & Dynamic Behavior of CMOS &BiCMOS circuits.*
2. *To design CMOS based Subsystems.*
3. *To design BiCMOS based subsystems.*
4. *To design combinational and sequential circuits.*

**COURSE OUTCOMES (COs)**

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

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

**UNIT – I**

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

**UNIT –II**

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

**UNIT – III**

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

**UNIT – IV**

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

**UNIT – V**

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

**TEXT BOOKS**

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

**REFERENCES**

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

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## (20EC4008) WIRELESS SENSOR NETWORKS
## (Programme Elective-IV)

**COURSE OBJECTIVES**

The objectives of this course:

1. *To understand the basic WSN technology with basic sensor systems and provide a survey of sensor technology.*
2. *To understand the medium access control protocols, routing and transport layer protocols for sensor networks and address physical layer issues.*
3. *To understand the Sensor management, sensor network hardware, operating systems.*
4. *To associate hardware platforms and software frameworks used to realize dynamic wireless sensor network.*

**COURSE OUTCOMES (COs)**

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

1. *Design wireless sensor network system for different applications under consideration.*
2. *Understand the hardware details of different types of sensors and select right type of sensor for various applications.*
3. *Understand radio standards and communication protocol to be used for wireless sensor network-based systems and application.*
4. *Use operating systems and programming languages for wireless sensor nodes, performance of wireless sensor networks systems and platforms.*
5. *Handle special issues related to sensors like energy conservation and security challenges.*
6. *Design and deploy the sensor networks.*

**UNIT – I**

Introduction and Overview of Sensor Network, Architecture and its Applications – Sensor Network Comparison with Adhoc Networks – Sensor Node Architecture with Hardware and Software Details.

**UNIT–II**

**Hardware:** Examples like mica2, micaZ, telosB, cricket, Imote2, tmote, btnode, and Sun SPOT
**Software (Operating Systems):**TinyOS, MANTIS, Contiki, and RetOS – Programming Tools, C, nesC – Performance Comparison of Wireless Sensor Networks – Simulation and Experimental Platforms like Open source (ns-2) and Commercial (QualNet, Opnet)

**UNIT–III**

**Overview of Sensor Network Protocols:** Physical, MAC and Routing/ Network Layer Protocols, Node Discovery Protocols, Multi-hop and Cluster based Protocols, Fundamentals of 802.15.4, Bluetooth, BLE (Bluetooth low energy) and UWB.

**UNIT–IV**

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

**UNIT–V**

**Specialized Features:** Energy Preservation and Efficiency **–** Security Challenges – Fault Tolerance **–** Issues related to Localization **–** Connectivity and Topology.

**Sensor Deployment Mechanisms:** Coverage issues, sensor Web, Sensor Grid - Open Issues for Future Research, and Enabling Technologies in Wireless Sensor Network.

**TEXT BOOKS**

1. H. Karl and A.Willig, John Wiley & Sons, *Protocols and Architectures for Wireless Sensor Networks*, India, 3rd Edition, 2012.
2. C.S. Raghavendra, K.M. Sivalingam, and T.Znati, *Wireless Sensor Networks*, Editors, Springer Verlag, 1st Edition,2010.

**REFERENCES**

1. F. Zhao and L. Guibas, Morgan Kaufman, *Wireless Sensor Networks: An Information Processing Approach*,1st Edition, 2013.
2. YingshuLi, MyT. Thai, Weili Wu, *Wireless sensor Network and Applications,* Springer series on signals and communication technology, 3rd Edition, 2008.
3. J. Pan, Y. Hou, L. Cai, Y. Shi and S. Shen, *Topology Control for Wireless Sensor Networks*, in proceedings of 9th International Conference on Mobile Computing and Networking, San Diego, CA, Sept. 2003, pp. 286-299.

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## (20EC4113) INTERNET OF THINGS LAB

### COURSE OBJECTIVES

The objectives of this course :

1. *Understand Sensors, Actuators & get started with python on Raspberry Pi.*
2. *Understand how cloud services work.*
3. *Design IoT applications in different domain and be able to analyze their performance.*
4. *Fabricate and implement the mini project intended solution for project based learning.*
5. *Improve the team building, communication and management skills of the students.*

### COURSE OUTCOMES (COs)

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

1. *Identify the requirements for the real-world problems.*
2. *Conduct a survey of several available literatures in the preferred field of study.*
3. *Study and enhance software/ hardware skills.*
4. *Demonstrate and build the project successfully by hardware requirements, coding, emulating and testing.*
5. *Implement project intended solution for project based learning.*
6. *Demonstrate an ability to work in teams and manage the conduct of the research study.*

### LIST OF EXPERIMENTS

1. Automatic lightening system
2. Air pollution monitoring and alert system
3. Automatic gardening system
4. Intruder detection and alert system
5. Home automation system
6. Weather monitoring and alert system
7. Smart car Parking system
8. Face detection and identification system
9. Health Monitoring system
10. Path following robot

**Equipment Required:**

1. Raspberry Pi 4 development kit
2. Sensors and Actuators

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## (20EC4114) MICROCONTROLLERS & INTERFACING LAB

### COURSE OBJECTIVES

The objectives of this course :

1. *Familiar with the architecture and Instruction set of ARM processor.*
2. *Understand interfacing & programming of peripherals with ARM processors.*
3. *Provide solutions to real world problems.*

### COURSE OUTCOMES(COs)

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

1. *Demonstrate an in-depth knowledge of ARM Cortex-M architecture.*
2. *Understand the work environment with advanced tools used for developing microcontroller-based systems.*
3. *Analyze the programming techniques used for developing solutions.*
4. *Test, debug and deploy the microcontroller-based systems using code composer studio.*
5. *Understand the interfacing of advanced peripherals to microcontroller.*
6. *Provide solid foundation on interfacing the external devices to the processor according to the user requirements to create novel products and solutions for the real time problems.*

**Note:** Minimum **Ten** experiments to be conducted

### List of Experiments

1. Learn and understand how to configure EK-TM4C123GXL Launchpad digital I/O pins. Write a C program for configuration of GPIO ports for Input and output operation (blinking LEDs, push buttons interface).

   **Exercises**:

   a) Modify the code to make the red LED of EK-TM4C123GXL Launchpad blink.

   b) Modify the code to make the green and red LEDs blink: (i) Together (ii) Alternately

   c) Alter the code to turn the LED ON when the button is pressed and OFF when it is released.

   d) Modify the delay with which the LED blinks.

   e) Alter the code to make the green LED stay ON for around 1 second every time the button is pressed.

   f) Alter the code to turn the red LED ON when the button is pressed and the green LED ON when the button is released.

2. Learn and understand Timer based interrupt programming. Write a C program for EK-TM4C123GXL Launchpad and associated Timer ISR to toggle onboard LED using interrupt programming technique.

**Exercises**:

a) Modify the code for a different timer toggling frequency.

b) Write the code to turn on interrupt globally.

3. Configure hibernation module of the TM4C123GH6PM microcontroller to place the device in low power state and then to wake up the device on RTC (Real- Time Clock) interrupt.
   **Exercise**: Write a program to configure hibernation mode and wake upthe EK-TM4C123GXL Launchpad when onboard switch SW2 is pressed.

4. Configure in-build ADC of TM4C123GH6PM microcontroller and interface potentiometer with EK-TM4C123GXL Launchpad to observe corresponding 12- bit digital value.
   **Exercises**:
   a) Tabulate ten different position of the Potentiometer and note down the Digital value and calculate the equivalent analog value.
   b) Use the ADC to obtain the analog value from the internal temperature sensor.
   c) Configure Dual ADC modules to read from 2 analog input (could be from 2 potentiometers)
   d) What are the trigger control mechanisms for this ADC?
   e) What does the resolution refer on ADC Specification?
   f) The current sampling method is single ended sampling. This ADC could also be configured to do differential sampling. What is the difference between the two methods of sampling?

5. Learn and understand the generation of Pulse Width Module (PWM) signal by configuring and programming the in-build PWM module of TM4C123GH6PM microcontroller.
   **Exercises**:
   a) Change the software to output a set Duty Cycle, which can be user programmed.
   b) Change the frequency of the PWM Output from 6.25 KHz to 10 KHz and do the tabulation again.
   c) Generate Complementary signals, route it to two pins, and observe the waveforms.
   d) What is dead band generation mean and where is it applied?
   e) Is it possible to construct a DAC from a PWM? Identify the additional components and connection diagram for the same.
   f) Sketch the gate control sequence of 3 phase Inverter Bridge andhow many PWM generator blocks are required? Can we generatethis from TIVA Launchpad?

6. Configure the PWM and ADC modules of TM4C123GH6PM microcontroller to control the speed of a DC motor with a PWM signal based on the potentiometer output.
   **Exercises**:
   a) With the same ADC input configure 2 PWM generator modules with 2 different frequencies.
   b) Read the Internal temperature sensor and control a DC Motor that could be deployed in fan Controller by observing the unit or ambient temperature.
   c) What is the resolution of the PWM in this experiment?
   d) What would be the maximum frequency that can be generated from the PWM generator?
   e) Briefly explain an integrated application of ADC and PWM based control.

7. Learn and understand to connect EK-TM4C123GXL Launchpad to PC terminal and send an echo of the data input back to the PC using UART.
   **Exercises**:
   a) Change the baud rate to 19200 and repeat the experiment.
   b) What is the maximum baud rate that can be set in the UART peripheral of TIVA?
   c) Modify the software to display "Switch pressed" by pressing a user input switch on the Launchpad.

8. Learn and understand interfacing of accelerometer in Sensor Hub Boosterpack with EK-TM4C123GXL Launchpad using I2C.
   **Exercises**:
   a) Make a LED ON when the acceleration value in the x axis crosses a certain limit, say +5.
   b) What is the precaution taken in this experiment in order to avoid theoverflow of UART buffer?
   c) Change the value of PRINT_SKIP_COUNT to 100 and see the difference in the output.
   d)Change MPU9150_ACCEL_CONFIG_AFS_SEL_2G to MPU9150_ACCEL_CONFIG_AFS_SEL_4G on line 461 of thesame source file andobserve the difference.

9. USB bulk transfer mode: Learn and understand to transfer data using bulk transfer mode with the USB2.0 peripheral of the TM4C123GH6PM device.
   **Exercises**:
   a) What are the different modes offered by USB 2.0?
   b) What are the typical devices that use Bulk transfer mode?

10. Learn and understand to find the angle and hypotenuse of a right-angle triangle using IQmath library of TivaWare.
    **Exercises**:
    a) Change the base and adjacent values in the program to othervalues, build the program and observe the values in the watchwindow.
    b) Open IQmathLib.h and browse through the available functions.What function is to be used if the IQ number used in the program isto be converted to a string?

11. Learn and understand interfacing of CC3100 WiFi module with EKTM4C123GXL Launchpad and configuration of static IP address for CC3100booster pack.
    **Exercises**:
    a) Try pinging the same IP address before connecting to the AccessPoint (AP) and note down the observation.
    b) What is the difference between static IP address and dynamic IPaddress?

12. Configure CC3100 Booster Pack connected to EK-TM4C123GXL Launch pads a Wireless Local Area Network (WLAN) Station to send Email over SMTP.
    **Exercises**:
    a) In the terminal output window, we have received a debug message "Pinging…!". Search in the code and change the message to"Pinging the website". Repeat the experiment to observe thischange in the Serial Window.

b) In line no: 62 of main. C replace www.ti.com with any non-existing web address and repeat the experiment and observe what happens

c) In line no: 62 of main. C replace again with www.ti.comand repeatthe experiment.

d) Identify the code that helps in establishing connection over SMTP.Modify the code to trigger E-mail application based upon external analog input.

e) How to configure the AP WLAN parameters and networkparameters (IP addresses and DHCP parameters) using CC3100API.

13. Configure CC3100 Booster Pack connected to EK-TM4C123GXL Launchpadas a HTTP server.

**Exercises**:

a) Where are the webpages stored in the CC3100?

b) What happens if we try to access a webpage, which is not there inside the CC3100?

c) List 3 applications with a 3 to 4-line brief description that you think can be performed with this experimental setup.

**Equipment required:**

1.Code Composer Studio v6.1 (Preferably Latestversion)

2.TM4C launchpad development boards

3.TI Sensor hub booster pack

4. CC3100 booster pack

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## (20HS0829) CONSTITUTION OF INDIA
## (Audit Course-II)

**COURSE OBJECTIVES**

The objectives of this course :

1. *Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.*
2. *Address 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.*
3. *Address 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.*
4. *Address the federal structure and its effects on administration.*
5. *Understand parliamentary form of government.*

**COURSE OUTCOMES (COs)**

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

1. *Explain the key concepts of political economy*
2. *Analyze the significant developments in the political ideologies*
3. *Describe the salient features of the constitution of India interpret, integrate and critically*
4. *Analyze the political economy of Indian international relations and gain knowledge in Judiciary system*
5. *Apply their knowledge and skills acquired to write various competitive examinations*
6. *Understand the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the IndianConstitution*

**UNIT-I**

Introduction to the Constitution.

**UNIT-II**

Historical Perspective of the Constitution ofIndia- Salient features and characteristics of the Constitution of India.

**UNIT-III**

Scheme of the fundamental rights-The scheme of the Fundamental Duties and its legalstatus-The Directive Principles of State Policy – Its importance and implementation.

**UNIT-IV**

Parliamentary Form of Government in India – Powers and Functions-The President of India - Status and Powers -The historical perspectives of the constitutional amendments inIndia-Judiciary system - Powers and Functions

**UNIT-V**

Local Self Government – Constitutional Scheme inIndia - Election Commission: Role and Functions.

**TEXT BOOKS**

1. Government of India Ministry of Law and Justice (Legislative Department)*The Constitution of India, 1950 (Bare Act)* GovernmentPublication,1st Edition, 2015
2. Dr. S. N. Busi, *Dr. B. R. Ambedkar framing of Indian Constitution*, Government Publication 1st Edition, 2015.

**REFERENCES**

1. M. P.Jain, *Indian Constitution Law*, Lexis Nexis,7thEdition.,2014.
2. D.D. Basu, *Introduction to the Constitution of India*, Lexis Nexis, 10th Edition,2015
3. P.M.Bakshi, *Constitution of India* Universal Law Publishing,15th Edition,2018

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## (20EC4002) ADVANCED DIGITAL SIGNAL PROCESSING
**(Common to ES & DECS)**
**(Programme Elective-V)**

### COURSE OBJECTIVES
The objectives of this course:

1. *Comprehend mathematical description and modeling of discrete time random signals.*
2. *Familiar with important theorems and algorithms of Digital Signal Processing*.
3. *Understand the concepts of estimation, prediction and filtering concepts and techniques.*

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

1. *Analyze the Discrete-time signals*
2. *Understand the digital Signal Processing algorithms and its applications*
3. *Apply the knowledge of usage of Digital systems in real time applications*
4. *Apply the algorithms for recent trend applications in Digital Signal Processing*
5. *Understand the modern filter design and their implementation*
6. *Able to understand the parametric method for estimation of power spectral density*

**UNIT – I**

**Overview:** Discrete-Time Signals, Sequences and sequence Representation, Discrete-Time Systems, Time-Domain Characterization and Classification of LTI Discrete-Time Systems. The Continuous-Time Fourier Transform, The Discrete-Time Fourier Transform, Energy Density Spectrum of a Discrete-Time Sequence, Band-Limited Discrete-Time signals, The Frequency Response of LTI Discrete-Time System.

**LTI Systems:** Types of Linear-Phase transfer functions, Simple Digital Filters, Complementary Transfer Function, Inverse Systems, System Identification, Digital Two-Pairs, Algebraic Stability Test.

**UNIT – II**

**Digital Filter Structure and Design:** All Pass Filters, Tunable IIR Digital Filter, IIR Tapped Cascade Lattice Structures, FIR Cascaded Lattice Structures, Parallel All Pass Realization of IIR Transfer Functions, State Space Structures, Polyphase Structures, Digital Sine-Cosine Generator, Computational Complexity of Digital Filter Structures, Design of IIR Filter using pade approximation, Least Square Design Methods, Design of Computationally Efficient FIR Filters.

**UNIT– III**

**FFT Algorithms:** Fast DFT algorithms based on Index mapping, Sliding Discrete Fourier Transform, DFT Computation Over a narrow Frequency Band, Split Radix FFT, Linear filtering approach to Computation of DFT using Chirp Z-Transform.

**Multi Rate Signal Processing:** Decimation by a factor D, Interpolation by a factor I, Sampling rate conversion by a rational factor I/D, Filter design & Implementation for Sampling rate conversion.

**UNIT– IV**

**Power Spectral Estimation**: Estimation of Spectra from Finite duration observation of Signals, Non-parametric methods: Bartlett, Welch & Blackmann &Tukey methods.

**Parametric Methods for Power Spectrum Estimation:** Relation between auto correlation & Model parameters, Yule-Waker & Burg Methods, MA & ARMA models for Power spectrum estimation.

**UNIT – V**

**Analysis of Finite Word length Effects in Fixed-Point DSP Systems:** Fixed, Floating Point Arithmetic – ADC quantization, Noise & Signal Quality-Finite word length effect in IIR digital Filters – Finite word-length effects in FFT algorithms.

**Applications of Digital Signal Processing:** Dual Tone Multi-Frequency Signal Detection, Spectral Analysis of Sinusoidal Signals, Spectral Analysis of Non-Stationary Signals, Musial Sound Processing, Over Sampling A/D Converter, Over Sampling D/A Converter, Discrete-Time Analytic Signal Generation.

**TEXTBOOKS**

1. Sanjit K Mitra, *Digital Signal Processing*, Tata MCgraw Hill Publications.
2. J G Proakis, D G Manolokis, *Digital Signal Processing Principles*, Algorithms, Applications PHI.

**REFERENCES**

1. *Discrete-Time Signal Processing*, A V Oppenhiem, R W Schafer, Pearson Education.
2. *DSP- A Practical Approach*, Emmanuel C Ifeacher Barrie. W. Jervis, Pearson Education.
3. *Modern spectral Estimation techniques*, S. M. Kay, PHI,1997.

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## (20EC4116) RADIO FREQUENCY IDENTIFICATION
## (Programme Elective-V)

### COURSE OBJECTIVES

The objectives of this course :

1. *Familiarize with RFID technology.*
2. *Understand the applications of RFID technology.*
3. *Familiarize with privacy policy and regulations of RFID technology*

### COURSE OUTCOMES (COs)

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

1. *Understand the fundamentals of RFID technology.*
2. *Recognize the development history of RFID technology.*
3. *Understand the global privacy policy and regulations of RFID technology.*
4. *Analyze the impact of RFID in various sectors.*
5. *Describe various applications of RFID technology.*
6. *Analyze the implementation of RFID technology in various application areas.*

**UNIT – I**

**Understanding RFID Technology:** Introduction, RFID Technology, The Elements of an RFID system, Coupling, Range, and Penetration, RFID Applications, Veri Chip and Mark of the Beast.

**UNIT – II**

**A History of the EPC**: Introduction, The Distributed Intelligent Systems Center, Meanwhile, at Procter & Gamble, "Low-Cost" RFID Protocols, "Low-cost" Manufacturing, The Software and the Network, Privacy, Harnessing the Juggernaut, The Six Auto-ID Labs, The Evolution of the Industry, The Creation of EPCglobal.

**UNIT – III**

**RFID and Global Privacy Policy:** Introduction, Definitions of Privacy, Definitions of Personal Information, History of Current Privacy Paradigm, Mapping the RFID Discovery process, Functions and Responsibilities for chips, Readers, and Owners, Privacy as a Fundamental Human Right, Constitutional Rights.

**UNIT – IV**

**RFID,Privacyand Regulation:** Introduction, Understanding RFIDs Privacy &Threats,RFID and the United States Regulatory Landscape: Introduction, Current State of RFID Policy, Individuals, Business, Government, Miscellaneous, Integrity and Security of the System, Government Access, Health Impact, Labor Impact

**UNIT – V**

**Applications:** RFID Payments at ExxonMobil, Exxon Mobil Corporation, Transforming the Battlefield with RFID, Logistics and the Military, RFID in the Pharmacy, CVS and Auto-ID, Project Jump Start, RFID in theStore.

**TEXT BOOKS**

1. Simson Garfinkel and Beth Rosenberg, *RFID Applications, Security and privacy*, PearsonEducation. 1st Edition, 2008.
2. Steven Shepard, *Radio Frequency Identification*, McGraw-Hill Professional, 1st Edition, 2013

**REFERENCES**

1. Narayanan, A., Sanjay singh, &Somasekharan, M. *Implementing RFID in Library: Methdologies, Advantages and Disadvantage*s. 1st Edition, 2012.
2. Patil, S.K., Wadekar, P., Chikate, R.V. & Joshi, S, *Implementation of RFID Technology in Jayakar Library*. 1st Edition, 2012

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## (20EC4117) SYSTEM ON CHIP ARCHITECTURE
## (Programme Elective-V)

**COURSE OBJECTIVES**

The objectives of this course:

1. *Describe the architecture of System on Chip (SOC).*
2. *Develop project based on SOC using System C or any HDL language.*
3. *Select memory for specific SOC operating system.*
4. *Build the complex logic circuit using minimal logic blocks.*
5. *Explain the SOC interconnect architectures.*
6. *Compare SOC architectures suitable for current needs.*

**COURSE OUTCOMES(COs)**

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

1. *Design processors keeping area, power and speed as constraints and to Deepen CMOS VLSI design knowledge.*
2. *Design full custom/ semicustom/ standard cells for ASIC.*
3. *Implement both hardware and software solutions, formulate hardware/software tradeoffs, and perform hardware/software codesign.*
4. *Implement network on chip technologies.*
5. *Analyze memories using reconfigurable architectures for rapid prototyping*
6. *Analyze system on chip and board based systems.*

**UNIT –I**

**Introduction to the System Approach:** System Architecture **–** Components of the System, Hardware & Software, Processor Architectures, Memory and Addressing. System level interconnection, An approach for SOC Design, System Architecture and Complexity.

**UNIT** –**II**

**Processors:** Introduction, Processor Selection for SOC, Basic concepts in Processor Architecture, Basic concepts in Processor Micro Architecture, Basic elements in Instruction handling. Buffers: Minimizing Pipeline Delays, Branches, More Robust Processors, Vector Processors and Vector Instructions extensions, VLIW Processors, Superscalar Processors.

**UNIT**– **III**

**Memory Design for SOC:** Overview of SOC External Memory, Internal Memory, Size, Scratchpads and Cache memory, Cache Organization, Cache data, Write Policies, Strategies for line replacement at Miss time, Types of Cache, Split – I, and D – Caches, Multilevel Caches, Virtual to real translation, SOC Memory System, Models of Simple Processor – memory Interaction.

**UNIT – IV**

**Interconnect Customization and Configuration:** Inter Connect Architectures, Bus: Basic Architectures, SOC Standard Buses, Analytic Bus Models, Using the Bus model, Effects of Bus Transactions and Contention Time. SOC Customization: An Overview, Customizing Instruction Processor, Reconfiguration Technologies, Mapping design onto Reconfigurable devices, Instance-Specific design, Customizable Soft Processor, Reconfiguration - Overhead Analysis and Trade-off analysis on Reconfigurable Parallelism.

**UNIT – V**

**Application Studies / Case Studies:** SOC Design approach, AES algorithms, Design and Evaluation, Image compression – JPEG compression.

**TEXT BOOKS**

1. Michael J. Flynn and Wayne Luk, *Computer System Design System-On-Chip*, Wiely India Pvt.Ltd, 1st Edition, 2011.
2. Steve Furber Addison, *ARM System on Chip Architecture*, Wesley Professional, 2nd Edition, 2000.

**REFERENCES**

1. Ricardo Reis, *Design of System on a Chip: Devices and Components*, Springer,1st Edition, 2004.
2. Jason Andrews, *Co-Verification of Hardware and Software for ARM System on Chip Design(Embedded Technology)*– Newnes, 1st Edition, 2004
3. Prakash Rashinkar, Peter Paterson and Leena Singh L, *System on Chip Verification – Methodologies and Techniques*, Kluwer Academic Publishers, 1st Edition, 2007.

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## (20HS0824) BUSINESS ANALYTICS
**(Open Elective)**

### COURSE OBJECTIVES
The objectives of this course:

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

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

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

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

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

### UNIT- III
**Organization Structures of Business analytics:** Team management - Management Issues - Designing Information Policy – Outsourcing - Ensuring Data Quality - Measuring contribution of Business

analytics - Managing Changes - Descriptive Analytics - predictive analytics - predicative Modelling - Predictive analytics analysis - Data Mining - Data Mining Methodologies - Prescriptive analytics and its step in the business analytics Process - Prescriptive Modelling - nonlinear Optimization.

**UNIT- IV**

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

**UNIT- V**

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

**TEXT BOOKS**

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

**REFERENCES**

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

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

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

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## (20CE1028) COST MANAGEMENT OF ENGINEERING PROJECTS

**(Open Elective)**

### COURSE OBJECTIVES

The objectives of this course:

1. *Establish systems to help streamline the transactions between corporate support departments and the operating units.*
2. *Devise transfer pricing systems to coordinate the buyer-supplier interactions between decentralized organizational operating units.*
3. *Use pseudo profit centers to create profit maximizing behavior in what were formerly cost centers.*

### COURSE OUTCOMES (COs)

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

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

### UNIT – I

Introduction and Overview of the Strategic Cost Management Process.

### UNIT-II

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

### Unit – III

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

**UNIT – IV**

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

**UNIT-V**

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

**TEXT BOOKS**

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

**REFERENCES**

1. *Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi*.
2. Charles T. Horngren and George Foster *Advanced Management Accounting.*
3. Ashish K. Bhattacharya, *Principles & Practices of Cost Accounting A. H. Wheeler publisher.*
4. https://nptel.ac.in/courses/110/101/110101132/
5. *https://nptel.ac.in/courses/105104161/*

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## (20EE2128) WASTE TO ENERGY

**(Open Elective)**

**COURSE OBJECTIVES**

The objectives of this course:

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

**COURSE OUTCOMES (COs)**

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

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

**UNIT- I**

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

**UNIT- II**

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

**UNIT- III**

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

**UNIT- IV**

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

**UNIT- V**

**Properties of Biogas:** Biogas plant Technology and status – Biomass resources and their classification- Biomass conversion processes- thermo chemical conversion –Direct Combustion- Biomass gasification- Pyrolysis and liquefaction – bio-chemical conversion- anaerobic digestion- Types of biogas plants- applications-Biomass Energy Programme in India.

**TEXT BOOKS**

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

**REFERENCES**

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

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**(20ME3026) INDUSTRIAL SAFETY**
**(Open Elective)**

**COURSE OBJECTIVES**

The objectives of this course:

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

**COURSE OUTCOMES(COs)**

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

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

**UNIT-I**

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

**UNIT-II**

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

**UNIT-III**

**Wear and Corrosion and their Prevention:** Wear- types, causes, effects, wear reductionmethods, 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 treeconcept, need andapplications, 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. Higgins & Morrow, *Maintenance Engineering Handbook*, Da Information Services, 1st Edition, 2002
2. H. P. Garg,*Maintenance Engineering,* S. Chand and Company,1st Edition, 2008

**REFERENCES**

1. Audels, *Pump-hydraulic Compressors*, McGraw Hill Publication, 2nd Edition, 2009
2. Winterkorn, Hans, *Foundation Engineering Handbook,* Chapman & Hall London, 3rd Edition, 2010

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## (20ME3027) ADVANCES IN OPERATIONS RESEARCH
**(Open Elective)**

### COURSE OBJECTIVES
The objectives of this course :

1. *Enumerate the fundamentals of Linear Programming*
2. *Learn classical optimization techniques*
3. *Develop the best strategy of Game and identifying the Queuing theory.*
4. *Understand about sequence and optimum Duration of the Project*
5. *Develop the importance of Replacement models and Inventory control*

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

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

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

### UNIT-II
**Transportation Problem** :Formulation; Initial Basic Feasible Solution-North-West Corner Rule, Least Cost Method, Vogel‘s Approximation Method, Modified Distribution (MODI) Method, Unbalanced Transportation - Problems

**Assignment Problem** – Formulation, Optimal Solution -Traveling Salesman problem.

### UNIT-III
**Game Theory**: Introduction – Minimax (Maxi mini) Criterion and Optimal Strategy, Saddle Point, Solution of Games with Pure Strategy and Mixed Strategies – 2 X 2 Games – Dominance Principle.

**Queuing Theory**: Introduction to queuing system–Service Channel, Arrival Pattern, Size of Population, Service Pattern, Queue Discipline, Customer Behavior, Probability Distribution-Birth & Death Process, Simple Problems on Single Service channel only.

**UNIT-IV**

**Sequencing:** Terminology - Johnson's Algorithm for n-jobs x 2 Machines and n-jobs x 3 machines models - Problems

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

**UNIT-V**

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

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

**TEXT BOOKS**

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

**REFERENCES**

1. Manohar Mahajan, *Operations Research,* Dhanpat Rai & Co, 3rd Edition, 2016
2. Er. Prem kumar Guptha & Dr.D.S.Hira, *Operations Research*, Schand publications, 4th Edition, 2012.
3. R Panneer selvam, *Operations Research,* PHI, 2nd edition, 2012.

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## (20ME3028) COMPOSITE MATERIALS
**(Open Elective)**

**COURSE OBJECTIVES**
The objectives of this course :

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

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

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

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

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

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

**UNIT-IV**
**Mechanics of Composites:** Basic assumptions of laminated anisotropic plates, symmetric laminates, angle ply laminates, cross ply laminates, laminate structural moduli, evaluation of lamina properties, determination of lamina stresses, maximum stress and strain criteria, Von -Mises Yield criterion for

isotropic materials, generalized Hill's criterion for anisotropic materials, Tsai-Hill's criterion for composites, prediction of laminate failure, thermal analysis of composite laminates

**UNIT-V**

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

**TEXT BOOKS**

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

**REFERENCES**

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