PSN College of Engineering and Technology

(An Autonomous Institution)
Melathediyoor-627152.

(Approved by AICTE, New Delhi and Affiliated to Anna University, Chennai)
(Accredited by NAAC, and an ISO 9001:2015 Certified Institution)
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

M.E (EMBEDDED SYSTEM TECHNOLOGIES)
REGULATION-2018
CURRICULAM FOR I, II, III & IV SEMESTER (FULL TIME)

SEMESTER I

S.NO	SUB CODE	SUBJECT NAME	L	T	P	C
		THEORY				
1	520001	Applied Mathematics for Electronics Engineers	3	1	0	4
2	525001	Embedded Computing System Design	3	0	0	3
3	525002	Real Time Operating Systems	3	0	0	3
4	525003	Digital System Design and Testing	3	1	0	4
5	525004	ARM Processors and Controllers	3	0	0	3
6		**Professional Elective I**	3	0	0	3
		PRACTICAL				
7	525101	Embedded System Lab – I	0	0	4	2
		TOTAL	**18**	**2**	**4**	**22**

SEMESTER II

S.NO	SUB CODE	SUBJECT NAME	L	T	P	C
		THEORY				
1	525005	Embedded Linux	3	0	0	3
2	525006	Internet of Things	3	0	0	3
3	525007	Software for Embedded Systems	3	0	0	3
4	525008	RISC Processor Architecture and Programming	3	0	0	3
5	525009	Embedded Networking	3	0	0	3
6		Professional Elective II	3	0	0	3
		PRACTICAL				
7	**525102**	Embedded System Lab- II	0	0	4	2
8	**520501**	Technical Seminar	0	0	2	1
		TOTAL	**18**	**0**	**6**	**21**

LIST OF ELECTIVES
ELECTIVE-I

S.NO	SUB CODE	SUBJECT NAME	L	T	P	C
1.	525202	Analog VLSI Circuit Design	3	0	0	3
2.	525203	System Design using FPGA	3	0	0	3
3.	525204	System on Chip design	3	0	0	3
4.	525205	Foundations of VLSI CAD	3	0	0	3
5.	525206	Low Power VLSI Design	3	0	0	3
6.	525207	ASIC Design	3	0	0	3

ELECTIVE-II

S.NO	SUB CODE	SUBJECT NAME	L	T	P	C
1.	525201	Automotive Electronics	3	0	0	3
2.	525208	Digital Instrumentation	3	0	0	3
3.	525209	Smart System Design	3	0	0	3
4.	525210	Network On Chip	3	0	0	3
5.	525211	Nano Electronics	3	0	0	3
6.	525230	Robotics and Control				

SEMESTER III

S.NO	SUB CODE	SUBJECT NAME	L	T	P	C
THEORY						
1		Professional Elective III	3	0	0	3
2		Professional Elective IV	3	0	0	3
3		Professional Elective V	3	0	0	3
PRACTICAL						
4	525301	Project Work (Phase – I)	0	0	12	6
		TOTAL	**9**	**0**	**12**	**15**

SEMESTER IV

S.NO	SUB CODE	SUBJECT NAME	L	T	P	C
PRACTICAL						
1	525302	Project Work (Phase – II)	0	0	24	12
		TOTAL	**0**	**0**	**24**	**12**

Total No. of credits to be earned for the award of Degree 22+21+15+12=70

ELECTIVE-III

S.NO	SUB CODE	SUBJECT NAME	L	T	P	C
1.	525212	Embedded Control Systems	3	0	0	3
2.	525213	Embedded Product Development	3	0	0	3
3.	525214	Automotive Embedded System	3	0	0	3
4.	**525215**	Embedded Networking and Automation of Electrical System	3	0	0	3
5.	525216	Distributed Embedded Computing	3	0	0	3
6.	525217	Embedded Systems in Automotive Applications	3	0	0	3

ELECTIVE-IV

S.NO	SUB CODE	SUBJECT NAME	L	T	P	C
1.	525218	Information Theory and Coding	3	0	0	3
2.	525219	Soft Computing and Optimization Techniques	3	0	0	3
3.	525220	Cryptography And Network Security	3	0	0	3
4.	525221	Network Routing Algorithm	3	0	0	3
5.	525222	Hardware Description Language	3	0	0	3
6.	525223	Advanced Computer Architecture and Parallel Processing	3	0	0	3

ELECTIVE-V

S.NO	SUB CODE	SUBJECT NAME	L	T	P	C
1.	525224	Advanced Digital Image Processing	3	0	0	3
2.	525225	Pattern Recognition and Artificial intelligence	3	0	0	3
3.	525226	Application of MEMS Technology	3	0	0	3
4.	525227	Wireless and Mobile Communication	3	0	0	3
5.	525228	Big Data Analytics	3	0	0	3
6.	525229	Research Methodologies	3	0	0	3

SEMESTER I

520001

APPLIED MATHEMATICS FOR ELECTRONICS ENGINEERS
(Common to I ME Applied Electronics / Embedded Systems)

L	T	P	C
4	0	0	4

AIM:

To provide the basic mathematical knowledge to enhance the exposure of technical knowhow essential for electrical / electronics engineers

LEARNING OUTCOMES:

Having successfully completed this course, the students should be able to:

- The students will become familiar with the basics of matrix factorizations and their sources .The application of different kinds of processes

UNIT I CALCULUS OF VARIATIONS **12**

Maximum and minimum of functions of several independent variables – Lagrangian method of multipliers – Variational problems of fixed boundaries only: Simplest variational problems – Euler equation – Brachistochrone problem – Variational problems involving several unknown functions – Functional involving first and second order derivations – Functional involving two or more independent variables – Isoperimetric problems.

UNIT II MATRIX THEORY **12**

Some important matrix factorizations – The Cholesky decomposition – QR factorization– Least squares method – Singular value decomposition - Toeplitz matrices and some applications.

UNIT III STOCHASTIC PROCESSES **12**

Introduction and classification of stochastic processes , Chapman Kolmogorov equation, Poisson process- Discrete Markov chain, computation of n-step transition probabilities, state classification and continuous time Markov chain – Birth and death processes, pure birth process and pure death process applications. Assignment using applications of Stochastic process software ,AR modelling

UNIT IV QUEUING MODELS **12**

Poisson Process - Markovian Queues - Single and Multi-Server Models - Little's Formula - Machine Interference Model - Self Service Queue - Non- Markovian Queues - Pollaczek Khintchine Formula

UNIT V GRAPH THEORY **12**

Introduction – Basic terminology – Representation of graphs – Connected graphs – Matrix representation of graphs (excluding graphs) – Applications – Critical path method – Shortest path problems – trees – definition – Binary tree

L=60 TOTAL: 60 PERIODS

REFERENCES:

1. Sheldon M. Ross, "Introduction to Probability Models", Academic Press, 2003.

TEXT BOOK :

1.Elsgolts L, "Differential Equation and Calculus of variation", MIR Publishers, 2005.(For unit 1)
2.Narasingh Deo,"Graph Theory &its Applications" Prentice Hall publications, New Edition(For unit 5)
3. Trivedi K.S, "Probability and Statistics with Reliability, Queuing and Computer Science Applications, Prentice Hall, 2003. (For units 3,4)
4. Bronson.R. Matrix Operations, "Schaum's outline series", Mc Graw Hill, New York, New Edition. (For unit 2)

525001 EMBEDDED COMPUTING SYSTEM DESIGN

L	T	P	C
3	0	0	3

COURSE OBJECTIVE:

To study the overview of Embedded System Architecture and understand about the design methodologies in hardware and software design.

COURSE OUTCOMES:

At the end of this course students will gain knowledge in the topics such as

- Construct embedded system hardware.
- Develop software programs to control embedded system.
- Generate product specification for embedded system.
- Design real time embedded systems using the concepts of RTOS.
- Foster ability to understand the role of embedded systems in industry.

UNIT I INTRODUCTION TO EMBEDDED SYSTEMS 9

Introduction to Embedded Systems –Structural units in Embedded processor, selection of processor & memory devices- DMA, Memory management methods- memory mapping, cache replacement concept, Timer and Counting devices, Watchdog Timer, Real Time Clock

Unit- II PROCESSING ELEMENTS **9**

Custom single purpose processor design-RT level custom single purpose processor design optimizing custom single purpose processors-General purpose processor's software: architecture, operation, programmer's view and development environment – ASIPs - selecting a microprocessor - general purpose processor design.

Unit- III MEMORY **9**

Introduction-memory write ability and storage Permanence-common memory types-composing memory-memory hierarchy and caches-advanced RAM.

UNIT IV SOFTWARE DEVELOPMENT TOOLS **9**

Software Development environment-IDE, assembler, compiler, linker, simulator, debugger, In circuit emulator, Target Hardware Debugging, need for Hardware-Software Partitioning and Co-Design. Overview of UML, Scope of UML modelling, Conceptual model of UML, Architectural, UML basic elements-Diagram- Modelling techniques - structural, Behavioural, Activity Diagrams.

UNIT V EMBEDDED SYSTEM APPLICATION DEVELOPMENT 9

Objectives, different Phases & Modelling of the Embedded product Development Life Cycle (EDLC), Case studies on Smart card- Adaptive Cruise control in a Car -Mobile Phone software for key inputs.

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. Rajkamal, 'Embedded system-Architecture, Programming, Design', TMH, 2011.
2. Peckol, "Embedded system Design",JohnWiley&Sons,2010
3. Shibu.K.V, "Introduction to Embedded Systems", TataMcgraw Hill,2009
4. Lyla B Das," Embedded Systems-An Integrated Approach", Pearson 2013.
5. Elicia White,"Making Embedded Systems", O'Reilly Series,SPD,2011
6. Frank Vahid and Tony Givargis, Embedded system design: A unified hardware/Software introduction, Third edition, John Wiley & sons, 2010
7. Wayne Wolf, Computers as Components: Principles of Embedded Computing System Design, Morgan Kaufman Publishers, 2008.

COURSE OUTCOMES		PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES	
CO's	Statement's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO-1	Construct embedded system hardware	3	2	2	2	3						2	2	2	
CO-2	Develop software programs to control embedded system	2	3	2	3	3	1						2	2	
CO-3	Generate product specification for embedded system	3	3	3	2	2	1						2	2	
CO-4	Design real time embedded systems using the concepts of RTOS	3	3	2	2	3	2						2	2	1
CO-5	Foster ability to understand the role of embedded systems in industry	3	2	3	2	3	2						2	2	2

525002	REAL TIME OPERATING SYSTEM	L	T	P	C
		3	0	0	3

Aim: To introduce the concepts, terminologies and technologies used in embedded systems on Real Time Operating Systems.

Course Objectives:

1 To understand the fundamentals of real time operating systems
2 To learn about tasks, process, threads and designing in RTOS
3 To study about Embedded hardware with Works and Micro/OS-II
4 To understand Commercial RTOS

Course Outcomes:

CO1: Understand the basic concepts of Real Time Operating Systems.
CO2: Understand the concept of Task, process and Threads.
CO3: Analyze the various methods on designing operating systems.
CO4: Analyze the different techniques on embedded hardware development.
CO5: Understand the concept of Commercial Real Time Operating Systems.

UNIT – I INTRODUCTION **9**

Brief History of OS - Defining an RTOS - The Scheduler – Objects - Services - Key Characteristics of RTOS – Tasks: Defining a Task - Tasks State and Scheduling - Task Operations, Structure- Synchronization - Communication and Concurrency - Types of Real time tasks – Tasks periodicity – Task scheduling – Classification of scheduling algorithms – Clock driven scheduling – Event driven scheduling

UNIT – II TASKS, PROCESS AND THREADS **9**

Process concept – States and transition – Management - Threads - Multiprocessing and Multitasking – Non-preemptive and preemptive scheduling - Threads, Processes and Scheduling: Putting them altogether - Task Communication: Shared memory – Message passing - RPC and sockets

UNIT – III DESIGNING EMBEDDED SYSTEMS **9**

Factors–8051 micro controller – Designing with 8051-microcontroller 8052-8051/52 variants – Addressing modes of 8051 – 8051 instruction set – issues in hardware software co design–computational models–hardware software tradeoffs- Task Communication/Synchronization Issues - Task Synchronization Techniques - Device Drivers - How to choose an RTOS: Functional Requirements – Non- Functional Requirement.

UNIT - IV EMBEDDED HARDWARE DEVELOPMENT 9

Analog Electronic Components–Digital Electronic Components.- VLSI and integrated Circuit Design-Electronic Design Automation–OrCAD EDA tool–Printed Circuit Board Fabrication–Embedded Firmware Design–Embedded Firmware Development Languages-Programming in Embedded C-Timing and Reference - The VxWorks and Micro/OS-II Development Environment

UNIT – V COMMERCIAL RTOS 9

Time Services – Features of a RTOS – UNIX as a RTOS: Non-preemptive kernel – Dynamic priority levels – Other deficiencies of UNIX – UNIX-based RTOS –Windows as a RTOS – POSIX –A survey of contemporary RTOS – Benchmarking real time systems

Total: 45 Periods

Reference Book(s)

1. Qing Li, Caroline Yao, Real-Time Concepts for Embedded Systems, Elsevier, 2003
2. Shibu K.V, Introduction to Embedded Systems, First Edition, Tata McGraw Hill Education Pvt. Ltd., 2009
3. Santanu Chattopadhyay, Embedded System Design, PHI Learning Pvt. Ltd., 2013
4. Rajib Mall, Real-Time Systems: Theory and Practice, Dorling Kindersley (India) Pvt. Ltd., Second Impression, 2008

COURSE OUTCOMES		PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES	
CO's	Statement's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO-1	Understand the basic concepts of Real Time Operating Systems	3	2	3	2	2					2		3	3	2
CO-2	Understand the concept of Task, process and Threads	3	2	2	3	2					2		2	2	2
CO-3	Analyze the various methods on designing operating systems	3	2	3	2	2					2		2	2	
CO-4	Analyze the different techniques on	3	2	3	2	2					2		2		2

	embedded hardware development														
CO-5	Understand the concept of Commercial Real Time Operating Systems	3	2	3	2	3							2	2	2

525003 DIGITAL SYSTEM DESIGN AND TESTING

L	**T**	**P**	**C**
3	**1**	**0**	**4**

COURSE OBJECTIVE:

To provide an understanding of the fundamentals of digital logic and digital circuit design**.**

COURSE OUTCOMES:

At the end of this course students will gain knowledge in the topics such as

- understand system design using programming technologies
- introduce gate arrays and software to design
- design the circuits with MSI devices
- analyse fault models and systems
- analyse the fault tolerance system for various programming

UNIT I SYSTEM DESIGN USING PLDS 9

Basic concepts – Programming technologies – Programmable Logic Element (PLE) – Programmable Array Logic (PLA) – Programmable Array Logic (PAL) – Programmable Logic Architectures -16L8 -16R4 -22V10 – Design of combinational and sequential al circuits using PLDs - Complex PLDs (CPLDs) – Design of state machines using Algorithmic State Machines (ASM) chart as a design tool.

UNIT II FIELD PROGRAMMABLE GATE ARRAYS 9

Types of FPGA – Xilinx XC3000 series – Logic Cell Array (LCA) – Configurable Logic Blocks (CLB) – Input/output Blocks (IOB) – Programmable Interconnection Points (PIP) – Xilinx XC4000 Series – Introduction to Xilinx SPARTAN, VIRTEX FPGA-Design examples.

UNIT III INTRODUCTION TO VHDL 9

Design process flow – Software tools – Hardware Description Languages – VHDL : Data Objects-Data types – Operators – Entities and Architectures – Components and Configurations – Concurrent signal assignment – Conditional signal assignment – Selected signal assignment Concurrent statements – Sequential statements – Transport and Inertial delays – Delta delays – Behavioral, Data flow and Structural modeling – Attributes – Generics – Packages and Libraries – Multivalued logic and Signal resolution – IEEE 1164 std logic – Subprograms: Functions and Procedures – Operator overloading – Test Benches – Design examples.

UNIT IV FAULT MODELING 9

Defects, errors, faults, Levels of Fault models, Types, Fault Detection and Redundancy in Combinational Logic circuits: Path sensitization method, Boolean difference method. Fault Detection in sequential logic circuit, Design for Testability: Scan path Testing, Boundary Scan Test, Built in Self-test for testing memories. Logic and fault simulation: simulation for verification and test evaluation.

UNIT V FAULT TOLERANT SYSTEMS 9

Fault avoidance and fault tolerance – Techniques of fault tolerance – Hardware fault tolerance: Static, Dynamic and Hybrid redundancy – Fault tolerance in memories. Software Fault tolerance Design of fault tolerant software – N-version programming – Recovery block – Reliability models for fault tolerant software – Validation of fault tolerant software.

L=45 T=15 TOTAL: 60 PERIODS

REFERENCES:

1. Palmer, J.E., Perlman, D.E., “Introduction to Digital Systems”, Tata McGraw Hill, 1997.
2. Nelson, V.P., Nagale, H.T., Carroll, B.D., and Irwin, J.D., "Digital Logic Circuit Analysis and Design", PrenticeHall International, Inc., 1995.
3. Robert K Dueck, “Digital Design with CPLD applications and VHDL”, Thomson 2002.
4. J. Bhaskar, “A VHDL Primer”, Addison Wesley 2006.
5. Charles H Roth, “Digital Systems Design Using VHDL,” Thomson Asia, 2006.

COURSE OUTCOMES		PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES	
CO's	Statement's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO-1	understand system design using programming technologies	3	2	3	2	3					2	2	2	2	
CO-2	introduce gate arrays and software to design	3	2	2	2	2					2	2	2		2
CO-3	design the circuits with MSI devices	3	2	3	2	3					3	3	2	2	2
CO-4	analyse fault models and systems	3	2	3	2	2					2		2	2	
CO-5	analyse the fault tolerance system for various programming	3	2	3	2	2	2				2		2	2	2

525004	ARM PROCESSORS AND CONTROLLERS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

To study the concepts of Architecture and Assembly language programming of ARM Processor and concepts of Architectural Support for High level language and memory hierarchy.

COURSE OUTCOMES:

At the end of this course students will gain knowledge in the topics such as

- Analyze various types of coprocessors and design suitable co-processor interface to ARM processor.
- Analyze floating point processor architecture and its architectural support for higher level language.
- Identify the architectural support of ARM for operating system and analyze the function of memory Management unit of ARM.
- Understand the architectural support of ARM memory system interface and prototype
- Design the ARM techniques and real time application

UNIT I AVR MICROCONTROLLER ARCHITECTURE 9

Architecture – memory organization – addressing modes – I/O Memory – EEPROM – I/O Ports –SRAM –Timer –UART – Interrupt Structure- Serial Communication with PC – ADC/DAC Interfacing

Unit- II ARM ARCHITECTURE AND PROGRAMMING 9

Arcon RISC Machine – Architectural Inheritance – Core & Architectures -- The ARM Programmer's model -Registers – Pipeline - Interrupts – ARM organization - ARM processor family – Co-processors. Instruction set – Thumb instruction set – Instruction cycle timings.

Unit- III ARCHITECTURAL SUPPORT FOR HIGH LEVEL LANGUAGE AND MEMORY HIERARCHY 9

Data Types – Abstraction in software design – expressions – Loops – Functions and Procedures – Conditional Statements – use of memory- Memory size and speed – On Chip Memory – Caches Design – an example –Memory management.

UNIT IV ARCHITECTURAL SUPPORT FOR SYSTEM DEVELOPMENT 9

Advantaged Microcontroller Bus Architecture – ARM memory Interface – ARM Reference Peripheral Specification – Hardware System Prototyping Tools – Emulator – Debug Architecture.

UNIT V DESIGN WITH ARM MICROPROCESSORS 9

Assembler Rules and Directives- Simple ASM/C programs- Hamming Code- Division-Negation-Simple Loops –Look up table- Block copy- subroutines-application.

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. Steve Furber, 'ARM system on chip architecture', Addision Wesley, 2001
2. Muhammad Ali Mazidi, Sarmad Naimi, Sepehr Naimi' AVR Microcontroller and Embedded Systems using Assembly and C", Pearson Education 2014.
3. Developer's Guide Designing and Optimizing System Software', Elsevier 2007.

4. Steve Furber, ARM System on Chip Architecture, Addison –Wesley Professional, 2000.
5. Ricardo Reis, Design of System on a Chip: Devices and Components, Springer, 2004.
6. Jason Andrews, o-Verification of Hardware and Software for ARM System on Chip Design (Embedded Technology), ewnes, BK and CD-ROM, Aug 2004.

COURSE OUTCOMES		PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES	
CO's	Statement's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO-1	Analyze various types of coprocessors and design suitable co-processor interface to ARM processor	3	2	3	2	2	2				2	2	2	2	
CO-2	Analyze floating point processor architecture and its architectural support for higher level language	3	2	3	2	3	2				2	2	2		2
CO-3	Identify the architectural support of ARM for operating system and analyze the function of memory Management unit of ARM	3	2	3	2	3	2				2		2	2	2
CO-4	Understand the architectural support of ARM memory system interface and prototype	3	2	2	2	3	2				2	2	2		2
CO-5	Design the ARM techniques and real time application	3	2	3	2	3	2					2	2		2

525101 EMBEDDED SYSTEM LAB – I

L	T	P	C
0	0	4	2

COURSE OBJECTIVE

The students will learn design with simulators/programming environments.

COURSE OUTCOMES:

Having successfully completed this course, the students should be able to:

- Apply the fundamentals of assembly level programming of microprocessors and microcontroller.
- Elaborate the Assembly and Embedded C programming
- Analyze basic programming concepts using ARM Processor.
- examine the interfacing of various peripherals using microprocessors and microcontroller
- Elaborate interactions between software and hardware

PIC MICROCONTROLLER PROGRAMMING

1. Make LEDs blink
2. Read input from switches
3. Display message in LCD
4. Simulate RTC (Real time Clock) and display in seven segment LEDs
5. Rotate a stepper motor with different speeds
6. Read the ADC Analog input and Plot the Corresponding signal on a LCD
7. Simulate the elevator movement

ARM PROCESSOR PROGRAMMING

1. Write a Simple Assembly Program for

a. Addition b. Subtraction b. Multiplication d. Division.

Write a Program for

a. 8-Bit Digital Output (LED Interface)

b. 8-Bit Digital Inputs (Switch Interface)

2. Write a Program for character based LCD Interface

3. Write a Program for Analog to Digital Conversion (On chip ADC)

4. Write a Program for I2-C Device Interface
   a. Serial EEPROM
   b. Seven Segment LED Display Interface
   c. Real Time Clock

5. Interfacing with Temperature Sensor

6. Stepper Motor Interface

TOTAL: 60 PERIODS

List of Requirements:

S.NO.	DESCRIPTION OF EQUIPMENT	QUANTITY REQUIRED

1.	Pic Microcontroller	5 KIT
2.	Interfacing With Led,Lcd,Seven Segment Led	3
3.	Arm Processor	3 KIT
4.	Interfacing With Led,Lcd,Seven Segment Led	3
5.	Temperature Sensor	3

COURSE OUTCOMES		PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES	
CO's	Statement's	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO-1	apply the fundamentals of assembly level programming of microprocessors and microcontroller	3	2	3	3	3	2			3	1	2	2	2	2
CO-2	Elaborate the Assembly and Embedded C programming	3	2	3	2	2	3			2	2	2	2	2	2
CO-3	Analyze basic programming concepts using ARM Processor	3	2	3	2	3	2			2	2	2	2	3	2
CO-4	examine the interfacing of various peripherals using microprocessors and microcontroller	3	2	3	2	3	2			2	2	2	2	2	2
CO-5	Elaborate interactions between software and hardware	3	2	3	2	2	2			2	2	2	2	1	2

SEMESTER II

525005 **EMBEDDED LINUX** **L T P C**
3 0 0 3

Aim: To introduce the basic concepts and technologies used in recent trends of embedded programming.

Course Objectives:

1 To learn fundamentals of embedded Linux.
2 To learn to use GNU tool chain.

3 To learn to implement embedded Linux applications.
4 To make the students get familiarized with different embedded concepts.

Course Outcomes:

CO1: Understand the basic concepts of Linux environment.
CO2: Understand the concept of Linux initialization
CO3: Analyze the various logical methods on device handling.
CO4: Analyze the different techniques on development tools.
CO5: Understand the concept of device applications.

UNIT- I LINUX FUNDAMENTALS **9**

Introduction - host-target development setup - hardware support - development languages and tools – RT linux.

UNIT- II INITIALIZATION AND DEVICE HANDLING **9**

Linux kernel and kernel initialization - system initialization – hardware support – bootloaders - Device driver basics - module utilities - file systems - MTD subsystems – Busybox.

UNIT- III DEVELOPMENT TOOLS **9**

Embedded development environment - GNU debugger - tracing & profiling tools - binary utilities - kernel debugging - debugging embedded Linux applications - porting Linux - Linux and real time - SDRAM interface.

UNIT-IV DEVICE APPLICATIONS **9**

Asynchronous serial communication interface - parallel port interfacing - USB interfacing - memory I/O interfacing - using interrupts for timing.

UNIT-V REAL TIME SYSTEM **9**

The Xenomai Real-Time System - Porting Traditional RTOS Applications to Linux - The Xenomai Architecture - How Xenomai Works - The Real-Time Driver Model - Xenomai, Chameleon by Design

Total : 45 Hours

Reference Books

1. Christopher Hallinan, “Embedded Linux Primer: A practical real world approach”, Prentice Hall, 2007.
2. Karim Yaghmour, Jon Masters, Gillad Ben Yossef, Philippe Gerum, “Building embedded linux systems”, O'Reilly, 2008.
3. Craig Hollabaugh, “Embedded Linux: Hardware, software and Interfacing”, Pearson education, 2002.
4. Doug Abbott, “Linux for embedded and real time applications”, Elsevier Science, 2003.

COURSE OUTCOMES		PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES	
CO's	Statement's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO-1	Understand the basic concepts of Linux environment	3	2	3	3	3	2				1		2	2	2
CO-2	Understand the concept of Linux initialization	3	2	3	2	2	3				2		2		2
CO-3	Analyze the various logical methods on device handling	3	2	3	2	3	2				2		2	2	
CO-4	Analyze the different techniques on development tools	3	2	3	2	3	2				2		2		2
CO-5	Understand the concept of device applications	3	2	3	2	2	2				2		2		2

525006 INTERNET OF THINGS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

The purpose of this course is to impart knowledge on IoT Architecture and various protocols

COURSE OUTCOMES:

- introduce the terminology, technology and its applications
- introduce the concept of M2M (machine to machine) with necessary protocols
- introduce the Python Scripting Language which is used in many IoT devices
- introduce the Raspberry PI platform, that is widely used in IoT applications
- introduce the implementation of web based services on IoT devices

UNIT I INTRODUCTION TO INTERNET OF THINGS 9

Definition and Characteristics of IoT, Physical Design of IoT – IoT Protocols, IoT communication models, Iot Communication APIs IoT enabaled Technologies – Wireless Sensor Networks, Cloud Computing, Big data analytics, Communication protocols, Embedded Systems, IoT Levels and Templates Domain Specific IoTs – Home, City, Environment, Energy, Retail, Logistics, Agriculture, Industry, health and Lifestyle

UNIT II IoT AND M2M 9

Software defined networks, network function virtualization, difference between SDN and NFV for IoT Basics of IoT System Management with NETCOZF, YANG- NETCONF, YANG, SNMP NETOPEER

UNIT III INTRODUCTION TO PYTHON 9

Language features of Python, Data types, data structures, Control of flow, functions, modules, packaging, file handling, data/time operations, classes, Exception handling Python packages – JSON, XML, HTTPLib, URLLib, SMTPLib

UNIT IV IoT PHYSICAL DEVICES AND ENDPOINTS 9

Introduction to Raspberry PI-Interfaces (serial, SPI, I2C) Programming – Python program with Raspberry PI with focus of interfacing external gadgets, controlling output, reading input from pins.

UNIT V IoT PHYSICAL SERVERS AND CLOUD OFFERINGS 9

Introduction to Cloud Storage models and communication APIs Webserver – Web server for IoT, Cloud for IoT, Python web application framework Designing a RESTful web API

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015, ISBN: 9788173719547
2. Bernd Scholz-Reiter, Florian Michahelles, "Architecting the Internet of Things", ISBN 978-3-642-19156-5 e-ISBN 978-3-642-19157-2, Springer
3. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118- 47347-4, Willy Publications
4. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014, ISBN: 9789350239759
5. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1 st Edition, Academic Press, 2014
6. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-onApproach)", 2nd Edition, VPT, 2014.

COURSE OUTCOMES		PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES	
CO's	Statement's	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO-1	introduce the terminology, technology and its applications	3	2	3	2								2	2	2
CO-2	introduce the concept of M2M (machine to machine) with necessary protocols	3	3	2	2	2	2						2	2	

CO-3	introduce the Python Scripting Language which is used in many IoT devices	3	2	2	2	3							2	2	2
CO-4	introduce the Raspberry PI platform, that is widely used in IoT applications	2	2	2	2	2	2						2	2	2
CO-5	introduce the implementation of web based services on IoT devices	2	2	2	2	2							2	2	2

525007 SOFTWARE FOR EMBEDDED SYSTEMS L T P C
3 0 0 3

Aim: To introduce the concepts, terminologies and technologies used in embedded systems on modern software technologies.

Course Objectives:

1 To understand the concepts of software Technology
2 To study the functions of software systems
3 To introduce the languages concepts for Assembly processing.
4 To make the students get familiarized with different embedded concepts.

Course Outcomes:

CO1: Understand the basic concepts of Software Technology and its function
CO2: Understand the concept of C Language in Assembly level processing.
CO3: Analyze the various logical methods on input output programming
CO4: Analyze the different techniques on memory management.
CO5: Understand the concept of unified modelling language

UNIT – I INTRODUCTION TO SOFTWARE TECHNOLOGY 9

Software Architectures, Software development Tools, Software Development Process Life Cycle and its Model, Software Analysis, Design and Maintenance. Introduction To Data Representation:- Data representation ,Two's complement, Fixed point and Floating Point Number Formats ,Manipulating Bits in -Memory, I/O Ports, Low level programming in C, Primitive data types , Arrays, Functions ,Recursive Functions, Pointers, Structures & Unions , Dynamic Memory Allocation ,File handling ,Linked lists, Queues, Stacks

UNIT - II MIXING C AND ASSEMBLY 9

Overview of Embedded C -Compilers and Optimization- C and assembly- Programming in assembly -Register Usage Conventions- Typical use of Addressing Options- Instruction Sequencing - Procedure Call and Return - Parameter passing- Retrieving Parameters , Everything in pass by value ,Temporary variables

UNIT- III INPUT/OUTPUT PROGRAMMING **9**

Program Elements – Queues – Stack- List and ordered lists-concurrent software- Portability Issues - I/O Instructions, Synchronization, Transfer Rate & Latency, Polled Waiting Loops, Interrupt – Driven I/O, Writing ISR in Assembly and C- Non Maskable and Software Interrupts- Example programs in c for the interactive embedded systems .

UNIT - IV MEMORY MANAGEMENT **9**

Objects in C-Life time-Shared memory- Read only data- Applications of Direct Memory Access in the embedded system-Local and Global Scope- Automatic and Static Allocation-Distinguishing Static from Automatic Object Creation- Initialization and Destruction-Dynamic Allocation –Real world examples related with the Direct Memory Access.

UNIT – V UNIFIED MODELING LANGUAGE **9**

UML basics, elements of Modeling in the UML programs-Object state behavior - UML state charts - Role of scenarios in the definition of behavior - Timing diagrams - Sequence diagrams - Event hierarchies - types and strategies of operations - Architectural design in UML concurrency design - threads in UML.

Total: 45 periods

Reference Book(s):

1. Raj Kamal, "Embedded Systems- Architecture, Programming and Design", Tata McGraw Hill Publications, 2010
2. Daniel Lewis "Fundamentals of Embedded Software where C and Assembly Meet", PHI 2009
3. Bruce Powel Douglas, "Real-time UML Workshop for Embedded Systems", Newness Publication, 2011.
4. Wayne Wolf, "Computers as Components: Principles of Embedded Computer
5. System Design", Elsevier, 2006.Michael J. Pont, "Embedded C", Pearson Education, 2007.

COURSE OUTCOMES		PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES	
CO's	Statement's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO-1	Understand the basic concepts of Software Technology and its function	3	2	3	2	3	2				2		2	2	
CO-2	Understand the concept of C Language in Assembly level processing.	3	2	3	2	3					2	2	2		2

CO-3	Analyze the various logical methods on input output programming	3	2	3	2	3	2				2		2	2	2
CO-4	Analyze the different techniques on memory management.	3	2	3	2	2					2		2	2	2
CO-5	Understand the concept of unified modelling language	3	2	3	2	2	2					2	2	2	2

525008 RISC PROCESSOR ARCHITECTURE & PROGRAMMING

L	T	P	C
3	0	0	3

COURSE OBJECTIVE:

To study basics of microprocessor & concepts of various architectures.

COURSE OUTCOMES:

- understand the architecture of advanced processor, cache memory and various dependencies between instructions and registers
- understand the program of Pentium Processors.
- Students are able to write programs using both ARM and Thumb instruction set and also able to compare 3 stage pipeline with 5 stage pipeline.
- Students are able to know the difference between microprocessor and microcontroller architecture.
- Students are able to do simple programs using PIC microcontroller.

UNIT I OVERVIEW **9**

Generic Architecture-Instruction Set – Data formats –Addressing modes – Memory hierarchy –register file –Cache – Virtual memory and paging – Segmentation- pipelining –the instruction pipeline – pipeline hazards – instruction level parallelism – reduced instruction set –Computer principles – RISC versus CISC.

UNIT II HIGH PERFORMANCE CISC ARCHITECTURE – PENTIUM **9**

CPU Architecture- Bus Operations – Pipelining – Branch predication – floating point unit-Operating Modes –Paging – Multitasking – Exception and Interrupts – Instruction set – addressing modes – Programming the Pentium processor.

UNIT III HIGH PERFORMANCE RISC ARCHITECTURE – ARM **9**

Organization of CPU – Bus architecture –Memory management unit - ARM instruction set-Thumb Instruction set- addressing modes – Programming the ARM processor- ARM RISC architecture and its programming

UNIT IV MOTOROLA 68HC11 MICROCONTROLLERS **9**

Instruction set, addressing modes – operating modes- Interrupt system- RTC-Serial Communication Interface – A/D Converter PWM and UART.

UNIT V PIC MICROCONTROLLER 9

CPU Architecture – Instruction set – interrupts- Timers- I^2C Interfacing – UART- A/D Converter –PWM and introduction to C-Compilers.

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. Barry.B.Breg," The Intel Microprocessors Architecture , Programming and Interfacing " , 3rd edition, PHI,2012.
2. Daniel Tabak , '' Advanced Microprocessors" McGraw Hill.Inc., 3rd edition, 2009.
3. Gene .H.Miller." Micro Computer Engineering," Pearson Education, 4th edition, 2009,ISBN-13: 978-0131428041,ISBN-10: 0131428047.
4. James L.Antonakos ," An Introduction to the Intel family of Microprocessors '' Pearson Education, 3rd edition, 2011.
5. Jurij Silc, Borut Robic, Theo Ungerer, "Processor architecture" , Springer publication, 3rd edition, 2014.
6. Steve Furber , '' ARM System –On –Chip architecture "Addision Wesley , 2009.

COURSE OUTCOMES		PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES	
CO's	Statement's	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO-1	understand the architecture of advanced processor, cache memory and various dependencies between instructions and registers	3	2	2	2	2							2	2	2
CO-2	understand the program of Pentium Processors	3	2	3	2	3	2				1		2	2	
CO-3	Students are able to write programs using both ARM and Thumb instruction set and also able to compare 3 stage pipeline with 5 stage pipeline	3	2	2	2	2	2						2	2	
CO-4	Students are able to know the difference between microprocessor and microcontroller architecture	2	2	3	2	2							2	2	2

CO-5	Students are able to do simple programs using PIC microcontroller	3	2	2	2	2	2						2	2	2

525009 EMBEDDED NETWORKING

L	**T**	**P**	**C**
3	**0**	**0**	**3**

COURSE OBJECTIVE:

The aim of the course is to investigate embedded system design approaches from both the software and hardware perspectives.

COURSE OUTCOMES:

- Illustrate the process and issues of embedded system life cycle.
- Evaluate mapping of hardware and software design for Embedded Systems
- Apply debugging techniques for testing of an embedded system.
- Design an embedded prototype using In-circuit Emulator.
- Choose testing environment for different embedded devices.

UNIT I EMBEDDED DESIGN LIFE CYCLE **9**

Product specification – Hardware /Software Partitioning – Detailed hardware and software design – integration – Product Testing –Selection Processes –Microprocessor Vs Microcontroller –Performance tools – Bench Marking –RTOS Microcontroller –RTOS availability – Tool Chain availability – Other issues in selection Processes.

UNIT II PARTITIONING DECISION **9**

Hardware / Software duality – Coding Hardware – ASIC revolution – Managing the Risk - Co-Verification – execution environment – memory organization –System startup- Hardware manipulation –Object Placement memory mapped access –speed and code density.

UNIT III INTERRUPT SERVICE ROUTINES **9**

Watch dog timers –Flash Memory basic toolset – Host based debugging – Remote debugging – ROM emulators – Logic analyzer –caches – Compiler optimization- Statistical profiling.

UNIT IV IN CIRCUIT EMULATORS **9**

BDM, JTAG, and Nexus- Bullet proof run control – Real time trace –Hardware break points – Overlay memory - Timing constraints – usage issues –Triggers.

UNIT V TESTING & APPLICATION DESIGN **9**

BUG Tracking –Reduction of Risks & costs –performance – Unit testing –Regression testing - Choosing test cases – functional tests –coverage tests –Testing embedded software - performance testing -Maintenance. Case studies - Model train controller, IVRS, Alarm Clock, Digital Camera and Software modem.

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. Arnold S.Berger, "Embedded System Design ", CMP books, USA 2002.
2. Arkin, R.C., "Behavior-based Robotics", The MIT Press, 5th edition, 2008.
3. Frank Vahid, "Embedded System Design", Wiley, Student Edition, 2006.
4. Gul N. Khan, Krzysztof Iniewski, "Embedded and Networking Systems: Design, Software, and Implementation" , CRC Press, 5th edition, 2014.
5. SriramIyer, "Embedded Real time System Programming", Tata McGraw-Hill, 2003.
6. Steve Heath, "Embedded Systems Design", Second Edition, Newness, 2003.
7. Wayne Wolf, "Computers as Components: Principles of embedded computing system design", 3rd edition, Elsevier publication, 2012.

COURSE OUTCOMES		PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES	
CO's	Statement's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO-1	Illustrate the process and issues of embedded system life cycle	3	2	2	2	3						2	2	2	
CO-2	Evaluate mapping of hardware and software design for Embedded Systems	2	3	2	3	3	1						2	2	
CO-3	Apply debugging techniques for testing of an embedded system	3	3	3	2	2	1						2	2	
CO-4	Design an embedded prototype using In-circuit Emulator	3	3	2	2	3	2						2	2	1
CO-5	Choose testing environment for different embedded devices	3	2	3	2	3	2						2	2	2

525102 EMBEDDED SYSTEM LAB – II

L	T	P	C
0	0	4	2

COURSE OBJECTIVE

The students will learn design with simulators/programming environments.

COURSE OUTCOMES:

Having successfully completed this course, the students should be able to:

- Apply the fundamentals of assembly level programming of microprocessors and microcontroller.

- Elaborate the Assembly and Embedded C programming
- Analyze basic programming concepts using ARM Processor.
- examine the interfacing of various peripherals using microprocessors and microcontroller
- Elaborate interactions between software and hardware

LIST OF EXPERIMENTS

1.EXPERIMENTS USING RTOS

- Write a Simple Program with Two Separate LED Blinking Tasks
- Implement OS Real Time Multitasking by writing a multitasking program with the tasks
- Interface RTC and Display on LCD First Line Continuously
- Interface ADC and Display on LCD second line Continuously
- Read the Key input and display on seven segment LED
- Read the ADC Analog input and Plot the Corresponding signal on a LCD

2.TEXAS DSP - CODE COMPOSER STUDIO

3. EXPERIMENTS USING LABVIEW

- Simple experiments
- Experiment using Sub VI
- Loop Exercise
- Array exercise
- Cluster exercise
- Experiments using File input and Out put
- Temperature control
- Sine wave extractor
- Medial filter
- Spectrum measurement

TOTAL: 60 PERIODS

List of Requirements:

S.NO.	DESCRIPTION OF EQUIPMENT	QUANTITY REQUIRED
1.	PC WITH LABVIEW SOFTWARE	PC WITH LABVIEW SOFTWARE

2. PC WITH KEIL SOFTWARE

3. TEXAS DSP - CODE COMPOSER STUDIO

PC WITH KEIL SOFTWARE
TEXAS DSP - CODE COMPOSER STUDIO

COURSE OUTCOMES		PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES	
CO's	Statement's	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO-1	apply the fundamentals of assembly level programming of microprocessors and microcontroller	3	2	3	3	3	2			3	1	2	2	2	2
CO-2	Elaborate the Assembly and Embedded C programming	3	2	3	2	2	3			2	2	2	2	2	2
CO-3	Analyze basic programming concepts using ARM Processor	3	2	3	2	3	2			2	2	2	2	3	2
CO-4	examine the interfacing of various peripherals using microprocessors and microcontroller	3	2	3	2	3	2			2	2	2	2	2	2
CO-5	Elaborate interactions between software and hardware	3	2	3	2	2	2			2	2	2	2	1	2

LIST OF ELECTIVES
ELECTIVE-I

525202 ANALOG VLSI CIRCUIT DESIGN

L	T	P	C
3	0	0	3

COURSE OBJECTIVE:

To study the basics of analog VLSI circuit design and architecture.

COURSE OUTCOMES:

Having successfully completed this course, the students should be able to:

- Understand study the concepts of CMOS and BICMOS analog circuits.
- Understand the concepts of A/D convertors and analog integrated sensors.
- Understand the testing concepts in analog VLSI circuits and its statistical modelling.
- Analyse the concepts of analog VLSI interconnects.

- Identify the function of the modeling and simulation and analog circuit's representation.

UNIT I BASIC CMOS CIRCUIT TECHNIQUES, CONTINUOUS TIME AND LOWVOLTAGE SIGNAL PROCESSING **9**

Mixed-Signal VLSI Chips - Basic CMOS Circuits – Basic Gain Stage - Gain Boosting Techniques – Super MOS Transistor-Primitive Analog Cells-Linear Voltage-Current Converters -MOS Multipliers and Resistors-CMOS, Bipolar and Low-Voltage Bi CMOS Op-Amp Design Instrumentation Amplifier Design-Low Voltage Filters.

UNIT II BASIC BICMOS CIRCUIT TECHNIQUES, CURRENT -MODE SIGNAL PROCESSING AND NEURAL INFORMATION PROCESSING **9**

Continuous-Time Signal Processing-Sampled-Data Signal Processing-Switched-Current Data Converters-Practical Considerations in SI Circuits Biologically-Inspired Neural Networks - Floating - Gate, Low-Power Neural Networks-CMOS Technology and ModelsDesign Methodology-Networks-Contrast Sensitive Silicon Retina.

UNIT III SAMPLED-DATA ANALOG FILTERS, OVER SAMPLED A/D CONVERTERS AND ANALOG INTEGRATED SENSORS **9**

First-order and Second SC Circuits-Bilinear Transformation - Cascade Design-Switched Capacitor Ladder Filter-Synthesis of Switched-Current Filter- Nyquist rate A/D Converters Modulators for Over sampled A/D Conversion-First and Second Order and Multi bit Sigma Delta Modulators-Interpolative Modulators –Cascaded Architecture-Decimation Filters mechanical, Thermal, Humidity and Magnetic Sensors-Sensor Interfaces.

UNIT IV DESIGN FOR TESTABILITY AND ANALOG VLSI INTERCONNECTS **9**

Fault modelling and Simulation - Testability-Analysis Technique-Ad Hoc Methods and General Guidelines-Scan Techniques-Boundary Scan-Built-in Self Test-Analog Test Buses Design for Electron -Beam Testability-Physics of Interconnects in VLSI-Scaling of Interconnects-A Model for Estimating Wiring Density-A Configurable Architecture for Prototyping Analog Circuits

UNIT V STATISTICAL MODELING AND SIMULATION, **9**

Analog Computer- Aided Design and Analog and Mixed Analog-Digital Layout, Review of Statistical Concepts - Statistical Device Modeling- Statistical Circuit Simulation Automation Analog Circuit Design-automatic Analog Layout-CMOS Transistor Layout Resistor Layout-Capacitor Layout-Analog Cell Layout-Mixed Analog -Digital Layout.

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. Jose E.France, YannisTsividis, "Design of Analog-Digital VLSI Circuits for Telecommunication and signal processing ", Prentice Hall, 2013.
2. Randall L Geiger, Phillip E. Allen, " Noel K.Strader, VLSI Design Techniques for Analog and Digital Circuits ", Mc GrawHill International Company, 2010.
3. Mohammed Ismail, Terri Fief, "Analog VLSI signal and Information Processing ", McGraw- Hill International 4thEditons, 2008.
4. Malcom R.Haskard, LanC.May, "Analog VLSI Design - NMOS and CMOS", Prentice Hall, 2007.

5. Sina Balkir, Günhan Dündar, A. Selçuk Ögrenci, "Analog VLSI Design Automation" CRC Press, 2009.

COURSE OUTCOMES		PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES	
CO's	Statement's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO-1	Understand study the concepts of CMOS and BICMOS analog circuits	3	3	3	2	2	2						2	2	2
CO-2	understand the concepts of A/D convertors and analog integrated sensors	3	3	3	2	2	2			2		2	2	2	
CO-3	understand the testing concepts in analog VLSI circuits and its statistical modelling	3	3	3	3	3	2			2		2	2	2	2
CO-4	Analyse the concepts of analog VLSI interconnects	3	3	3	1	2	2			2		2		2	2
CO-5	Identify the function of the modeling and simulation and analog circuit's representation	3	3	3	3	3	2			2		2		2	2

525203 SYSTEM DESIGN USING FPGA L T P C

3 0 0 3

COURSE OBJECTIVE:

To study the basics of FPGA and PLDs.

COURSE OUTCOMES:

Having successfully completed this course, the students should be able to:

- Demonstrate the VLSI Cad tool to design CMOS VLSI analog circuits
- Design, implement and analyse various Analog mixed mode circuits
- Perform DRC, LVS for the designed circuits.
- Carry out the mini project on the design of a CMOS subsystem
- Design and analyse the FPGAs, Complex programmable logics.

UNIT I INTRODUCTION 9

VHDL description of combinational networks, Modeling flip-flops using VHDL, VHDL models for a multiplexer, Compilation and simulation of VHDL code, Modeling a sequential machine, Variables, Signals and constants, Arrays, VHDL operators, VHDL functions, VHDL procedures, Packages and libraries, VHDL model for a counter.

UNIT II DESIGNING WITH PROGRAMMABLE LOGIC DEVICES 9

Read-only memories, Programmable logic arrays (PLAs), Programmable array logic (PLAs), Other sequential programmable logic devices (PLDs), Design of a keypad scanner.

UNIT III DESIGN OF NETWORKS FOR ARITHMETIC OPERATIONS 9

Design of a serial adder with accumulator, State graphs for control networks, Design of a binary multiplier, Multiplication of signed binary numbers, Design of a binary divider.

UNIT IV DIGITAL DESIGN WITH SM CHARTS 9

State machine charts, Derivation of SM charts, Realization of SM charts. Implementation of the dice game, Alternative realization for SM charts using microprogramming, Linked state machines.

UNIT V DESIGNING WITH PROGRAMMABLE GATE ARRAYS AND COMPLEX PROGRAMMABLE LOGIC 9

Xlinx 3000 series FPGAs, Designing with FPGAs, Xlinx 4000 series FPGAs, using a one-hot state assignment, Altera complex programmable logic devices (CPLDs), Altera FELX 10K series COLDs.

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. FPGA-Based System Design Wayne Wolf, Verlag: Prentice Hall,2006.
2. Jon F Wakerly, Digital Design: Principles and Practices, Prentice Hall, 2007.
3. Kevin Skahil, VHDL for programmable logic, Addison Wesley,2008.
4. ZainalabedinNavabi, VHDL, analysis and modeling of digital systems, McGraw-Hill, 2005.
5. Mark Zwolinski, Digital System Design Using VHDL, 2nd Edition, Prentice Hall, 2009 ISBN: ISBN 0-13-039985-X

COURSE OUTCOMES		PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES	
CO's	Statement's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO-1	Demonstrate the VLSI Cad tool to design CMOS VLSI analog circuits	3	3	3	2	2					2		2	2	
CO-2	Design, implement and analyse various Analog mixed mode circuits	2	3	2	3	2					2			2	2
CO-3	Perform DRC, LVS for the designed circuits	3	2	3	2	3						2	2	2	
CO-4	Carry out the mini project on the design of a CMOS subsystem	3	2	3	2					2		2	2	2	2

CO-5	Design and analyse the FPGAs, Complex programmable logics	3	2	3	2	2						2	2		2

525204 SYSTEM ON CHIP DESIGN

L	**T**	**P**	**C**
3	**0**	**0**	**3**

COURSE OBJECTIVE:

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

COURSE OUTCOMES:

- Understand about SoC Design Methodology.
- Understand the design of different embedded memories.
- Understand the simulation models and design methodology.
- Understand the concept of SoC Design Validation
- Analysis the Testing Concepts of system on chip.

UNIT I INTRODUCTION **9**

System tradeoffs and evolution of ASIC Technology- System on chip concepts and methodology – SoC design issues -SoC challenges and components

UNIT II DESIGN METHODOLOGICAL FOR LOGIC CORES **9**

SoC Design Flow – On-chip buses –Design process for hard cores –Soft and firm cores – Designing with hard cores, soft cores- Core and SoC design examples

UNIT III DESIGN METHODOLOGY FOR MEMORY AND ANALOG CORES **9**

Embedded memories –Simulation modes Specification of analog circuits – A to D converter – Phase located loops –High I/O.

UNIT IV DESIGN VALIDATION **9**

Core level validation –Test benches –SoC design validation – Co simulation –hardware/ Software coverification. Case Study: Validation and test of systems on chip

UNIT V SOC TESTING **9**

SoC Test Issues – Testing of digital logic cores –Cores with boundary scan –Test methodology for design reuse– Testing of microprocessor cores – Built in self method –testing of embedded memories. Case Study: Integrating BIST techniques for on-line SoC testing. Designing BIST techniques for SOC testing- soft core models for different logic circuits

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. .M.Keating, D.Flynn, R.Aitken, A, GibbonsShi, Low Power Methodology Manual for Systemon-ChipDesign Series: Integrated Circuits and Systems, Springer, 2007.
2. Prakash Raslinkar, Peter Paterson &Leena Singh, System-on-a-chip verification: Methodology and Techniques, Kluwer Academic Publishers, 2000

3. RochitRajsunah, System-on-a-chip: Design and Test, Artech House, 2007.

COURSE OUTCOMES		PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES	
CO's	Statement's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO-1	understand about SoC Design Methodology	3	2	3	2	2	2			2	2		2	2	2
CO-2	understand the design of different embedded memories	3	2	3	2	2					2		2	2	
CO-3	understand the simulation models and design methodology	3	2	2	2	2					2		2	2	
CO-4	understand the concept of SoC Design Validation	3	2	3	2	2						2	2		2
CO-5	analysis the Testing Concepts of system on chip	3	2	3	2	2						2	2	2	

525205 FOUNDATIONS OF VLSI CAD **L T P C**

3 0 0 3

COURSE OBJECTIVE:

To study various physical design methods of VLSI and design rules and routing techniques.

COURSE OUTCOMES:

Having successfully completed this course, the students should be able to:

- Understand the concepts behind the VLSI design rules and routing techniques.
- Analysis the simulation techniques at various levels in VLSI design flow,
- Understand the concepts of various algorithms used for floor planning and routing techniques.
- Understand the techniques of modeling.
- Understand the concept of the modeling and synthesis.

UNIT I VLSI DESIGN METHODOLOGIES **9**

Introduction to VLSI Design methodologies - Review of Data structures and algorithms - Review of VLSI Design automation tools - Algorithmic Graph Theory and Computational Complexity - Tractable and Intractable problems - general purpose methods for combinatorial optimization.

UNIT II DESIGN RULES **9**

Layout Compaction - Design rules - problem formulation - algorithms for constraint graph compaction - placement and partitioning - Circuit representation - Placement algorithms – partitioning

UNIT III FLOOR PLANNING 9

Floor planning concepts - shape functions and floorplan sizing - Types of local routing problems - Area routing - channel routing - global routing - algorithms for global routing.

UNIT IV SIMULATION 9

Simulation - Gate-level modeling and simulation - Switch-level modeling and simulationCombinational Logic Synthesis - Binary Decision Diagrams - Two Level Logic Synthesis.

UNIT V MODELLING AND SYNTHESIS 9

High level Synthesis - Hardware models - Internal representation - Allocation - assignment and scheduling - Simple scheduling algorithm - Assignment problem - High level transformations.

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. N.A. Sherwani, "Algorithms for VLSI Physical Design Automation", Kluwer Academic Publishers, 2005.
2. S.H. Gerez, "Algorithms for VLSI Design Automation", John Wiley & Sons, 2002.
3. Sadiq M. Sait, Habib Youssef, “VLSI Physical Design automation: Theory and Practice”, World scientific 2005.
4. Steven M.Rubin, “Computer Aids for VLSI Design”, Addison Wesley Publishing 2003.

COURSE OUTCOMES		PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES	
CO’s	Statement’s	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO-1	understand the concepts behind the VLSI design rules and routing techniques	3	2	2	1	2	2						2	2	1
CO-2	Analysis the simulation techniques at various levels in VLSI design flow	3	2	3	2	2							2	2	2
CO-3	understand the concepts of various algorithms used for floor planning and routing techniques	3	2	2	2	2							2	2	2

CO-4	understand the techniques of modeling	3	2	3	2	2								2	2
CO-5	understand the concept of the modeling and synthesis	3	2	2	3	2							2	2	

525206 LOW POWER VLSI DESIGN L T P C

3 0 0 3

COURSE OBJECITVE:

The Students will be able to understand the low power VLSI Design.

COURSEOUTCOMES:

- Simplify the reduction in power dissipation, size, cost and etc.
- Classify the sources of power in an IC.
- Identify the power reduction techniques based on technology independent and Technology dependent.
- Power dissipation mechanism in various MOS logic style.
- Determine suitable techniques to reduce the power dissipation.

UNIT I POWER DISSIPATION IN CMOS 9

Hierarchy of limits of power – Sources of power consumption – Physics of power dissipation in CMOS FET devices- Basic principle of low power design. Dynamic dissipation in CMOS, Transistor sizing & gate oxide thickness, Impact of technology Scaling, Technology & Device innovation

UNIT II POWER OPTIMIZATION 9

Logic level power optimization – Circuit level low power design – circuit techniques for reducing power consumption in adders and multipliers.

UNIT III DESIGN OF LOW POWER CMOS CIRCUITS 9

Computer Arithmetic techniques for low power systems – Reducing power consumption in memories – Low power clock, Interconnect and layout design – Advanced techniques – Special techniques. Power consumption in circuits. Flip Flops & Latches design, high capacitance nodes, low power digital cells library

UNIT IV POWER ESTIMATION 9

Power estimation techniques – Logic level power estimation – Simulation power analysis – Probabilistic power analysis. gate level logic simulation, capacitive power estimation, static state power, gate level capacitance estimation.

UNIT V SYNTHESIS AND SOFTWARE DESIGN FOR LOW POWER 9

Synthesis for low power – Behavioral level transform – software design for low power.

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. Anantha P. Chandrakasan& Robert W. Brodersen, "Low Power Digital CMOS Design" Kluwer Academic Publications, 2009.
2. Angsuman Sarkar, Swapnadip De, Manash Chanda, Chandan Kumar Sarkar, " Low Power VLSI Design: Fundamentals", webly publications, 2016.
3. Ajit Pal, "Low-Power VLSI Circuits and Systems" PRC press publications, 3rd edition, 2014.
4. Gary K. Yeap, "Practical Low Power Digital VLSI Design", KAP, 2002
5. Kaushik Roy, Sharat Prasad, "Low-Power CMOS VLSI Circuit Design", Wiley, 2000
6. Rabaey, Pedram, "Low Power Design Methodologies", Kluwer Academic, 2004.

COURSE OUTCOMES		PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES	
CO's	Statement's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO-1	Simplify the reduction in power dissipation, size, cost and etc	3	3	3	3	3	2						2	2	2
CO-2	Classify the sources of power in an IC	3	3	3	2	2						2	2	2	2
CO-3	Identify the power reduction techniques based on technology independent and Technology dependent	3	3	3	3	3						2	2	2	
CO-4	Power dissipation mechanism in various MOS logic style	3	3	2	2	2						2	2	2	2
CO-5	Determine suitable techniques to reduce the power dissipation	3	3	3	3	3							2	2	2

525207 **ASIC DESIGN** **L T P C**

3 0 0 3

COURSE OBJECTIVE:

To study about ASIC and FPGA design

COURSE OUTCOMES:

Having successfully completed this course, the students should be able to:

- Analysis the different types of ASICs design.

- Analysis the different Logic cell architecture and interconnects.
- Understand the function of simulation and testing of ASIC design.
- Analysis about different programmable ASIC design software.
- Identification of new developments in SOC and low power design.

UNIT I INTRODUCTION TO ASICS, CMOS LOGIC, ASIC LIBRARY DESIGN 9

Types of ASICs - Design flow – CMOS transistors- CMOS Design rules –Combinational logic Cell Sequential logic cell - Transistor as Resistors - Transistor parasitic capacitance – Logical effort -Library cell design – Library architecture- gate array design- standard cell design-data path cell design.

UNIT II PROGRAMMABLE ASICS, PROGRAMMABLE ASIC LOGIC CELLS AND PROGRAMMABLE ASIC I/O CELLS 9

Anti fuse - Static RAM - EPROM and EEPROM technology - PREP benchmarks - Actel ACT - Xilinx LCA –Altera FLEX - Altera MAX- DC & AC inputs and outputs – clock input-power input -Xilinx I/O blocks.

UNIT III LOGIC SYNTHESIS, SIMULATION AND TESTING 9

Design systems - Logic Synthesis - Half gate ASIC -Schematic entry - ASIC design flow interfaces- Low level design language -PLA tools -. Verilog and logic synthesis -VHDL and logic synthesis -types of simulation –Built-in-self test-boundary scan test - fault simulation - automatic test pattern generation.

UNIT IV ASIC CONSTRUCTION 9

Physical design- CAD tools- system partitioning- estimating ASIC size- power dissipation- FPGA partitioning- partitioning methods

UNIT V SOC DESIGN 9

Frontend design, Backend design-Design Methodologies – Processes and Flows - Embedded software development for SOC –Fabrication techniques for SOC- SoC Players- Techniques for SOC Testing – Configurable SOC – Hardware / Software code sign –MpSoc terminology. Case studies: Digital camera, Bluetooth radio / modem.

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. FarzadNekoogar and FaranakNekoogar, From ASICs to SOCs: A Practical Approach,Prentice Hall PTR, 2003.
2. Michael John Sebastian Smith, " Application-Specific Integrated Circuits" Addison Wesley Professional, 1997
3. Norman Einspruch, "Application Specific Integrated Circuits, Addison -Wesley Longman Inc., 2012.
4. Parag.K.Lala, Digital System Design using Programmable Logic Devices, BSP, 2008
5. R. Rajsuman, System-on-a-Chip Design and Test. Santa Clara, CA: Artech House Publishers,2003.

COURSE OUTCOMES		PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES	
CO's	Statement's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO-1	Analysis the different types of ASICs design	3	3	3	2	2						2	2	2	
CO-2	Analysis the different Logic cell architecture and interconnects	3		2	2	2	2					2	2		2
CO-3	Understand the function of simulation and testing of ASIC design	3	2	3	2	2						1	2	2	
CO-4	Analysis about different programmable ASIC design software	3	2	2	2	3						2	2	2	2
CO-5	Identification of new developments in SOC and low power design	3	2	3	2	2							2	2	

ELECTIVE-II

525201 AUTOMOTIVE ELECTRONICS

L	T	P	C
3	0	0	3

COURSE OBJECTIVE:

To study the fundamentals of automotive electronics and the starting, charging and ignition systems

COURSE OUTCOMES:

Having successfully completed this course, the students should be able to:

- Study different the fundamentals of automotive systems.
- Learn the concept of starting, charging.
- Study about the function of magnetic coil and ignition system.
- Study the batteries, lighting system
- Learn the concept of , sensors and actuators

UNIT I FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS 9

Automobile Systems –Engine – Engine control- Ignition system –Ignition timing- Drive train – Suspension – Brakes – Steering system. Control systems- Proportional controller- Proportional Integral controller - Proportional Integral differential controller - Closed-Loop Limit-Cycle Control, Electronic Dashboard instruments -On-board diagnostic systems

UNIT II STARTING AND CHARGING SYSTEMS 9

Requirements of Starter Motor, Starter Motor types, Construction and characteristics, Starter drive mechanisms, Starter Switches and Solenoids, Charging system components, Generators and Alternators, Types, Construction and Characteristics. Voltage and Current Regulation, Cut –out relays and regulators, Charging circuits for D.C. Generator, A.C. Single Phase and Three – Phase Alternators.

UNIT III IGNITION SYSTEM 9

Battery Coil and Magneto–Ignition System, Circuit details and Components of Battery Coil and Magneto–Ignition System, Centrifugal and Vacuum Advance Mechanisms, Spark Plugs, Constructional details and Types. Electronically–Assisted and Full Electronic Ignition System, Non–Contact–type Ignition Triggering devices, Capacitive Discharge Ignition Distributor–less Ignition System, Digital Ignition System.

UNIT IV BATTERIES AND LIGHTING SYSTEMS 9

Principle and construction of Lead Acid Battery, Characteristics of Battery, Battery Rating, Capacity and Efficiency, Various Tests on Battery, Battery–Charging Techniques-Maintenance of batteries. Lighting system: insulated and earth return system, details of head light and side light, LED lighting system, head light dazzling and preventive methods

UNIT V SENSORS AND ACTUATORS 9

Sensors – Oxygen (O2/EGO) Sensors, Throttle Position Sensor (TPS), Engine Crankshaft Angular Position (CKP) Sensor, Magnetic Reluctance Position Sensor, Engine Speed Sensor, Ignition Timing Sensor, Hall effect Position Sensor, Shielded Field Sensor, Engine Coolant Temperature (ECT) Sensor, Intake Air Temperature (IAT) Sensor, Knock Sensor, Airflow rat e sensor, Throttle angle sensor. Actuators– Fuel Metering Actuator, Fuel Injector, Ignition Actuator.

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. A W Judge, Modern Electrical Equipment of Automobiles, Chapman & Hall, 2004
2. A.P.Young, L.Griffiths Automotive Electrical Equipment, ELBS & New Press, 2004
3. P.L.Kholi, Automotive Electrical Equipment, Tata McGraw-Hill, 2004
4. Robert Bosch Automotive Hand Book, SAE, 2018.
5. Trevor Mellard, "Automotive Electronic Systems" oxford publication, 3rd edition, 2012.

COURSE OUTCOMES		PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES	
CO's	Statement's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2

CO-1	study different the fundamentals of automotive systems	3	3	3	2	2							2	2	2
CO-2	learn the concept of starting, charging	3	3	2	2	3					2		2	2	2
CO-3	study about the function of magnetic coil and ignition system	3	3	2	2	2					2		2	2	
CO-4	study the batteries, lighting system	3	3	3	2	2					1		2	2	
CO-5	learn the concept of , sensors and actuators	3	3	3	3		2				2		2		2

525208 DIGITAL INSTRUMENTATION L T P C

3 0 0 3

COURSE OBJECTIVE:

To introduce study about the principals of instrumentation and controllers

COURSE OUTCOMES:

Having successfully completed this course, the students should be able to:

- learn about the A/D and D/A conversion instruments
- Get knowledge of various time and measurement devices
- Know about application of the electrical instruments
- understand about the digital instruments
- Discuss IEEE standard mechanism

UNIT I INTRODUCTION 9

D/A and A/D converters – D/A converters – Binary weighted and R-2R ladder type – D/A accuracy and resolution – A/D converters counter ramp, successive approximation, Simultaneous, dual – slope A/D converters – A/D accuracy and resolution – sample and hold circuit.

UNIT II FREQUENCY MEASUREMENT 9

Frequency and time measurement – Frequency counter – Decimal counting and display – multiplexing displays – Time base circuitry – counting input events – Frequency ratio measurement – Period measurement – Time interval and pulse width measurement – Phase measurement – Scaling – Accuracy – Errors – Counting errors.

UNIT III ELECTRICAL INSTRUMENTS 9

Digital voltmeters and multimeters – Staircase – ramp and dual slope DVM – Successive approximation. DVM – sources of error – quantizing error – Automation in Voltmeters – Automatic polarity indication, ranging and zeroing – Fully automatic instrument – Digital multimeters – Current to voltage and resistance to voltage conversion – AC and RMS measurements – Q – measurement.

UNIT IV SPECTRUM AND DIGITAL INSTRUMENTS 9

Other digital instruments – Digital storage oscilloscope – Principles and instrumentation – Spectrum analyzer – Digital recorders and plotters.

UNIT V MICROCOMPUTERS AND CONTROLLERS 9

Microcomputer based instruments – microcomputer compatible D/A and A/D converters – Handshake input and output – Interfacing keyboard and display – common bus and data communication standards – Parallel bus standard, the HPIB OR IEEE 488 – Serial bus standard – RS 232C and Modems – Interfacing CRT display – CRT character generator – CRT controllers.

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. A.J. Bouwens – Digital Instrumentation – McGraw Hill. 2010.
2. A.D. Helfrick and W.D. Cooper – Modern electronic instrumentation and measurement techniques – Prentice Hall India. 2012.
3. D.V. Hall – Microprocessors and Digital Systems – McGraw Hill. 2009.
4. O'reaily, "digital instrumentation" 4th edition, Tata McGraw- HILL Edition, 2009.
5. U.A.Bakshi, A.V.Bakshi, "Electronic Instrumentation" ,Technical publications, Pune, 2014.
6. Walt Boyes, "modern application for the digital instrumentation" , 4th edition, 2009, ISBN**:** 9780750683081

COURSE OUTCOMES		PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES	
CO's	Statement's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO-1	learn about the A/D and D/A conversion instrument	3	3	2	2	2	2						2	2	2
CO-2	Get knowledge of various time and measurement devices	2	2	3	2	3	2						2	2	2
CO-3	Know about application of the electrical instruments	3	2	3	2	3	2			2			2		2
CO-4	understand about the digital instruments	3	2	3	2	2				2				2	2

CO-5	Discuss IEEE standard mechanism	3	2	3	2	3							2	2	2

525209 SMART SYSTEM DESIGN L T P C
3 0 0 3

COURSE OBJECTIVE:

To understand about the smart system technologies and its role in real time applications and familiarize the design and development of embedded system based system design

COURSE OUTCOMES:

- Understand about the function of the embedded system
- Understand about the embedded application and mobile embedded system.
- Understand about the concept of Raspberry pi and some essential components.
- Understand the concept of smart embedded appliances and integrated management system.
- Understand the embedded components of robotics and controllers.

UNIT I INTRODUCTION 9

Overview of smart system design and requirements- Hardware and software selection & co-design- Communications-smart sensors and actuators-Open-source resources for embedded system- android 42 for embedded system - Embedded system for Ecommerce- Embedded system for Smart card design and development –Recent trends.

UNIT II MOBILE EMBEDDED SYSTEM 9

Design requirements-Hardware platform- OS and Software development platform- Mobile Apps development- Applications: heart beat monitoring, blood pressure monitoring, mobile banking and appliances control.

UNIT III HOME AUTOMATION 9

Home Automation System Architecture-Essential Components- Linux and Raspberry Pi – design and real time implementation.

UNIT IV SMART APPLIANCES AND ENERGY MANAGEMENT 9

Overview- functional requirements-Embedded and Integrated Platforms for Energy Management- Energy Measurement Techniques for Smart Metering-Smart Embedded Appliances Networks – Security Considerations.

UNIT V EMBEDDED SYSTEMS AND ROBOTICS 9

Robots and Controllers-components - Aerial Robotics -Mobile Robot Design- Three-Servo Ant Robot- Autonomous Hexacopter System.

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. Anna Ha´c, “Wireless Sensor Network Designs”, John Wiley & Sons Ltd, 2003.

2. C.K.Toh, " AdHoc mobile wireless networks", Prentice Hall, Inc, 2002.
3. Grimm, Christoph, Neumann, Peter, Mahlknech and Stefan, Embedded Systems for Smart Appliances and Energy Management , Springer 2013.
4. KazemSohraby, Daniel Minoli and TaiebZnati, " Wireless Sensor Networks Technology, Protocols, and Applications", John Wiley & Sons, 2007.
5. Karim Yaghmour, Embedded Android , O'Reilly, 2013.

COURSE OUTCOMES		PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES	
CO's	Statement's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO-1	understand about the function of the embedded system	3	2		2						2		2		2
CO-2	understand the embedded application and mobile embedded system	3	2		2						2		2		2
CO-3	understand about the concept of Raspberry pi and some essential components	2	2		2	2	2				2		2	2	
CO-4	understand the concept of smart embedded appliances and integrated management system	3	2		2						2			2	2
CO-5	understand the embedded components of robotics and controllers	2	2			2						2		2	2

525210 **NETWORKS ON CHIP** **L T P C**
3 0 0 3

COURSE OBJECTIVE:

- To introduce the concept of NOC.
- To study the architectures and protocols of NOC.
- To identify the types of fault and study the testing methods for fault rectification.
- To learn DimDE router for 3D NOC.

COURSE OUTCOMES:

- understand the concept of Network on Chip.
- understand the architecture and design of NoC.
- evaluate the routing algorithm for 2D and 3D Networks.
- design the function of test and fault tolerance of NOC
- analysis about the three- dimensional network architecture.

UNIT I INTRODUCTION TO NOC 9

Introduction to NoC – OSI layer rules in NoC - Interconnection Networks in Network-on-ChipNetwork Topologies - Switching Techniques - Routing Strategies - Flow Control Protocol Quality-of-Service Support.

UNIT II ARCHITECTURE DESIGN 9

Baseline NoC Architecture – MICRO-Architecture Exploration ViChaR: A Dynamic Virtual Channel Regulator for NoC Routers- RoCo: The Row-Column Decoupled Router Switching Techniques and Packet Format - Asynchronous FIFO Design -GALS Style of Communication - Wormhole Router Architecture Design - VC Router Architecture Design - Adaptive Router Architecture Design.

UNIT III ROUTING ALGORITHM 9

Packet routing-Qos, congestion control and flow control – router design – network link design – Efficient and Deadlock-Free Tree-Based Multicast Routing Methods - Path-Based Multicast Routing for 2D and 3D Mesh Networks- Fault-Tolerant Routing Algorithms - Reliable and Adaptive Routing Algorithms

UNIT IV TEST AND FAULT TOLERANCE OF NOC 9

Design-Security in Networks-on-Chips-Formal Verification of Communications in Networks-on ChipsTest and Fault Tolerance for Networks-on-Chip Infrastructures-Monitoring Services for Networks-onChips.

UNIT V THREE-DIMENSIONAL INTEGRATION OF NETWORK-ON-CHIP 9

Three-Dimensional Networks-on-Chips Architectures. – A Novel Dimensionally-Decomposed Router for On-Chip Communication in 3D Architectures - Resource Allocation for QoS On-Chip Communication – Networks-on-Chip Protocols-On-Chip Processor Traffic Modeling for Networks-onChip

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. ChrysostomosNicopoulos, Vijaykrishnan Narayanan, Chita R.Das" Networks-on - Chip " Architectures Holistic Design Exploration", Springer. 2010.
2. Fayezgebali, Haythamelmiligi, HqhahedWatheq E1-Kharashi "Networks-on-Chips theory and practice CRC press, 2014.
3. Konstantinos Tatas and Kostas Siozios "Designing 2D and 3D Network-on-Chip Architectures" 2013

4. Palesi, Maurizio, Daneshtalab, Masoud "Routing Algorithms in Networks-on-Chip" 2014
5. SantanuKundu, SantanuChattopadhyay "Network-on-Chip: The Next Generation of System on-Chip Integration",2014.

COURSE OUTCOMES		PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES	
CO's	Statement's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO-1	understand the concept of Network on Chip	3	2	2	2	2	2			2	2		2		2
CO-2	understand the architecture and design of NoC	3	2	3	2	2					2		2	2	2
CO-3	evaluate the routing algorithm for 2D and 3D Networks	3	2	3	2	2							2	2	
CO-4	design the function of test and fault tolerance of NOC	3	2	3	2	2							2		2
CO-5	analysis about the three-dimensional network architecture	3	2	3	2	2							2		2

525211 NANO ELECTRONICS L T P C
3 0 0 3

COURSE OBJECTIVE:

To understand the basic concepts, how transistor as NANO device, various forms of NANO Devices, NANO Sensors, properties of NANO electronics with its applications.

COURSE OUTCOMES:

Having successfully completed this course, the students should be able to:

- Understand of NANO electronics fabrication methods.
- Analysis NANO electronics measurement techniques.
- Design the logic devices of silicon FET, MOSFET and its applications.
- Simulate and design the NANO device
- Learn about the logic devices and its applications.

UNIT I INTRODUCTION TO NANOELECTRONICS 9

Definition of a nano system -Microelectronics towards biomolecule electronics-Particles and waves- Wave-particle duality-Wave mechanics- Schrödinger wave equation- Wave mechanics of particles: - Atoms andatomic orbitals- Materials for nanoelectronics- Semiconductors- Crystal lattices: Bonding in crystals- Electron energy bands- Semiconductor heterostructures.

UNIT II ELECTRONIC AND PHOTONIC MOLECULAR MATERIALS 9

Preparation – Electroluminescent Organic materials - Laser Diodes - Quantum well lasers:- Quantum cascade lasers- Cascade surface-emitting photonic crystal laser- Quantum dot lasers - Quantum wire lasers:- White LEDs - LEDs based on nanowires - LEDs based on nanotubes - LEDs based on nanorods - High Efficiency Materials for OLEDs- High Efficiency Materials for OLEDs - Quantum well infrared photo detectors.

UNIT III THERMAL SENSORS 9

Thermal energy sensors -temperature sensors, heat sensors - Electromagnetic sensors - electrical resistance sensors, electrical current sensors, electrical voltage sensors, electrical power sensors, magnetism sensors - Mechanical sensors - pressure sensors, gas and liquid flow sensors, position sensors - Chemical sensors - Optical and radiation sensors.

UNIT IV GAS SENSOR AND BIO SENSORS 9

measurement of gas sensing property, Discussion of sensors for various gases, Gas sensors based on semiconductor devices, Principles - DNA based biosensors – Protein based biosensors – materials for biosensor applications

UNIT V LOGIC DEVICES AND APPLICATIONS 9

Logic Devices-Silicon MOSFETs-Ferroelectric Field Effect Transistors-Quantum Transport Devices Based on Resonant Tunneling-Single-Electron Devices for Logic Applications-Superconductor Digital Electronics-Quantum Computing Using Superconductors-Carbon Nanotubes for Data Processing-Molecular Electronics

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. K.E. Drexler, “Nano systems”, Wiley, 2009
2. Vladimir V. Mitin, Viatcheslav A. Kochelap, Michael A. Stroscio, “Introduction to Nanoelectronics: Science, Nanotechnology, Engineering, and Applications”, Cambridge University Press 2011
3. W. Ranier, “Nano Electronics and Information Technology”, John Wiley & Sons 2012
4. Wilson M., Kannangara K., Smith G., Simmons M., and Raguse B., “Nanotechnology: basic science and emerging technologies”, Overseas Press, 2005.

COURSE OUTCOMES		PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES	
CO's	Statement's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO-1	understand the NANO electronics fabrication methods	3	2	1	1	2		2					2	2	2
CO-2	To analysis the NANO electronics measurement techniques	3	2	2	2			2				2	2		2
CO-3	To design the logic devices of silicon FET, MOSFET and its applications	3	3	2	2	2		2			2	2	2	2	
CO-4	Simulate and design the NANO device	3	2		2			2					2	2	
CO-5	learn about the logic devices and its applications	3	2	2	2						2			2	2

525230 ROBOTICS AND CONTROL L T P C

3 0 0 3

COURSE OBJECTIVE:

- To understand the basic concepts associated with the design and functioning and applications of Robots and robot programming

COURSE OUTCOMES:

Upon the successful completion of the course, the students should be able to

- Define the fundamentals of robot
- Describe the parts and drive systems used in robotics.
- Identify different sensors and image processing technique in robots
- Know the kinematics of robots, robots language and its programming.
- Explain the importance of robots in industries and their safety considerations

UNIT I FUNDAMENTALS OF ROBOT 9

Robot – Definition – Robot Anatomy – Co-ordinate Systems, Work Envelope, types and classification – Specifications – Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load – Robot Parts and Functions – Need for Robots – Different Applications.

UNIT II ROBOT DRIVE SYSTEMS AND END EFFECTORS 9

Pneumatic Drives – Hydraulic Drives – Mechanical Drives – Electrical Drives – D.C. Servo Motors, Stepper Motor, A.C. Servo Motors – Salient Features, Applications and Comparison of Drives End Effectors – Grippers – Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic Grippers,

Vacuum Grippers – Two Fingered and Three Fingered Grippers– Internal Grippers and External Grippers– Selection and Design Considerations

UNIT III SENSORS AND MACHINE VISION 9

Requirements of a sensor – Position of sensors (Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, Pneumatic Position Sensors), Range Sensors (Triangulation Principle, Structured, Lighting Approach, Time of Flight Range Finders, Laser Range Meters), Proximity Sensors (Inductive, Hall Effect, Capacitive, Ultrasonic and Optical Proximity Sensors), Touch Sensors, (Binary Sensors, Analog Sensors), Wrist Sensors, Compliance Sensors, Slip Sensors– Camera, Frame Grabber, Sensing and Digitizing Image Data – Signal Conversion, Image Storage, Lighting Techniques– Image Processing and Analysis – Data Reduction–Edge detection, Segmentation Feature Extraction and Object Recognition – Algorithms – Inspection, Identification, Visual Serving and Navigation.

UNIT IV ROBOT KINEMATICS AND ROBOT PROGRAMMING 9

Forward Kinematics, Inverse Kinematics and Differences– Forward Kinematics andReverse Kinematics of Manipulators with Two, Three Degrees of Freedom (In 2 Dimensional), Four Degrees of Freedom (In 3 Dimensional) – Deviations and Problems– TeachPendant Programming, Lead through programming, Robot programming Languages – VAL Programming – Motion Commands, Sensor Commands, End effector commands, and Simple programs

UNIT V IMPLEMENTATION AND ROBOT ECONOMICS 9

RGV, AGV–Implementation of Robots inIndustries –Various Steps–Safety Considerations for Robot Operations– Economic Analysis of Robots – Pay back Method, EUAC Method, Rate of Return Method.

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. Mikell P, Groover (Author). , "Industrial Robotics – Technology,Programming and Applications", McGraw-Hill, (2008)
2. Saeed Niku ., "Introduction on Robotics", McGraw-Hill Book Co., (2010)
3. Deb,S.R., "Robotics Technology and Flexible Automation", Tata McGraw-Hill Publication, 8th edition, (2012)
4. John J. Craig, "introduction to robotics: Mechanics and control ", McGraw-Hill Book Co., (2018)

COURSE OUTCOMES		PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES	
CO's	Statement's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO-1	Define the fundamentals of robot	3	2	2	2	2		2				1	2	2	
CO-2	Describe the parts and drive systems used in robotics	3	2	2	2		1	2				1	2	2	
CO-3	Identify different sensors and image processing	3	2	2			1	2				1	1	2	

	technique in robots														
CO-4	Know the kinematics of robots, robots language and its programming	3		2	2			1				1	2		
CO-5	Explain the importance of robots in industries and their safety considerations	3	2	2	2		2	1				1	2	2	2

ELECTIVE III

525212 EMBEDDED CONTROL SYSTEMS

L	T	P	C
3	0	0	3

COURSE OBJECTIVE:

To aware the students about the real need of embedded system.

COURSE OUTCOMES:

The Students will be able to

- Apply different types of inputs and outputs for an embedded system work.
- Elaborate the basic operation of a digital to analog converter &analog to digital converter.
- Investigate applications of A/D and D/A conversion circuits.
- Apply the asynchronous serial communication in real time.
- Apply the various methods of embedded c programming.

UNIT I INTRODUCTION **9**

Controlling the hardware with software – Data lines – Address lines - Ports – Schematic representation – Bit masking – Programmable peripheral interface – Switch input detection – 74 LS 244.

UNIT II INPUT-OUTPUT DEVICES **9**

Keyboard basics – Keyboard scanning algorithm – Multiplexed LED displays – Character LCD modules – LCD module display – Configuration – Time-of-day clock – Timer manager - Interrupts - Interrupt service routines – IRQ- ISR - Interrupt vector or dispatch table multiple-point - Interrupt-driven pulse width modulation.

UNIT III D/A AND A/D CONVERSION **9**

R2R ladder - Resistor network analysis - Port offsets - Triangle waves analog vs. digital values - ADC0809 –Auto port detect - Recording and playing back voice - Capturing analog

information in the timer interrupt service routine - Automatic, multiple channel analog to digital data acquisition.

UNIT IV ASYNCHRONOUS SERIAL COMMUNICATION 9

Asynchronous serial communication – RS-232 – RS-485 – Sending and receiving data – Serial ports on PC –Low-level PC serial I/O module - Buffered serial I/O.

UNIT V EMBEDDED C PROGRAMMING 9

Multiple closure problems – Basic outputs with PPI – Controlling motors – Bi-directional control of motors – H bridge – Telephonic systems – Stepper control – Inventory control systems.

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. Alexandura forri, "Embedded control system design: A Model Based Approach", 4th edition, 2012.
2. Ball S.R. "Embedded microprocessor Systems – Real World Design", Prentice Hall, 5th Edition, 2009.
3. Daniel W. Lewis, —Fundamentals of Embedded Software where C and Assembly meet||, Prentice Hall of India, 2nd Edition, 2002
4. Herma K, —Real Time Systems – Design for distributed Embedded Applications||, Kluwer Academic, 4th Edition, 2010.
5. Jean J. Labrosse, —Embedded Systems Building Blocks: Complete and Ready-To-Use Modules in C, CMP, 2nd Edition, 2009
6. Tim Wescott, "Applied Control Theory for Embedded Systems" , 4th edition, Elsevier, 2013.

COURSE OUTCOMES		PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES	
CO's	Statement's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO-1	Apply different types of inputs and outputs for an embedded system work	3	2	3	2	2	2						2	2	2
CO-2	Elaborate the basic operation of a digital to analog converter &analog to digital converter	3	2	3	2	3	2						2		2
CO-3	Investigate applications of A/D and D/A conversion circuits	3	3	3	2	2	2						2	2	

CO-4	Apply the asynchronous serial communication in real time	2	3	2	2	2	3						2	2	2
CO-5	Apply the various methods of embedded c programming	3	2	3	2	2							2	2	

525213 EMBEDDED PRODUCT DEVELOPMENT L T P C

3 0 0 3

COURSE OBJECTIVE :

The course aims at providing the basic concepts of product design, product features and its architecture so that student can have a basic knowledge in the common features a product has and how to incorporate them suitably in product.

COURSE OUTCOMES:

- Understand the integration of customer requirements in product design
- Apply structural approach to concept generation, creativity, selection and testing
- Understand various aspects of design such as industrial design.
- Understand the design of Consumer specific product , its Reverse Engineering manufacture ,economic analysis and product architecture
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

UNIT I CONCEPTS OF PRODUCT DEVELOPMENT 9

Need for PD- Generic product Development Process Phases- Product Development Process Flows- Product Development organization structures-Strategic importance of Product Planning process – Product Specifications-Target Specifications-Plan and establish product specifications - integration of customer, designer, material supplier and process planner, Competitor and customer - Understanding customer and behavior analysis. Concept Generation, Five Step Method-Basics of Concept selection- Creative thinking –creativity and problem solving- creative thinking methods- generating design concepts-systematic methods for designing –functional decomposition – physical decomposition

UNIT II INTRODUCTION TO APPROACHES IN PRODUCT DEVELOPMENT 9

Product development management - establishing the architecture - creation - Product Architecture changes - variety – component standardization , clustering -geometric layout development - Fundamental and incidental interactions - related system level design issues - secondary systems - architecture of the chunks - creating detailed interface specifications- Portfolio Architecture- competitive benchmarking- Approach for the benchmarking process- Design for manufacturing - Industrial Design-Robust Design – Prototype basics - Principles of prototyping - Planning for prototypes- Economic & Cost Analysis -Testing Methodologies- Product Branding

UNIT III INDUSTRIAL DESIGN STRATEGIES 9

Role of Integrating CAE, CAD, CAM tools for Simulating product performance and manufacturing processes electronically- Basics on reverse engineering – Reverse engineering strategies – Finding reusable software components – Recycling real-time embedded software based approach and its logical basics- Incorporating reverse engineering for consumer product development –case study on DeskJet Printer.

UNIT IV ELECTRONIC PRODUCT DEVELOPMENT STAGES 9

Product Development Stages-Embedded product modeling- Linear, Iterative, Prototyping, Spiral - Selection of Sensor, Voltage Supply, Power supply protection, Grounding and noise elimination methods, Thermal protection with heat management – PCB design steps – Software design and testing method – documentation.

UNIT V EMBEDDED PRODUCTS DESIGN 9

Creating general Embedded System Architecture(with Case study example: Mobile Phone / DeskJet Printer./ Robonoid as a product) -Architectural Structures- Criteria in selection of Hardware & Software Components, processors, input/output interfaces & connectors, ADC System ,Memory ,choosing Bus Communication Standards, Criteria in selection of Embedded OS/Device Drivers, Need for Developing with IDE, Translation & Debugging Tools & Application Software, Performance Testing, Costing, Benchmarking ,Documentation

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. Anita Goyal, Karl T Ulrich, Steven D Eppinger, "Product Design and Development", McGraw –Hill International Edns.4th edition, 2004/ Tata McGraw Education, ISBN-10-007-14679-9
2. Clive L.Dym, Patrick Little, "Engineering Design: A Project-based Introduction", 4th Edition, John Wiley & Sons, 2013, ISBN 978-0-470-22596-7
3. George E.Dieter, Linda C.Schmidt, "Engineering Design", McGraw-Hill International Edition,5th Edition, 2012, ISBN 978-007-127189-9 8.
4. KEVIN OTTO & KRISTIN WOOD, "Product Design and Development", 5th Edition, 2016,
5. R.G. Kaduskar and V.B. Baru, " Electronic Product Design", 5th edition, Wiley, 2014
6. Rajkamal, "Embedded system-Architecture, Programming Design", 2nd edition TMH, 2011.
7. Stephen Armstrong, "Engineering and Product Development Management" 4th edition The Holistic Approach, CAMBRIDGE UNIVERSITY PRESS (CUP), 2014

COURSE OUTCOMES		PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES	
CO's	Statement's	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2

CO-1	Understand the integration of customer requirements in product design	3	2	3	2	2	2						2	2	2
CO-2	Apply structural approach to concept generation, creativity, selection and testing	3	2	3	2	3	2						2		2
CO-3	Understand various aspects of design such as industrial design	3	3	3	2	2	2						2	2	
CO-4	Understand the design of Consumer specific product , its Reverse Engineering manufacture ,economic analysis and product architecture	2	3	2	2	2	3						2	2	2
CO-5	To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills	3	2	3	2	2							2	2	

525214 AUTOMOTIVE EMBEDDED SYSTEM L T P C

3 0 0 3

COURSE OBJECTIVE :

To support the automotive parts industry by focusing on the electronics control system and relevant software. To constantly strengthen our human resources

COURSE OUTCOMES:

- Design and develop automotive embedded systems.
- Analyze various embedded products used in automotive industry.
- Evaluate the opportunities involving technology, a product or a service required for developing a startup idea used for automotive applications
- interface devices and build a complete system
- design the automotive embedded system

UNIT I ELECTRONICS IN THE AUTOMOBILE 9

Introduction- Body and convenience electronics: vehicle power supply controllers and lighting modules, door control modules, Safety electronics: active safety systems: ABS, ASR,

ESP passive safety systems: Restraint systems and their associated sensors in an automobile. Powertrain Electronics: Gasoline engine management, Infotainment electronics: Dashboard/instrument cluster, car audio, telematic systems navigation systems multimedia systems cross application technologies. 42V vehicle power supply system

UNIT II DRIVE BY WIRE 9

Challenges and opportunities of X-by-wire: system & design requirements, steer-by-wire, brake-by-wire, suspension-bypwire, gas-by-wire , power-by-wire, shift by wire. L T P/ S SW/F W TOTAL CREDIT UNITS 3 1 0 0 4 Future of Automotive Electronics

UNIT III HARDWARE MODULES 9

Basic sensor arrangement, types of sensors such as- oxygen sensors, crank angle position sensors- Fuel metering vehicle speed sensors and destination sensors, Attitude sensor, Flow sensor, exhaust temperature, air mass flow sensors. Throttle position sensor, solenoids, stepper motors, relays

UNIT IV ELECTRONIC IGNITION SYSTEMS 9

Electronic ignition systems. Types of solid state ignition systems and their principle of operation Digital engine control system. Open loop and closed loop control system, Engine cranking and warm up control. Acceleration enrichment. Deceleration learning and ideal speed control Distributor less ignition – Integrated engine control system, Exhaust emission control engineering

UNIT V AUTOMOTIVE EMBEDDED SYSTEM 9

Automotive Embedded systems. PIC, Freescale microcontroller based system. Recent advances like GLS, GPSS, GMS. Multiprocessor communication using CAN bus. Case study-cruise control of car. Artificial Intelligence and engine management.

L=45 TOTAL: 45 PERIODS

REFERENCES:

1.“Embedded System Design: A unified Hardware / Software Introduction” – Frank Vahid and Tony Givargis, Wiley India Publishers,2010

2.“A Practical Introduction to Hardware/Software Co-Design”- Patrick R. Schaumont, Springer Publishers.2014

COURSE OUTCOMES		PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES	
CO’s	Statement’s	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO-1	Design and develop automotive embedded systems	3	3	3	2	2							2	2	2
CO-2	Analyze various embedded products used in automotive industry	3	3	2	2	3					2		2	2	2

CO-3	Evaluate the opportunities involving technology, a product or a service required for developing a startup idea used for automotive application	3	3	2	2	2					2		2	2	
CO-4	interface devices and build a complete system	3	3	3	2	2					1		2	2	
CO-5	design the automotive embedded system	3	3	3	3		2				2		2		2

525215 EMBEDDED NETWORKING AND AUTOMATION OF ELECTRICAL SYSTEM

L	T	P	C
3	0	0	3

COURSE OBJECTIVES :

To expose the students to the fundamentals of wireless embedded networking

- To expose the students to the fundamentals of wired embedded networking techniques.
- To study on design of automation in instrumentation
- To introduce design of Programmable measurement& control of electrical Devices & grid
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired

COURSE OUTCOMES:

- provide a clear understanding on the basic concepts, Building Blocks of Embedded System
- understand the fundamentals of Embedded processor Modeling , Bus Communication in processors, Input/output interfacing
- introduce on processor scheduling algorithms , Basics of Real time operating system
- discuss on aspects required in developing a new embedded processor, different Phases & Modeling of embedded system
- involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

UNIT I INTRODUCTION TO CAN **9**

The CAN bus - General - Concepts of bus access and arbitration - Error processing and management - From concept to reality -Patents, licenses and certification – CAN protocol: „ISO

11898-1"-Content of the different ISO/OSI layers of the CAN bus-Compatibility of CAN 2.0A and CAN 2.0B.

UNIT II COMMUNICATION FOR LARGE ELECTRICAL SYSTEM AUTOMATION 9

Data Acquisition, Monitoring, Communication, Event Processing, and Polling Principles, SCADA system principles – outage management– Decision support application for substation automation, extended control feeder automation, Performance measure and response time, SCADA Data Models, need, sources, interface.

UNIT III WIRELESS EMBEDDED NETWORKING 9

Wireless sensor networks – Introduction – Sensor node architecture – Commercially available sensor nodes -Network Topology –Localization –Time Synchronization - Energy efficient MAC protocols – SMAC –Energy efficient and robust routing – Data Centric routing Applications of sensor networks; Applications - Home Control - Building Automation - Industrial Automation

UNIT IV INDUSTRIAL NETWORKING PROTOCOL 9

LIN – Local Interconnect Network - Basic concept of the LIN 2.0 protocol - Failsafe SBC – Gateways - Managing the application layers - Safe-by-Wire - Safe-byWire Plus - Audio-video buses - I2C Bus - D2B (Domestic digital) bus - MOST (Media oriented systems transport) bus - IEEE 1394 bus or „FireWire"- profi bus.

UNIT V MEASUREMENT AND EMBEDDED CONTROL OF ELECTRICAL APPARATUS 9

Sensor Types & Charecteristics:Sensing Voltage, Current, flux, Torque, Position, Proximity, Force, Data acquisition & Display system- Signal conditioning circuit design- computers/ embedded processor interfacing circuit -design automation and protection of electrical appliances –processor based digital controllers for switching Actuators: Servo motors, Stepper motors, Relays

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. Dominique Paret , "Multiplexed Networks for Embedded Systems- CAN, LIN, Flexray, Safe-by-Wire..." John Wiley & Sons Ltd- 2007.
2. Jan Axelson „Embedded Ethernet and Internet Complete", Penram publications, 2006.
3. Control and automation of electrical power distribution systems, James Northcote-Green, Robert Wilson, CRC, Taylor and Francis, 2017.
4. Krzysztof Iniewski,"Smart Grid, Infrastructure& Networking", TMcGH, 2014.
5. Robert Faludi,"Building Wireless Sensor Networks, O'Reilly, 2013.
6. W.Bolton, Programmable Logic Controllers, 6th Ed,Elseiver,2013.

COURSE OUTCOMES		PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES	
CO's	Statement's	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO-1	provide a clear understanding on the basic concepts, Building Blocks of Embedded System	3	2	3	2	3	2				2		2	2	2
CO-2	understand the fundamentals of Embedded processor Modeling , Bus Communication in processors, Input/output interfacing	3	2	2	2	2					2		2	2	
CO-3	introduce on processor scheduling algorithms , Basics of Real time operating system	3	2	3	2	2							2	2	2
CO-4	discuss on aspects required in developing a new embedded processor, different Phases & Modeling of embedded system	3	2	3	2	2							2	2	
CO-5	involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills	3	2	3	2	2							2	2	2

525216 DISTRIBUTED EMBEDDED COMPUTING

L	T	P	C
3	0	0	3

COURSE OBJECTIVE:

To Study distributed computing and java based networking.

COURSE OUTCOMES:

Having successfully completed this course, the students should be able to:

- Understand network protocol layers and explain the specific role of each
- having knowledge on Java based Networking and distributed computing
- understand the fundamentals of Internet
- Distributed computing to involve Discussions/ Practice/Exercise onto revising.
- Understand the concept of the protocols and automation techniques

UNIT I DISTRIBUTED SYSTEM 9

Introduction- Communication in distribution system-Client/Server Model-Synchronization in distributed system

UNIT II EMBEDDED JAVA 9

Overview of JAVA – Programs- Multithreaded programming- APPLET programming- I/O streaming–RMI- Introduction to Embedded JAVA

UNIT III DISTRIBUTED COMPUTING 9

Definition- Model of distributed computation- Distributed shared memory- Authentication in distributed system

UNIT IV SECURITY IN COMPUTING 9

Security meaning- Threads in networks- Network security control- Firewall- Authentication- E-mail security- Security in web services- Case studies

UNIT V WEB BASED HOME AUTOMATION 9

Components of Distributed Embedded - Protocols & Standards - Hardware/Software selection for Distributed Embedded – case study : Web based Home Automation

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. Andrew S. Tanenbaum, “Distributed operating systems”, Pearson 2013
2. Ajay D Kshemkalyani, MukeshSinghal, “Distributed Computing” – Principles, Algorithm and systems, Cambridge university press 2008
3. Charles P. Pfleeger, “Security in Computing”, Pearson 2009.
4. Dietel and Dietel, JAVA how to program, Prentice Hall, 2004.
5. E Balagurusamy,” Programming with JAVA”, Mc Graw Hill 2013

COURSE OUTCOMES		PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES	
CO’s	Statement’s	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO-1	Understand network protocol layers and explain the specific role of each	3	2	3	2	2					2		2	2	
CO-2	having knowledge on	3	2	2	2	2					2		2	2	2

	Java based Networking and distributed computing														
CO-3	understand the fundamentals of Internet	3	2	3	2						2		2		2
CO-4	Distributed computing to involve Discussions/ Practice/Exercise onto revising	3	2	2	2								2	2	2
CO-5	Understand the concept of the protocols and automation techniques	3	3	2	2	2							2	2	2

525217 EMBEDDED SYSTEMS IN AUTOMOTIVE APPLICATIONS L T P C
3 0 0 3

COURSE OBJECTIVE:

To provide the knowledge about the automotive applications and embedded systems.

COURSE OUTCOMES:

- Independently design and simulate one function of an advanced driving assistance/autonomous driving embedded system, evaluating its robustness from a software and hardware point of view
- Independently analyse and simulate an electronic circuit taking into account parasitic components and dependencies on environmental and working parameters
- Critically evaluate the quality of a program used to drive an automotive embedded system and independently identify weaknesses
- Critically understand the implication of automotive guidelines (MISRA C, ISO 26262) on system design and robustness
- Critically interpret and criticise current automotive embedded systems development processes

UNIT I INTRODUCTION 9

Embedded Systems Definition - Components of embedded systems – Hardware Module - Microprocessor, microcontrollers, on-chip peripherals - Program memory(PM), Data memory(DM), parallel port structures, timer, input capture & output compare units, ADC, PWM.

UNIT II EMBEDDED RTOS 9

Comparison of conventional OS with RTOS. Tasks & task states (Pre-emptive &Non-pre-emptive, scheduler, interrupt – Interrupt latency and context switch latency) – Task, multi-tasking, task synchronization, inter-task communication, shared data problem and its prevention -Features of a typical embedded RTOS (µC/OS-II).

UNIT III INTEGRATED SYSTEMS 9

Introduction to an embedded board, Software module - IDE- Getting Started- Creating new project, creating new files, adding files to project, compile, build, debug and simulation ofa project. Embedded system programming - Uploaders, ISP, ROM emulators, in-circuit emulators. Debug Interfaces - BDM and JTAG.

UNIT IV COMMUNICATION PROTOCOLS 9

Introduction to control networking – Communication protocols in embedded systems – SPI, I2C, USB. Vehicle communication protocols – Introduction to CAN, LIN, FLEXRAY, MOST, KWP2000. AUTOMOTIVE APPLICATIONS: Engine management systems –gasoline/diesel systems, Various sensors used in system – Electronic transmission control vehicle safety system – Electronic control of braking and traction.

UNIT V ADVANCED APPLICATIONS 9

Body electronics – Infotainment systems – Navigation systems –System level tests – Software calibration using engine and vehicle dynamometers – Environmental tests for electronic control unit - Application of Control elements and control methodology in automotive System.

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. Knowles D, "Automotive Electronic and Computer Controlled Lgnition Systems", Prentice Hall Publications, New Jersey, 2009.
2. BOSCH Automotive Handbook, Bentley Publications, Massachusetts Avenue, London, 2010.
3. Denton T , "Automobile Electrical and Electronic Systems", Elsevier Jordan Hill, Oxford, 2010.
4. Joerg Schaeuffele and Thomas Zurawka, "Automotive Software Engineering – Principles, Processes, Methods and Tools", SAE. International Publication, 2005.
5. Nicholas Navit, "Automotive Embedded System Handbook", CRC Press Publications, New Delhi, 2008.
6. Ronald K J, "Automotive Electronics Handbook", McGraw Hill Publications, Columbus, 2009.

COURSE OUTCOMES		PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES	
CO's	Statement's	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO-1	Independently design and simulate one function of an advanced driving assistance/autonomous driving embedded system, evaluating its robustness from a software and	3	2	3	2	3	2				2		2	2	2

	hardware point of view														
CO-2	Independently analyse and simulate an electronic circuit taking into account parasitic components and dependencies on environmental and working parameters	3	2	3	2	2							2	2	2
CO-3	Critically evaluate the quality of a program used to drive an automotive embedded system and independently identify weaknesses	3	2	2	3	2							2	2	
CO-4	Critically understand the implication of automotive guidelines (MISRA C, ISO 26262) on system design and robustness	3	2	3	2	2					2		2	2	2
CO-5	Critically interpret and criticise current automotive embedded systems development processes	3	2	2	2	2	2				2		2	2	

ELECTIVE-IV

525218 INFORMATION THEORY AND CODING

L	T	P	C
3	0	0	3

COURSE OBJECTIVE:

To Study the basic concepts of in formation theory and the performance characteristics

COURSE OUTCOMES:

Having successfully completed this course, the students should be able to:

- Understand the fundamentals of information theory
- Analyse the performance parameters of information theory.
- Expose to students fundamentals in coding and its applications.
- Understand about the function of error control coding
- Understand the concept about the cyclic codes.

UNIT I INFORMATION THEORY **9**

Introduction, Measure of information, Information content of message, Average Information content of symbols in Long Independent sequences ,Average Information content of symbols in Long dependent sequences,

UNIT II SOURCE CODING 9

Source Coding: Source coding theorem, Prefix Codes, Kraft McMillan Inequality property – KMI Encoding of the Source Output, Shannon's Encoding Algorithm Shannon Fano Encoding algorithm, Huffman codes, Extended Huffman coding, Arithmetic Coding, Lempel – Ziv Algorithm

UNIT III INFORMATION CHANNELS 9

Information Channels: Communication Channels. Channel Models, Channel Matrix, Joint probability Matrix, Binary Symmetric Channel, System Entropies, Mutual Information, Channel Capacity, Channel Capacity of :Binary Symmetric Channel, Binary Erasure Channel, Muroga Theorem, Continuous Channels

UNIT IV ERROR CONTROL CODING 9

Error Control Coding: Introduction, Examples of Error control coding, methods of Controlling Errors, Types of Errors, types of Codes, Linear Block Codes: matrix description of Linear Block Codes, Error Detection and Error Correction Capabilities of Linear Block Codes, Single Error Correcting hamming codes, Table lookup Decoding using Standard Array. Binary Cyclic Codes: Algebraic Structure of Cyclic Codes, Encoding using an (n-k) Bit Shift register, Syndrome Calculation, Error Detection and Correction

UNIT V CYCLIC CODES 9

Some Important Cyclic Codes: Golay Codes, BCH Codes Convolution Codes: Convolution Encoder, Time domain approach, Transform domain approach, Code Tree, Trellis and State Diagram, The Viterbi Algorithm)

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. Fred Halsall, "Multimedia Communications, Applications Networks Protocols And Standards", Pearson Education, Asia 2002; Chapters: 3,4,5.
2. Simon Haykin, "Communication Systems", 4th Edition, John Wiley And Sons, 2001.
3. Channel Codes: Classical and Modern by William Ryan, Shu Lin, 2009.
4. Elements of Information Theory by Thomas Cover, Joy Thomas, 2008.
5. Information Theory and Reliable Communication by Robert Gallager, 2010.

COURSE OUTCOMES		PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES	
CO's	Statement's	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2

CO-1	understand the fundamentals of information theory	3	2	2	2	2					2		2		2
CO-2	analyse the performance parameters of information theory	3	2	3	2								2	2	
CO-3	expose to students fundamentals incoding and itsapplications	3	2	2	2						2		2	2	2
CO-4	understand about the function of error control coding	3	2	2	2						2		2		2
CO-5	understand the concept about the cyclic codes	3	2	2	2								2	2	

525219 SOFT COMPUTING AND OPTIMIZATION TECHNIQUES L T P C
3 0 0 3

Aim: To study about different kind of Soft computing frame works with Fuzzy

Course Objectives:

1 To learn various Soft computing frameworks.
2 To familiarizes with the design of various neural networks.
3 To understand the concept of fuzzy logic.
4 To gain insight onto Neuro Fuzzy modeling and control.
5 To gain knowledge in conventional optimization techniques.
6 To understand the various evolutionary optimization techniques.

Course Outcomes: The students will be able to:

CO1: Implement machine learning through Neural networks.
CO2: Develop a Fuzzy expert system.
CO3: Model Neuro Fuzzy system for clustering and classification.
CO4: understand the optimization techniques to solve the real world problems
CO5: Evaluate the optimization for the algorithms

UNIT-I NEURAL NETWORKS 9

Machine Learning using Neural Network, Learning algorithms, Supervised Learning Neural Networks – Feed Forward Networks, Radial Basis Function, Unsupervised Learning Neural Networks – Self Organizing map , Adaptive Resonance Architectures, Hopfield network

UNIT-II FUZZY LOGIC 9

Fuzzy Sets – Operations on Fuzzy Sets – Fuzzy Relations – Membership Functions-Fuzzy Rules and Fuzzy Reasoning – Fuzzy Inference Systems – Fuzzy Expert Systems – Fuzzy Decision Making

UNIT- III NEURO-FUZZY MODELING 9

Adaptive Neuro-Fuzzy Inference Systems – Coactive Neuro-Fuzzy Modeling – Classification and Regression Trees – Data Clustering Algorithms – Rule base Structure Identification – Neuro-Fuzzy Control – Case Studies.

UNIT-IV CONVENTIONAL OPTIMIZATION TECHNIQUES 9

Introduction to optimization techniques, Statement of an optimization problem, classification, Unconstrained optimization-gradient search method-Gradient of a function, steepest gradientconjugate gradient, Newton's Method, Marquardt Method, Constrained optimization –sequential linear programming, Interior penalty function method, external penalty function method.

UNIT-V EVOLUTIONARY OPTIMIZATION TECHNIQUES 9

Genetic algorithm - working principle, Basic operators and Terminologies, Building block hypothesis, Travelling Salesman Problem, Particle swam optimization, Ant colony optimization.

Total : 45 Periods

Reference Books :

1. David E. Goldberg, Genetic Algorithms in Search, Optimization and Machine Learning, Addison wesley, 2009.
2. George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic-Theory and Applications, Prentice Hall, 1995.
3. James A. Freeman and David M. Skapura, Neural Networks Algorithms, Applications, and Programming Techniques, Pearson Edn., 2003.
4. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, Neuro-Fuzzy and Soft Computing, Prentice-Hall of India, 2003.
5. Mitchell Melanie, An Introduction to Genetic Algorithm, Prentice Hall, 1998.
6. Simon Haykins, Neural Networks: A Comprehensive Foundation, Prentice Hall International Inc, 1999.
7. Singiresu S. Rao, Engineering optimization Theory and practice, John Wiley & sons, inc,Fourth Edition, 2009

8. Timothy J.Ross, Fuzzy Logic with Engineering Applications, McGraw-Hill, 1997.
9. Venkata Rao, Vimal J. Savsani, Mechanical Design Optimization Using Advanced Optimization Techniques, springer 2012

COURSE OUTCOMES		PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES	
CO's	Statement's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO-1	Implement machine learning through Neural networks	3	2	2	2	2	2				2		2	2	
CO-2	Develop a Fuzzy expert system.	3	2	2	2								2	2	
CO-3	Model Neuro Fuzzy system for clustering and classification	3	2	2	2						2			2	2
CO-4	understand the optimization techniques to solve the real world problems	3	2	2	2								2	2	2
CO-5	Evaluate the optimization for the algorithms	3	2	3	2								2	2	

525220 CRYPTOGRAPHY AND NETWORK SECURITY

L	T	P	C
3	0	0	3

COURSE OBJECTIVE

To obtain comprehensive knowledge in cryptography and network security

COURSE OUTCOMES:

Having successfully completed this course, the students should be able to:

- Analyze the basic concepts of network protocols.
- Examine the process of cryptographic algorithms.
- Elaborate various public key encryption.
- Demonstrate the basic working principles of digital signature.
- Express various data security techniques

UNIT I INTRODUCTION TO SYMMETRIC-KEY ENCIPHERMENT

Security Goals, Cryptographic Attacks, Services and mechanism, Techniques. Traditional Symmetric-Key Ciphers: Introduction, Substitution Ciphers, Transposition Ciphers. Mathematics of Cryptography: Integer arithmetic, Modular arithmetic, Matrices, Linear Congruence. SLE: Stream and Block Ciphers.

UNIT II MATHEMATICS OF SYMMETRIC-KEY CRYPTOGRAPHY

Algebraic Structures, Introduction to Modern Symmetric-Key Ciphers: Modern Block Ciphers, Modern Stream Ciphers. Data Encryption Standard (DES): Introduction, DES Structure (overview only), Security of DES. SLE: Multiple DES-Conventional Encryption Algorithms.

UNIT III ADVANCED ENCRYPTION STANDARD (AES):

Introduction, Transformations, Key expansion, The AES Ciphers, Examples, Analysis of AES. Encipherment Using Modern Symmetric-Key Ciphers: Use of Modern Block Ciphers (overview only). SLE: Use of Stream Ciphers (overview only)

UNIT IV ASYMMETRIC-KEY CRYPTOGRAPHY

RSA Cryptosystems, Elliptic curve crypto systems . SLE: ElGamal Cryptosystem.

UNIT V MESSAGE INTEGRITY AND MESSAGE AUTHENTICATION

Message Integrity, Random Oracle Model, Message Authentication. Digital Signature: Comparison, Process, Services, Attacks of Digital Signature, Digital Signature Schemes. SLE: Variations and Applications. Entity Authentication: Introduction, Passwords, Challenge

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. Bruce Scheneier, "Applied Cryptography", 20th edition, John Wiley & Sons, 2017.
2. Behrouz A.Forouzan, "Cryptography and Network Security", Special Edition, Tata McGraw Hill, 2007.
3. Charlie Kaufmann, Radia Perlman, Mike Speciner, "Network Security", Second Edition, Prentice Hall, 2008.
4. PRAKASH C. GUPTA, "CRYPTOGRAPHY AND NETWORK SECURITY" PHP Publications, 4th edition, 2014.
5. William Stallings. "Cryptography and Network" Security Principles and Practices, Fourth Edition. By Publisher: Prentice Hall. Pub Date: November 16, 2005.

COURSE OUTCOMES		PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES	
CO's	Statement's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO-1	Analyze the basic concepts of network protocols	3	3	2	1								3	3	
CO-2	Examine the process of cryptographic algorithms	3	3	3	2	2							2	3	2
CO-3	Elaborate various public key encryption	3	3	2	2		3			2			2	3	3

CO-4	Demonstrate the basic working principles of digital signature	3	2	3	2	3				2			2	2	2
CO-5	Express various data security techniques	3	3	2	3	2	2		2	2		2	2	2	

525221 NETWORK ROUTING ALGORITHMS L T P C

3 0 0 3

Objectives: To obtain the network routing algorithms and protocols for modern computer networks

Course outcomes:

CO1: Understand the principles behind the data transfer mechanisms over the conventional network.

CO2: Ability to configure routing algorithms over the routers

CO3: Understand the data traversal through various cross points (routers) in the network

CO4: Design routing algorithms for any conventional networks

CO5: Understand the various types of key routing protocols used in modern computer networks.

UNIT I CIRCUIT SWITCHING NETWORKS 9

AT & T's Dynamic Routing Network, Routing in Telephone Network-Dynamic Non Hierarchical Routing-Trunk Status Map Routing-Real Time Network Routing- Dynamic Alternative Routing-Distributed Adaptive Dynamic Routing-Optimized Dynamic Routing.

UNIT II **PACKET SWITCHING NETWORKS** 9

Distance vector Routing- Link State Routing, Inter domain Routing-Classless Inter domain routing (CIDR)-Interior Gateway routing protocols (IGRP) - Routing Information Protocol (RIP)-Open Shortest Path First(OSPF)- Exterior Gateway Routing Protocol (EGRP) - Border Gateway Protocol (BGP)- Apple Talk Routing and SNA Routing.

UNIT III HIGH SPEED NETWORKS 9

Routing in optical networks-The optical layer-Node Designs- Network design and operation- Optical layer cost tradeoffs- Routing and wavelength assignment- Architectural variations- Routing in ATM networks-ATM address structure- ATM Routing- PNNI protocol- PNNI signaling protocol- Routing in the PLANET network and Deflection Routing.

UNIT IV MOBILE NETWORKS 9

Routing in Cellular Mobile Radio Communication networks-Mobile Network Architecture-Mobility management in cellular systems- Connectionless Data service for cellular systems-Mobility and Routing in Cellular Digital Packet Data (CDPD) network, Packet Radio Routing-DARPA packet radio network- Routing algorithms for small, medium and large sized packet radio networks.

UNIT V MOBILE AD-HOC NETWORKS (MANET) 9

Internet based mobile ad-hoc networking, communication strategies, routing algorithms – Table-driven routing - Destination Sequenced Distance Vector (DSDV)- Source initiated on-demand routing- Dynamic Source Routing (DSR)- Ad-hoc On- demand Distance Vector (AODV)-Hierarchical based routing- Cluster head Gateway Switch Routing (CGSR) and Temporally-Ordered Routing Algorithm (TORA)-Quality of Service.

TOTAL: 45 HOURS

TEXT BOOKS

1. Steen strub.M, “Routing in Communication networks”, Prentice Hall International,

NewYork, 1995.

2. “Internetworking Technologies Handbook”, Fourth Edition, Inc. Cisco Systems, ILSG

Cisco Systems, 2003.

REFERENCES

1. William Stallings, “ISDN and Broadband ISDN with Frame Relay and ATM”, PHI, New

Delhi, 2004.

2. Behrouz A Forouzan, “Data Communications and Networking (3/e)”, TMH, 2004

3. William Stallings, “High Speed Networks TCP/IP and ATM Design Principles”, Prentice Hall International, New York.

4. Mohammad Ilyas, “The Handbook of Ad hoc Wireless Networks” CRC Press, 2002.

5. Vijay K.Garg, “Wireless Network Evolution: 2G to 3G”, Pearson Education, New Delhi, India,2003.

6. Rajiv Ramaswami and Kumar N.Sivarajan, “Optical Networks”,Morgan Kaufmann Publishers.

7. SumitKasera and Pankaj sethi, ”ATM Networks”, Tata McGraw-Hill Publishing Company limited, New Delhi.

8. IEEE Journal on Selected Areas in Communications, “Special issue on Wireless Ad-hoc Networks”, Vol. 17, No.8.

9. Scott. M. Corson, Joseph P. Macker, Gregory H. Cirincione, “IEEE Internet Computing” Vol.3, No. 4.

10. Alder M.Scheideler.Ch. Annual ACM Symposium on “Parallel Algorithms and Architectures”, ACM, NewYork.

COURSE OUTCOMES		**PROGRAMS OUTCOMES**												**PROGRAM SPECIFIC OUTCOMES**	
CO's	**Statement's**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO-1	Understand the principles behind the data transfer mechanisms over the conventional network	3	2	3	2	2							2	2	
CO-2	Ability to configure routing algorithms over the routers	3	2	2	2	2					2		2	2	
CO-3	Understand the data traversal through various cross points (routers) in the network	3	2	2	2								2	2	
CO-4	Design routing algorithms for any conventional networks	3	2	3	2								2	2	

CO-5	Understand the various types of key routing protocols used in modern computer networks	3	2	2	2								2	2	

525222 HARDWARE DESCRIPTION LANGUAGE L T P C
3 0 0 3

COURSE OBJECTIVE:

To introduce the students to design the analog and digital circuits by means HDL languages and Layout tool.

COURSE OUTCOMES:

The Students will be able to

- Compile the HDL code for basic as well as advanced digital integrated circuits.
- Construct the logic modules into FPGA Boards
- Design the test bench for all the digital circuits.
- Design the layouts of Analog IC Blocks using EDA tools.
- Compile and Extract the layouts of Analog IC Blocks using EDA tools.

UNIT I INTRODUCTION TO VERILOG HDL 9

Verilog as HDL, Levels of Design Description, Concurrency, Simulation and Synthesis, Function Verification, Systems tasks, programming language interface, Module, Simulation and Synthesis tools. Language Constructs and Conventions: Introduction, Keywords, Identifiers, White Space Characters, Comments, Numbers, Strings, Logic values, Strengths, Data types, Scalars and Vectors, Parameters, Operators.

UNIT II GATE LEVEL MODELING 9

Introduction, AND Gate Primitive, Module, Structure, Other Gate Primitives, Illustrative Examples, Tristate Gates, Array of Instances of Primitives, Design of Flip – Flops with Gate Primitives, Delays, Strengths and Construction Resolution, Net Types, Design of Basic Circuit. Modeling at Dataflow Level: Introduction, Continuous Assignment Structure, Delays and Continuous Assignments Assignment to Vectors, Operators.

UNIT III BEHAVIORAL MODELING 9

Introduction, Operations and Assignments, Functional Bifurcation, Initial Construct, Always Construct, Assignments with Delays, Wait Construct, Multiple Always Block, Designs at Behavioral Level, Blocking and Non-Blocking Assignments, The Case Statement, Simulation Flow if an if-Else Constructs, Assign- De-Assign Construct, Repeat Construct, for Loop, the Disable Construct, While Loop, For Ever Loop, Parallel Blocks, Force Release, Construct, Event.

UNIT IV SWITCH LEVEL MODELING 9

Basic Transistor Switches, CMOS Switches, Bi Directional Gates, Time Delays with Switch Primitives, Instantiation with Strengths and Delays, Strength Contention with Trireg Nets. System Tasks, Functions and Compiler Directives: Parameters, Path Delays, Module

Parameters, System Tasks and Functions, File Based Tasks and Functions, Computer Directives, Hierarchical Access, User Defined Primitives..

UNIT V SEQUENTIAL CIRCUIT DESCRIPTION: 9

Sequential Models – Feedback Model, Capacitive Model, Implicit Model, Basic Memory Components, Functional Register, Static Machine Coding, Sequential Synthesis. Component Test and Verification: Test Bench-Combinational Circuit Testing, Sequential Circuit Testing, Test Bench Techniques, Design Verification, Assertion Verification

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. Advanced Digital Design with verilog HDL – Michel D.Ciletti, PHI,,2nd edition, 2012.
2. Stephen Brown, Zvonkoc Vranesic, "Fundamentals of Digital Logic with Verilog Design", 4nd Edition, 2014.
3. Sunggu Lee, "Digital Logic Design using Verilog, State Machine & Synthesis for FPGA," Cengage Learning 2010.
4. Stephen Brown, Zvonkoc Vranesic, "Fundamentals of Digital Logic with Verilog Design", 2nd Edition, 2010.
5. T R Padmanabhan, B.Bala Tripura Sundari, Design Through Verilog HDL, 2012.
6. Verilog HDL – Samir Palnitkar, 3rd Edition, Pearson Education, 2013.
7. Zainalabdien Navabi, Verilog Digital System Design, TMH, 4th Edition, 2013.

COURSE OUTCOMES		PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES	
CO's	Statement's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO-1	Compile the HDL code for basic as well as advanced digital integrated circuits	3	2	3	2	3	2				2	2	2	2	2
CO-2	Construct the logic modules into FPGA Boards	3	2	3	2	2							2	2	2
CO-3	Design the test bench for all the digital circuits	3	2	3	2	2							2	2	
CO-4	Design the layouts of Analog IC Blocks using EDA tools	3	2	2	2	2						2	2	2	
CO-5	Compile and Extract the layouts of Analog IC	3	2	2	2	2						2	2	2	2

	Blocks using EDA tools														

525223 ADVANCED COMPUTER ARCHITECTURE AND PARALLEL PROCESSING **L T P C 3 0 0 3**

COURSE OBJECTIVES

- To educate the students to the fundamentals of parallel processing
- To teach the fundamentals of network topologies for multiprocessors
- To introduce different pipeline designs
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills.

OUTCOMES : After the completion of this course the student will be able to:

- Understand the operations of multiprocessor and multicomputer systems.
- Understand the various advanced processor technology, pipelining and scalable architectures.
- Know the working of superscalar pipeline, cache memory organization.
- Introduce features of parallel processors , memory technologies, OS for multi programmed computer
- Understand the principles of multithreading, multithread architecture, static and dynamic dataflow.

UNIT I THEORY OF PARALLELISM **9**

Parallel Computer models – the state of computing-introduction to parallel processing-parallelism in uniprocessors& Multiprocessors,-parallel architectural classification schemes-speedup performance laws- -Program and Network Properties-H/W-S/W Parallelism

UNIT II SYSTEM INTERCONNECT ARCHITECTURES **9**

System interconnect Architectures-Network Properties and routing-Static Interconnection Networks- Dynamic Interconnection Networks-Multiprocessor System Interconnects-interprocessor communication network-Structure of Parallel Computers; Hierarchical bus systems-Crossbar switch and multiport memory-multistage and combining network

UNIT III PIPELINING AND SUPERSCALAR TECHNOLOGIES 9

Pipeline principle and implementation-classification of pipeline processor-introduction of arithmetic, instruction, processor pipelining-pipeline mechanisms-hazards.

UNIT IV HARDWARE TECHNOLOGIES 9

Introduction to features of advanced embedded processors through Basic Comparative study : of Architectures -addressing modes -instruction types-performance of- Parallel and scalable architectures, Multiprocessor and SIMD ,MIMD computers, RISC, CISC, Superscalar, VLIW, Vector, Systolic processors of their unique features -Scalable, Multithreaded and data flow Architectures-interPE communication-interconnection networks- Array & vector processors, vector instruction types performance modeling-design of vectorising compiler-case Architecture of Itanium processor, Pentium Processor, SPARC Processor

UNIT V OS ISSUES FOR MULTI PROCESSOR 6

Introduction-Need for Preemptive OS – Synchronising and Scheduling in Multiprocessor OS-, Usual Os scheduling Techniques, threads – Classification of multi processor OS – Software requirements of multiprocessor OS, Distributed scheduler – PVM – PT Threads in shared memory systems Note: Class room discussions and tutorials can include the following guidelines for improved teaching /learning process: Discussions/Practice on Workbench : modelling of Computing Algorithms /ALU Functional Blocks

TOTAL : 45 PERIODS

REFERENCES:

1. Kai Hwang “Advanced Computer Architecture” Tata McGraw Hill 2000

2. Advanced Computer architecture , By Rajiv Chopra, S Chand , 2010

3. John L. Hennessy, David A. Petterson, “Computer Architecture: A Quantitative Approach”, 4th Edition, Elsevier, 2007

4. Dezso Sima, Terence Fountain, Peter Kacsuk, “Advanced computer Architecture – A design Space Approach”. Pearson Education,2003.

5. Sajjan G. Shiva “Advanced Computer Architecture”, Taylor & Francis, 2008

6. Rajaraman, C.Siva Ram Murthy, “Parallel Computers- Architecture and Programming”, Prentice Hall India, 2008

7. Carl Homacher, Zvonko Vranesic, Sefwat Zaky, “Computer Organisation”, 5th Edition, TMH, 2002. 29

8. David E. Culler, Jaswinder Pal Singh with Anoop Gupta “Parallel Computer Architecture” ,Elsevier, 2004.

9. John P. Shen. “Modern processor design Fundamentals of super scalar processors”, Tata

McGraw Hill 2003.

10. Harry F. Jordan Gita Alaghaband, “Fundamentals of Parallel Processing”. Pearson Education, 2003.

11. Richard Y. Kain, “Advanced computer architecture – A system Design Approach”, PHI, 2003.

COURSE OUTCOMES		**PROGRAMS OUTCOMES**												**PROGRAM SPECIFIC OUTCOMES**	
CO's	**Statement's**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO-1	An ability to understand the operations of multiprocessor and multicomputer systems	3	2	2	2	2							2	2	2
CO-2	understand the various advanced processor technology, pipelining and scalable architectures	3	2	2	2	2	2						2	2	2
CO-3	know the working of superscalar pipeline, cache memory organization	3	2	2	2								2	2	
CO-4	introduce features of parallel processors , memory technologies, OS for multi programmed computer	3	2	2	2	2							2		2
CO-5	understand the principles of multithreading, multithread architecture, static and dynamic dataflow	3	3	2	2								2	2	

ELECTIVE-V

525224	ADVANCED DIGITAL IMAGE PROCESSING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

To explore the concepts of digital image processing and design image analysis techniques in the form of image segmentation and to evaluate the methodologies for segmentation.

COURSE OUTCOMES:

Having successfully completed this course, the students should be able to:

- Understand the fundamentals of medical image processing techniques.
- Develop computational methods and algorithms to analyze and quantify biomedical data
- Apply image processing concepts for medical images.
- Analyze Morphology, Segmentation techniques and implement these in images.
- Enables quantitative analysis and visualization of medical images of numerous modalities such as PET, MRI, CT, or microscopy

UNIT I FUNDAMENTALS OF DIGITAL IMAGE PROCESSING 9

Elements of visual perception, brightness, contrast, hue, saturation, mach band effect, 2D image transforms-DFT, DCT, KLT, and SVD. Image enhancement in spatial and frequency domain, Review of morphological image processing

UNIT II SEGMENTATION 9

Image Segmentation: Edge Detection - Line Detection - Curve Detection - Edge Linking And Boundary Extraction, Boundary Representation, Region Representation And Segmentation, Morphology-Dilation, Erosion, Opening And Closing. Hit And Miss Algorithms Feature Analysis

UNIT III FEATURE EXTRACTION 9

First and second order edge detection operators, Phase congruency, Localized feature extraction detecting image curvature, shape features Hough transform, shape skeletonization, Boundary descriptors, Moments, Texture descriptors- Autocorrelation, Co-occurrence features, Runlength features, Fractal model based features, Gabor filter, wavelet features.

UNIT IV REGISTRATION AND IMAGE FUSION 9

Registration- Pre-processing, Feature selection-points, lines, regions and templates Feature Correspondence-Point pattern matching, Line matching, region matching Template matching. Transformation functions-Similarity transformation and Affine Transformation. Resampling-Nearest Neighbour and Cubic Spines Image Fusion-Overview of image fusion, pixel fusion, Multiresolution based fusion discrete wavelet transform, Curvelet transform. Region based fusion.

UNIT V 3D IMAGE VISUALIZATION 9

Sources of 3D Data sets, Slicing the Data set, Arbitrary section planes, The use of color, Volumetric display, Stereo Viewing, Ray tracing, Reflection, Surfaces, Multiply connected surfaces, Image processing in 3D, Measurements on 3D images.

Total: 45 periods

REFERENCES:

1. John C.Russ, "The Image Processing Handbook", CRC Press, 2007, 6th Edition.
2. Mark Nixon, Alberto Aguado, "Feature Extraction and Image Processing", Academic Press, 2th Edition 2008.
3. Ardeshir Goshtasby, " 2D and 3D Image registration for Medical, Remote Sensing and Industrial Applications", John Wiley and Sons,2005.
1. Rafael C. Gonzalez, Richard E. Woods, , Digital Image Processing', Pearson, Education, Inc., Second Edition, 2004.
2. Anil K. Jain, , Fundamentals of Digital Image Processing', Pearson Education, Inc., 2002.

COURSE OUTCOMES		PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES	
CO's	Statement's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO-1	To understand the fundamentals of medical image processing techniques	3	2	2	2	2	1				1		2	1	2
CO-2	To develop computational methods and algorithms to analyze and quantify biomedical data	3	2	2	2	3					1		2	2	
CO-3	To apply image processing concepts for medical images	3	2	2	2	1					2		3		2
CO-4	To analyze Morphology, Segmentation techniques and implement these in images	3	3	2	2	2							3	2	
CO-5	Enables quantitative analysis and visualization of medical images of numerous modalities such as PET, MRI,	3	3	3	2	2					1		2	2	

	CT, or microscopy														

525225 PATTERN RECOGNITION & ARTIFICAL INTELLIGENCE

L	T	P	C
3	0	0	3

COURSE OBJECTIVE:

- To understand different supervised and unsupervised learning techniques
- To obtain sound knowledge on recent advancement on pattern recognition techniques.

COURSE OUTCOMES:

- Analysis the procedure for various pattern recognition principles in real world problem.
- Analysis feature enhancement and optimization methods
- Analysis the windowing of better solution in rough surface searching algorithms both using association and non association rules.
- Identification of new developments in object recognition systems
- To study about the neural networks and neural pattern recognition.

UNIT I PATTERN CLASSIFIER **9**

Overview of pattern recognition - Discriminate functions - Supervised learning - Parametric estimation -Maximum likelihood estimation - Bayesian parameter estimation - Perceptron algorithm - LMSE algorithm-Problems with Bayes approach - Pattern classification by distance functions - Minimum distance pattern classifier

UNIT II UNSUPERVISED CLASSIFICATION **9**

Clustering for unsupervised learning and classification - Clustering concept - C-means algorithm –Hierarchical clustering procedures - Graph theoretic approach to pattern clustering - Validity of clustering solutions

UNIT III STRUCTURAL PATTERN RECOGNITION **9**

Elements of formal grammars - String generation as pattern description - Recognition of syntactic description -Parsing - Stochastic grammars and applications - Graph based structural representation

UNIT IV FEATURE EXTRACTION AND SELECTION **9**

Entropy minimization - Karhunen - Loeve transformation - Feature selection through functions approximation -Binary feature selection.

UNIT V RECENT ADVANCES **9**

Neural network structures for Pattern Recognition - Neural network based Pattern associators –Unsupervised learning in neural Pattern Recognition - Self organizing networks - Fuzzy logic – Fuzzy pattern classifiers -Pattern classification using Genetic Algorithms.

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. Duda R.O., Hart.P.E., and Strok, Pattern Classification, second Edition Wiley, New York, 2008..
2. Robert J.Schalkoff, Pattern Recognition: Statistical, Structural and Neural Approaches, JohnWiley&Sons Inc., New York, 2007..
3. IEEE Transaction on Pattern Recognition Techniques 2006
4. IEEE Engineering Medicine and Biology Magazine 2006

COURSE OUTCOMES		PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES	
CO's	Statement's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO-1	Analysis the procedure for various pattern recognition principles in real world problem	3	3	3	2								2	2	3
CO-2	Analysis feature enhancement and optimization methods	3	2	3	2								2	2	2
CO-3	Analysis the windowing of better solution in rough surface searching algorithms both using association and non association rules	3	3	3	3	2	2						2	2	2
CO-4	Identification of new developments in object recognition systems	2	3	3	2	2	2						2	2	
CO-5	To study about the neural networks and neural pattern recognition	3	3	3	2	3					2		3		2

525226 APPLICATION OF MEMS TECHNOLOGY

L	T	P	C
3	0	0	3

COURSE OBJECTIVE:

To introduce the concepts of micro electro mechanical devices and to know the fabrication process of Microsystems.

COURSE OUTCOMES:

Having successfully completed this course, the students should be able to:

- Understanding the concepts of MEMS
- Design of different type of micro sensors
- Understanding the concepts of MEMS transducers
- understand about the MEMS and thermal transducers
- Design a different type of sensors and MEMS sensors

UNIT I INTRODUCTION TO MEMS 9

MEMS, Use of MEMS, Fabrication process. The Substrate and adding material to it: Introduction, The silicon substrate, Additive technique Oxidation, Additive technique-Physical vapor deposition, other additive techniques.

UNIT II MEMS FABRICATION TECHNOLOGIES 9

Microsystem fabrication processes: Photolithography, Ion Implantation, Diffusion, Oxidation. Thin film depositions: LPCVD, Sputtering, Evaporation, Electroplating; Etching techniques: Dry and wet etching, electrochemical etching; Micromachining: Bulk Micromachining, Surface Micromachining, High Aspect- Ratio (LIGA and LIGA-like) Technology; Packaging: Microsystems packaging, Essential packaging technologies, Selection of packaging materials

UNIT III MEMS TRANSDUCERS-I 9

Modelling: Units, The input-output concept, Physical variables and notation, Preface to the modeling chapters. MEMS Transducers: An overview-Transducer, Distinguishing between sensors and actuators, Response characteristics of transducers, MEMS Sensors- Principles of operation, MEMS Actuators Principles of operation, Signal conditioning, RF applications and Optical applications. Piezoresistive Transducers: Introduction, Modeling Piezoresistive transducers, Piezoresistive pressure sensor.

UNIT IV MEMS TRANSDUCERS – II 9

Capacitive Transducers: Introduction, Capacitor fundamentals, Modeling a capacitor sensor, Capacitive accelerometer, Thermal Transducers: Introduction, Basic heat transfer, Hot-arm actuator.

UNIT V MICRO SENSORS 9

MEMS Sensors: Design of Acoustic wave sensors, resonant sensor, Vibratory gyroscope, Capacitive and Piezo Resistive Pressure sensors

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. Adams, Thomas M., Layton, Richard A., "Introductory MEMS Fabrication and Applications", Springer.2010
2. Chang Liu, "Foundations of MEMS", Pearson education India limited, 2006.
3. Mohamed Gad-el-Hak, "MEMS-Applications", CRC Press, 29-Nov-2005.
4. Michael Kraft, Neil M White, "Mems for Automotive and Aerospace Applications" , WP Publication 4th edition, 2013.

5. Tai-Ran Hsu, "MEMS and Microsystems- Design and Manufacture", McGraw-Hill, 2002.
6. Vikas Choudhary, Krzysztof Iniewski, "MEMS: Fundamental Technology and Applications" CRC Press, 4th edition, 2013.

COURSE OUTCOMES		PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES	
CO's	Statement's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO-1	Understanding the concepts of MEMS	3	3	3	3	1							2		3
CO-2	Design of different type of micro sensors	3	3	3	2	1							2	1	1
CO-3	Understanding the concepts of MEMS transducers	3	3	3	3	2	2						2		2
CO-4	understand about the MEMS and thermal transducers	3	3	2	3	2	2						2	1	1
CO-5	Design a different type of sensors and MEMS sensors	3	3	3	2	2	2						2	2	2

525227 WIRELESS AND MOBILE COMMUNICATION

L	T	P	C
3	0	0	3

COURSE OBJECTIVES :

To teach the fundamentals of wireless mobile network protocols

- To expose the students to the fundamentals of wireless communication technologies.
- To study on wireless network topologies
- To introduce network routing protocols
- To study the basis for classification of commercial family of wireless communication technologies

COURSE OUTCOMES:

- General knowledge of Mobile and Wireless Communication technology.
- Brief knowledge of 3G and 4 G wireless standards.
- Understand The Concept Of IEEE Standard Numbers.
- Understand The Concept Of Routing Protocols.
- Analysis the various kind of networks and application of network.

UNIT I CELLULAR COMMUNICATIONS 9

The Cellular Engineering Fundamentals : Introduction, Cell, Frequency Re-use, Channel Assignment Strategies, Fixed and Dynamic Channel Assignment Strategies, Handoff Process, Factors affecting Handoff Process, Handoff Strategies, Few practical cases of Handoff Scenario, Interference and System Capacity, Co-channel Interference (CCI), Adjacent Channel Interference (ACI), Cell Splitting, Sectoring, Microcell Zone concept, Repeaters, Trunked Radio System.

UNIT II MULTIPLE ACCESS TECHNOLOGIES 9

Narrowband Systems, Wideband Systems, Frequency Division Multiple Access, Time Division Multiple Access, Spread Spectrum Multiple Access, Space Division Multiple Access.

UNIT III WIRELESS NETWORKS 9

Wireless LAN – IEEE 802.11 Standard-Architecture – Services – Hiper LAN, Bluetooth

UNIT IV ROUTING 9

Mobile IP- SIP – DHCP – AdHoc Networks – Proactive and Reactive Routing Protocols – Multicast Routing - WSN routing – LEACH- SPIN- PEGASIS

UNIT V TRANSPORT AND APPLICATION LAYERS 9

TCP over Adhoc Networks – WAP – Architecture – WWW Programming Model – WDP – WTLS – WTP – WSP – WAE – WTA Architecture – WML – WML scripts.

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. Uwe Hansmann, Lothar Merk, Martin S. Nicklons and Thomas Stober, " Principles of Mobile computing", Springer, New york, 2010,**ISBN: 9788181280732**
2. C. Siva Ram Murthy and B.S. Manoj, AdHoc Wireless Networks: Architectures and protocols, Prentice Hall PTR, 2008.
3. Charles E. Perkins, " Adhoc Networking", Addison-Wesley, 2011.
4. Jochen Schiller, " Mobile communications", PHI/Pearson Education, Second Edition, 2013.
5. Kaveh Pahlavan, Prasanth Krishnamoorthy, " Principles of Wireless Networks' PHI/Pearson Education, 2012.
6. Subir Kumar Sarkar, T.G. Basavaraju, C. Puttamadappa , " AdHoc mobile wireless networks", Prentice Hall, Inc, 2016.
7. Yan Zhang, MOHSEN GUIZANI , " Wireless communications and Networks", PHI/Pearson Education, 2011.

COURSE OUTCOMES		PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES	
CO's	Statement's	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2

CO-1	General knowledge of Mobile and Wireless Communicatio n technology	3	2	3	2	2	1						2	2	
CO-2	Brief knowledge of 3G and 4 G wireless standards	3	2	3	2	2	2						2	2	
CO-3	Understand The Concept Of IEEE Standard Numbers	3	3	3	2	2	2	1			2		2	2	2
CO-4	Understand The Concept Of Routing Protocols	3	3	3	2	2							2		2
CO-5	Analysis the various kind of networks and application of network	3	2	2	2	2	1						1	2	

525228 **BIG DATA ANALYTICS** **L T P C**

3 0 0 3

COURSE OBJECTIVE:

The Students will be able to understand the concept of big data analytics.

COURSEOUTCOMES:

- Examine a mixture of structured, semi-structured and unstructured data.
- Evaluate analytics techniques for text, audio, video, and social media data.
- Build a data model for analyzing large data sets.
- Utilizes a variety of statistical, modeling, data mining, & machine learning Techniques.
- Model nominal outcome variables using logical regression model.

UNIT I INTRODUCTION **9**

Big Data - Risk of Big Data - Need to Tame Big Data - Exploring big Data - Mixing with traditional data - Need for Standards.

UNIT II ANALYTIC PROCESS **9**

Evolution of Analytics Scalability: Parallel Processing System - Cloud Computing - Grid Computing - MapReduce - Evolution of Analytics Processes: The Analytic Sand box - Analytic data set - Enterprise Analytic set - Embedded Scoring - Wrap up.

UNIT III CLUSTERING AND CLASSIFICATION **9**

Advanced Analytical Theory and Methods: Overview of Clustering - K-means - Use Cases - Overview of the Method - Determining the Number of Clusters - Diagnostics - Reasons to Choose and Cautions .- Classification: Decision Trees - Overview of a Decision Tree - The General Algorithm - Decision Tree Algorithms - Evaluating a Decision Tree - Decision Trees in R - Naïve Bayes - Bayes‟ Theorem - Naïve Bayes Classifier.

UNIT IV ASSOCIATION AND RECOMMENDATION SYSTEM 9

Advanced Analytical Theory and Methods: Association Rules - Overview - Apriori Algorithm - Evaluation of Candidate Rules - Applications of Association Rules - Finding Association & finding similarity - Recommendation System: Collaborative Recommendation- Content Based Recommendation -Knowledge Based Recommendation- Hybrid Recommendation Approaches

UNIT V GRAPH MEMORY AND STREAM MEMORY 9

Using Graph Analytics for Big Data: What Is Graph Analytics? - The Simplicity of the Graph Model Representation as Triples - Graphs and Network Organization - Choosing Graph Analytics - Graph Analytics Use Cases - Graph Analytics Algorithms and Solution Approaches - Technical Complexity of Analyzing Graphs- Features of a Graph Analytics Platform - Considerations: Dedicated Appliances for Graph- Introduction to Streams Concepts – Stream Data Model and Architecture - Stream Computing, Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating moments – Counting oneness in a Window – Decaying Window – Realtime Analytics Platform(RTAP) applications - Case Studies - Real Time Sentiment Analysis, Stock Market Predictions.

L=45 TOTAL: 45 PERIODS

REFERENCES:

1. AnandRajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, 2012.
2. Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications", Wiley Publishers, 2015.
3. Bill Franks,”Taming the Big Data Tidal Wave Finding Opportunities in huge data streams with Advanced Analytics”, John Wiley & Sons. 2013.
4. David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", 2013.
5. "Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data", EMC Education Services, Wiley publishers, 2015.
6. Kevin Roebuck,”Big Data: High Impact Strategies” Lightning Source Incorporated, 2011.

COURSE OUTCOMES		PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES	
CO's	Statement's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO-1	Examine a mixture of structured, semi-structured and	3	2	3	2	1							2	2	

	unstructured data														
CO-2	Evaluate analytics techniques for text, audio, video, and social media data	3	3	3	3	2							2	2	
CO-3	Build a data model for analyzing large data sets	3	2	3	2	2							2		2
CO-4	Utilizes a variety of statistical, modeling, data mining, & machine learning Techniques	3	2	2	2	2							2		2
CO-5	Model nominal outcome variables using logical regression model	3	2	2	2								2	2	

525229 RESEARCH METHODOLOGIES L T P C

3 0 0 3

COURSE OBJECTIVE:

To familiarize the student with the basic need of research for their evolution using various methods and techniques.

COURSE OUTCOMES:

Having successfully completed this course, the students should be able to:

- To Introduce about research and its importance.
- To understand the experimental design
- To understand about design and data collection techniques evolve in research.
- To understand the multivariate statistical techniques
- Get idea about prepare research report and its execution

UNIT I INTRODUCTION TO RESEARCH 9

The hallmarks of scientific research – the building blocks of science in research – the research process for applied and basic research – the need for theoretical frame work – hypothesis development – hypothesis testing with quantitative data. The research design. The purpose of the study: Exploratory, Descriptive, Hypothesis testing (Analytical and Predictive) – cross sectional and longitudinal studies.

UNIT II EXPERIMENTAL DESIGN 9

The laboratory and the field experiment – Simulation--internal and external validity – factors affecting internal validity. Measurement of variables – scales and measurement of variables – development scales - rating scale and concept in scales being developed. Stability measures. Meaning & Role of hypothesis

UNIT III DATA COLLECTION METHOD 9

Interviewing, questionnaires etc. Secondary sources of data collection. Guidelines for questionnaire design – electronic questionnaire design and surveys. Special data source: Focus groups, Static and dynamic data-collection methods and when to use each. Sampling techniques and confidence in determining sample size. Hypothesis testing determination of optimal sample size.

UNIT IV A REFRESHER ON SOME MULTIVARIATE STATISTICAL TECHNIQUES 9

Factor analysis – cluster analysis – discriminate analysis –multiple regression & Correlation – canonical correlation – application of SPSS package.

UNIT V THE RESEARCH REPORT 9

The purpose of the written report – concept of audience – Basics of written reports. The integral parts of a report – the title of a report. The table of content, the synopsis, the introductory section, method of sections of a report, result section – discussion section – recommendation and implementation section

TOTAL : 45 PERIODS

REFERENCES:

1. Donald R.Cooper and Ramcis S.Schindler, Business Research Methods, TataMcGraw Hill Publishing CompanyLimited, New Delhi, 2000
2. C.R.Kothari Research Methodology, Wishva Prakashan, New Delhi, 2001
3. Uma Sekaran, Research Methods for Business, John Wiley and Sons Inc., New York, 2000.
4. Donald H.Mc.Burney, Research Methods, Thomson Asia Pvt. ltd. Singapore 2002
5. G.W.Ticehurst and A.J.Veal, Business Research Methods, Longman, 1999
6. Ranjit Kumar, Research Methodology, Sage Publication, London, New Delhi, 1999.
7. Raymond-Alain Thie'tart, ET, al., doing management research, sage publication, London, 1999.

COURSE OUTCOMES		PROGRAMS OUTCOMES												PROGRAM SPECIFIC OUTCOMES	
CO's	Statement's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO-1	To Introduce about research and its importance	3	2	2	2	2					2	2	2		2
CO-2	To understand the	3	2	2	2						2	2		2	

	experimental design														
CO-3	To understand about design and data collection techniques evolve in research	3	2	2		1				2		2	2		2
CO-4	To understand the multivariate statistical techniques	3	2		2	2				2		2	2	2	
CO-5	Get idea about prepare research report and its execution	3	2	2		2					2	2			2