SRI CHANDRASEKHARENDRA SARASWATHI VISWA MAHAVIDYALAYA

(University established under section 3of UGC Act 1956)
(Accredited with 'A' Grade by NAAC)

CURRICULUM FOR FULL TIME

M.E. (EMBEDDED SYSTEM TECHNOLOGIES)

(Applicable for the Students admitted from 2023-24 onwards)

CURRICULUM (2023-24)
M.E (EMBEDDED SYSTEM TECHNOLOGIES)

CURRICULUM I TO IV SEMESTERS (FULL TIME)

SEMESTER I

S.No:	COURSE CODE	COURSE TITLE	L	T	P	C
1.		ADVANCED MATHEMATICS FOR ELECTRONICS ENGINEERS	4	2	0	4
2.		ADVANCED DIGITAL SYSTEM DESIGN	4	2	0	4
3.		MICROCONTROLLER BASED SYSTEM DESIGN & ANALYSIS	4	2	0	4
4.		DESIGN OF EMBEDDED SYSTEMS	4	2	0	4
5.		EMBEDDED PROGRAMMING	4	2	0	4
6.		ELECTIVE I	4	2	0	4
TOTAL			**24**	**12**	**0**	**24**

SEMESTER II

S.No:	COURSE CODE	COURSE TITLE	L	T	P	C
1.		REAL TIME OPERATING SYSTEM	4	2	0	4
2.		SOFTWARE TECHNOLOGY FOR EMBEDDED SYSTEMS	4	2	0	4
3.		EMBEDDED NETWORKING	4	2	0	4
4.		EMBEDDED COMMUNICATION AND SOFTWARE DESIGN	4	2	0	4
5.		ELECTIVE –II	4	2	0	4
6.		ELECTIVE – III	4	2	0	4
7.		EMBEDDED SYSTEM LABORATORY	0	0	3	2
TOTAL			**24**	**12**	**3**	**26**

CURRICULUM (2023-24)
M.E (EMBEDDED SYSTEM TECHNOLOGIES)

SEMESTER III

S.No:	COURSE CODE	COURSE TITLE	L	T	P	C
1.		ELECTIVE – IV	4	2	0	4
2.		ELECTIVE – V	4	2	0	4
3.		ELECTIVE – VI	4	2	0	4
4.		PROJECT WORK PHASE-I	0	0	12	6
TOTAL			**12**	**6**	**12**	**18**

SEMESTER IV

S.No:	COURSE CODE	COURSE TITLE	L	T	P	C
1.		PROJECT WORK PHASE-II	0	0	24	12
TOTAL			**0**	**0**	**24**	**12**

Total Credit to be earned for the award of degree is: 24+26+18+12=80

LIST OF ELECTIVES:

ELECTIVE 1:

S.No:	COURSE CODE	COURSE TITLE	L	T	P	C
1		ADVANCED DIGITAL SIGNAL PROCESSING	4	2	0	4
2		RISC PROCESSOR ARCHITECTURE AND PROGRAMMING	4	2	0	4
3		WIRELESS AND MOBILE COMMUNICATION	4	2	0	4
4		BIG DATA ANALYTICS	4	2	0	4

ELECTIVE II & III:

S.No:	COURSE CODE	COURSE TITLE	L	T	P	C
1		ASIC DESIGN	4	2	0	4
2		ADVANCED EMBEDDED SYSTEMS	4	2	0	4
3		EMBEDDED LINUX	4	2	0	4
4		VLSI ARCHITECTURE AND DESIGN METHODOLOGIES	4	2	0	4
5		PROGRAMMING WITH VHDL	4	2	0	4
6		PRINCIPLE OF ROBOTICS	4	2	0	4
7		APPLICATION OF MEMS TECHNOLOGY	4	2	0	4
8		DIGITAL IMAGE PROCESSING	4	2	0	4

ELECTIVE IV, V & VI:

S.No:	COURSE CODE	COURSE TITLE	L	T	P	C
1		EMBEDDED ANALOG INTERFACING	4	2	0	4
2		EMBEDDED AUTOMOTIVE NETWORKING WITH CAN	4	2	0	4
3		EMBEDDED SYSTEM DESIGN USING ARM PROCESSOR	4	2	0	4
4		DISTRIBUTED EMBEDDED COMPUTING	4	2	0	4
5		SMART METERS AND SMART GRID COMMUNICATION	4	2	0	4
6		SOFT COMPUTING TECHNIQUES	4	2	0	4

Course Code		L	T	P	C	IA	EA	TM
Course Name	ADVANCED MATHEMATICS FOR ELECTRONIC ENGINEERS	3	1	0	3	40	60	100
Course Category		Syllabus Revision					V.1.0	
Pre-requisite								

Course Objectives:

The course should enable the students -

1. To encourage students to develop a working knowledge of the central ideas of linear algebra.
2. To study and understand the concepts of probability and random variable of the various functions.
3. To understand the notion of a Markov chain, and how simple ideas of conditional probability and matrices can be used to give a thorough and effective account of discrete-time Markov chains.
4. To formulate and construct a mathematical model for a linear programming problem in real life situation.
5. Introduce the Fourier Transform as an extension of Fourier techniques on periodic functions and to solve partial differential equations.
6. To develop the use of matrix algebra techniques this is needed by engineers for practical applications.

Course Outcomes:

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

Course Outcomes	Description
CO1	Develop knowledge and understanding in the fields of linear algebra.
CO2	Develop knowledge and understanding in the fields of probability.
CO3	Develop knowledge and understanding in the fields stochastic process.
CO4	Develop knowledge and understanding in the fields of linear matrix.
CO5	Develop knowledge and understanding in the fields of Fourier transform.

UNIT-I	LINEAR ALGEBRA	12Hours
Vector spaces – norms – Inner Products – Eigen values using QR trans formations – QR factorization - generalized eigenvectors – Canonical forms – singular value decomposition and applications – pseudo inverse – least square approximations -Toeplitz matrices and some applications.		
UNIT-II	**ONE DIMENSIONAL RANDOM VARIABLES**	**12 Hours**
Random variables - Probability function – moments – moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions –Function of a Random Variable.		
UNIT-III	**MATRIX THEORY**	**12 Hours**
Some important matrix factorizations – The Cholesky decomposition – Q R factorization – Least squares method – Singular value decomposition - Toeplitz matrices and some applications.		
UNIT-IV	**QUEUEING MODELS**	**12 Hours**
Poisson Process – Markovian queues – Single and Multi-server Mode ls – Little's formula - Machine Interference Model – Steady State analysis – Se lf Service queue.		
UNIT-V	**FOURIER TRANSFORM FOR PARTIAL DIFFERENTIAL EQUATIONS**	**12 Hours**
Fourier transforms: Definitions, properties-Transform of elementary functions, Dirac Delta functions – Convolution theorem – Parseval's identity – Solutions to partial differential equations: Heat equations, Wave equations, Laplace and Poison's equations.		
	Total Hours	**60 Hours**

Text Book(s)

1.	Bronson, R.Matrix Operation, Schaum's outline series, Mc Graw Hill, New york (1989).
2.	Oliver C. Ibe, "Fundamentals of Applied Probability and Random Processes, Academic Press, (An imprint of Elsevier), 2010.
3.	Taha H.A. "Operations Research : An introduction" Ninth Edit ion, Pearson Education, Asia, New Delhi 2012. **ACC.NO: B120195**
4.	Sankara Rao, K. "Introduction to partial differential equations " Prentice Hall of India, pvt, Ltd, New Delhi, 1997. **ACC.NO: B58352**
5.	Andrews,L.C. and Philips.R.L. "Mathematical Techniques for engineering and scientists", Printice Hall of India,2006.
6.	O'Neil P.V. "Advanced Engineering Mathematics", (Thomson Asi a pvt ltd, Singapore) 2007, cengage learning India private limited **ACC.NO: B119035**
7.	Donald Gross and Carl M. Harris, Fundamentals of Queueing theory, 2nd edition, John Wiley and Sons, New York (1985). **ACC.NO: B99276**

Course Code		L	T	P	C	IA	EA	TM
Course Name	ADVANCED DIGITAL SYSTEM DESIGN	3	1	0	3	40	60	100
Course Category		Syllabus Revision				V.1.0		
Pre-requisite								

Course Objectives:

The course should enable the students -

1. Basics on Synchronous & Asynchronous digital switching design.
2. Design & realisation of error free functional blocks for digital systems

Course Outcomes:

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

Course Outcomes	Description
CO1	Develop knowledge and understanding in the basics on Synchronous & Asynchronous digital switching design.
CO2	Develop knowledge and understanding in the basics on Fault Diagnosis and Testability Algorithms
CO3	Develop knowledge and understanding in the basics on Synchronous Design Using Programmable Devices.
CO4	Develop knowledge and understanding in the basics on Synchronous & Asynchronous digital switching design, Design & realisation of error free functional blocks for digital systems and system design using hardware descriptive language.
CO5	Develop knowledge and understanding in the basics on Synchronous & Asynchronous digital switching design, Design & realisation of error free functional blocks for digital systems and system design using hardware descriptive language.

UNIT-I	SEQUENTIAL & ASYNCHRONOS CIRCUIT DESIGN	12 Hours

Analysis of Clocked Synchronous Sequential Networks (CSSN) Modelling of CSSN – State Stable Assignment and Reduction – Design of CSSN – Design of Iterative Circuits – ASM Chart – ASM Realization, Design of Arithmetic circuits for Fast adder- Array Multiplier. Analysis of Asynchronous Sequential Circuit (ASC) – Flow Table Reduction – Race s in ASC – State Assignment – Problem and the Transition Table – Design of ASC – Static and Dynamic Hazards – Essential Hazards – Data Synchronizers – Designing Vending Machine Controller – Mixed Operating Mode Asynchronous Circuits.

UNIT-II	FAULT DIAGNOSIS AND TESTABILITY ALGORITHMS	12 Hours

Fault Table Method – Path Sensitization Method – Boolean Difference Method – Kohavi Algorithm – Tolerance Techniques – The Compact Algorithm – Practical PLA's – Fault in PLA – Test Generation – Masking Cycle – DFT Schemes – Built-in Self Test.

UNIT-III	**SYNCHRONOUS DESIGN USING PROGRAMMABLE DEVICES**	**12 Hours**
Programming Techniques -Re-Programmable Devices Architecture- Function blocks, I/O blocks, Interconnects, Realize combinational, Arithmetic, Sequential Circuit with Programmable Array Logic; Architecture and application of Field Programmable Logic Sequence.		
UNIT-IV	**NEW GENERATION PROGRAMMABLE LOGIC DEVICES**	**12 Hours**
Fold back Architecture with GAL, EPLD, EPLA , PEEL, PML; PROM – Realization State machine using PLD – FPGA – Xilinx FPGA – Xilinx 2000 - Xilinx 3000.		
UNIT-V	**SYSTEM DESIGN USING VHDL**	**12 Hours**
VHDL Description of Combinational Circuits – Arrays – VHDL Operators – Compilation and Simulation of VHDL Code – Modelling using VHDL – Flip Flops – Registers – Counters – Sequential Machine – Combinational Logic Circuits – VHDL Code for – Serial Adder, Binary Multiplier – Binary Divider – complete Sequential Systems – Design of a Simple Microprocessor.		
	Total Hours	**60 Hours**

Text Book(s)

1.	Donald G. Givone, “Digital principles and Design”, Tata McGraw Hill 2002. **ACC.NO: B100970**
2.	Mark Zwolinski, “Digital System Design with VHDL”, Pear son Education, 2004.
3.	Stephen Brown and Zvonk Vranesic, “Fundamentals of Digital Logic with VHDL Deisgn”, Tata McGraw Hill, 2002
4.	John M Yarbrough, “Digital Logic applications and Design”, Thom son Learning, 2001
5.	Parag K Lala, “Digital System design using PLD”, BS Publications, 2003
6.	Nripendra N Biswas, “Logic Design Theory”, Prentice Hal l of India, 2001 ACC.NO: B130827
7.	Charles H. Roth Jr., “Fundamentals of Logic design”, Thomson Learning, 2004. **ACC.NO: B134442**
8.	Navabi.Z. “VHDL Analysis and Modelling of Digital Systems, McGraw International, 1998.

Course Code		L	T	P	C	IA	EA	TM
Course Name	MICROCONTROLLER BASED SYSTEM DESIGN	3	1	0	3	40	60	100
Course Category		Syllabus Revision					V.1.0	
Pre-requisite								

Course Objectives:

The course should enable the students -

Basic understanding of embedded systems design. This includes system requirements specifications, architectural and detailed design, and implementation, focusing on real-time applications. Learning the concepts will be enforced by a Project to design and develop an embedded system based on a single-chip microcontroller.

Course Outcomes:

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

Course Outcomes	Description
CO1	Develop knowledge and understanding on the system requirements specifications, architectural and detailed design, and implementation, focusing on real-time applications of 8051.
CO2	Develop knowledge and understanding on the system requirements specifications, architectural and detailed design, and implementation, focusing on real-time applications of 32 bit ARM 920
CO3	Understanding on the system requirements specifications, architectural and detailed design, and implementation of ARM Processor Organization.
CO4	Understanding on the system requirements specifications, architectural and detailed design, and implementation of Microcontroller Based Embedded Systems.
CO5	Learning the concepts will be enforced by a Project to design and develop an embedded system based on a single-chip microcontroller.

UNIT-I	REVIEW OF 8051	12 Hours

Introduction to Embedded System. Architecture, 8051- CPU Block diagram, Memory Organization, Program memory, Data Memory, Interrupts Peripherals: Timers, Serial Port, I/O Port Programming: Addressing Modes, Instruction Set, Programming Timing Analysis Case study with reference to 8-bit 8051 Microcontroller.

UNIT-II	INTRODUCTION FOR 32 BIT ARM 920	12 Hours

32- Bit ARM920T Processor Core -Introduction: RISC/ARM Design Philosophy, About the ARM920T Core, Processor Functional Block Diagram. Programmers Model. Cache: Memory hierarchy and cache memory-. Memory Management Units: - ARM Instruction Set- Thumb Instruction Set. Interrupt Handling.

UNIT-III	ARM PROCESSOR ORGANIZATION	12 Hours
ARM9 Microcontroller Architecture-Block Diagram, Features, Memory Mapping Memory Controller (MC)-External Bus Interface (EBI)-External Memory Interface-Interrupt Controller-System Timer (ST- Real Time Clock (RTC) Parallel Input/output Controller (PIO).		
UNIT-IV	**PERIPHERALS OF ARM PROCESSOR**	**12 Hours**
AT91RM9200 PERIPHERALS -Universal Synchronous Asynchronous Receiver Transceiver (USART)-Block Diagram, Functional Description, Synchronous and Asynchronous Modes.		
UNIT-V	**DEVELOPMENT & DEBUGGING TOOLS FOR MICROCONTROLLER BASED EMBEDDED SYSTEMS**	**12 Hours**
Software and Hardware tools like Cross Assembler, Compiler, Debugger, Simulator, In-Circuit Emulator (ICE), Logic Analyser.		
	Total Hours	**60 Hours**

Text Book(s)

1.	Intel Hand Book on "Embedded Microcontrollers", 1st Edition.
2.	Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay, "The 8051 Microcontroller and Embedded Systems using Assembly and C", 2e, PHI.
3.	ARM Company Ltd. "ARM Architecture Reference Manual– ARM D DI 0100E".
4.	David Seal "ARM Architecture Reference Manual", 2001 Addison Wesley, England; Morgan Kaufmann Publishers.
5.	Andrew N Sloss, Dominic Symes, Chris Wright, "ARM System Developer's Guide - Designing and Optimizing System Software", 2006, Elsevier.
6.	Ayala, Kenneth J "8051 Microcontroller - Architecture, Programming & Applications", 1 st Edition, Penram International Publishing.
7.	Steve Furber, "ARM System-on-Chip Architecture", 2 nd Edition, Pearson Education **ACC.NO: B129645.**
8.	Predko, Myke, "Programming and Customizing the 8051 Microcontroller", 1st Edition, McGraw Hill International **ACC.NO: B100892.**
9.	Schultz, Thomas W, "C and the 8051 Programming for Multitask ing", 1 st Edition, Prentice Hall.
10.	Stewart, James W, Miao, Kai X, "8051 Microcontroller: Hardware, Software and Interfacing", 2 nd Edition, Prentice Hall.
11.	Arnold. S. Berger, "Embedded Systems Design - An introduction t o Processes, Tools and Techniques", Easwer Press.
12.	Raj Kamal, "Microcontroller - Architecture Programming Interfacing and System Design" 1 st Edition, Pearson Education.
13.	P.S Manoharan, P.S. Kannan, "Microcontroller based System Design", 1 st Edition, Scitech Publications **ACC.NO: B113621.**
14.	David Calcutt, Fred Cowan, Hassan Parchizadeh, "8051 Micro controllers – An Application based Introduction", Elsevier.
15.	Ajay Deshmukh, "Microcontroller - Theory & Applications", Tata McGraw Hill.

Course Code		L	T	P	C	IA	EA	TM
Course Name	DESIGN OF EMBEDDED SYSTEMS	3	1	0	3	40	60	100
Course Category		Syllabus Revision				V.1.0		
Pre-requisite								

Course Objectives:

The course should enable the students -

1. Basics Embedded Design Cycle
2. Design & realization of system with testing process.

Course Outcomes:

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

Course Outcomes	Description
CO1	Develop knowledge and understanding on the basics of embedded systems design life cycle.
CO2	Develop knowledge and understanding on the basics of partitioning decision.
CO3	Develop knowledge and understanding on the basics of interrupt service routines.
CO4	Develop knowledge and understanding on the basics of in circuit emulators.
CO5	Develop knowledge and understanding on the basics embedded systems design and the Testing procedure to be done for the embedded applications.

UNIT-I	EMBEDDED DESIGN LIFE CYCLE	12 Hours

Embedded Design life cycle – Product specification – Hardware / Software partitioning – Detailed hardware and software design – Integration – Product testing – Selection Processes – Microprocessor Vs Micro Controller – Performance tools – Bench marking – RTOS Micro Controller – Performance tools – Bench marking – RTOS availability – Tool chain availability – Other issues in selection processes.

UNIT-II	PARTITIONING DECISION	12 Hours

Partitioning decision – Hardware / Software duality – co ding Hardware – ASIC revolution – Managing the Risk – Co-verification – execution environment – memory organization – System startup – Hardware manipulation – memory – mapped access – speed and code density.

UNIT-III	INTERRUPT SERVICE ROUTINES	12 Hours

Interrupt Service routines – Watch dog timers – Flash memory Basic toolset – Host based debugging – Remote debugging – ROM emulators – logic Analyzer – Caches – Computer optimisation – Statistical profiling.

UNIT-IV	**IN CIRCUIT EMULATORS**	**12 Hours**
In circuit emulators – Buller proof run control – Real time trace – Hardware break points – Overlay memory – Timing constraints – Usage issues – Triggers.		
UNIT-V	**TESTING**	**12 Hours**
Testing – Bug tracking – reduction of risks & costs – Performance – Unit testing – Regression testing – Choosing test cases – Functional tests – Coverage tests – Testing embedded software – Performance testing – Maintenance.		
	Total Hours	**60 Hours**
Text Book(s)		
1.	Arnold S. Berger – Embedded System Design CMP books, USA 2002.	
2.	Sriram Iyer, "Embedded Real time System Programming".	
3.	ARKIN, R.C., Behaviour-based Robotics, The MIT Press, 1998.	

Course Code		L	T	P	C	IA	EA	TM
Course Name	EMBEDDED PROGRAMMING	3	1	0	3	40	60	100
Course Category		Syllabus Revision				V.1.0		
Pre-requisite								

Course Objectives:
The course should enable the students -

1. To impart the knowledge of the Embedded Programming.
2. To Impart the knowledge in the Application with Data Structures.

Course Outcomes:
On completion of the course, the student will be able to

Course Outcomes	Description
CO1	Develop knowledge and understanding on the various programming concepts used in the field of embedded.
CO2	Develop knowledge and understanding on the various programming concepts used in the field of embedded OS fundamentals.
CO3	Develop knowledge and understanding on the various programming concepts used in the field of embedded C programming.
CO4	Develop knowledge and understanding on the various programming concepts used in the field of embedded applications using data structures.
CO5	Develop knowledge and understanding on the various programming concepts used in the field of embedded java.

UNIT-I	INTRODUCTION	12 Hours

Introduction – Issues in Real Time Computing – Structure of a Real Time System – Task classes – Performance Measures for Real Time Systems – Estimating Program Run Times – Task Assignment and Scheduling – Classical uniprocessor scheduling algorithms – Uniprocessor scheduling of IRIS tasks – Task assignment – Mode changes and Fault Tolerant Scheduling.

UNIT-II	EMBEDDED OS FUNDAMENTALS	12 Hours

Introduction: Operating System Fundamentals, General and Unix OS architecture Embedded Linux. Booting Process in Linux GNU Tools: gcc, Conditional Compilation, Pre-processor directives, Command line arguments, Make files.

UNIT-III	EMBEDDED C PROGRAMMING	12 Hours

Review of data types –scalar types-Primitive types-Enumerated types-sub ranges Structure types-character strings –arrays- Functions introduction to Embedded C- Introduction, Data types Bit manipulation, Interfacing C with Assembly. Embedded programming issues -Re-entrancy, Portability, Optimizing and testing embedded C programs.

UNIT-IV	EMBEDDED APPLICATIONS USING DATA STRUCTURES	L	T	P	C	IA	EA	TM	12 Hours

Linear data structures– Stacks and Queues Implementation of stacks and Queues- Linked List - Implementation of linked list, Sorting, Searching, Insertion and Deletion, Nonlinear structures.

UNIT-V	EMBEDDED JAVA	12 Hours

Introduction to Object Oriented Concepts. Core Java/Java Core- Java buzzwords, Overview of Java programming, Data types, variables and arrays, Operators, Control statements. Embedded Java – Understanding J2ME,Connected Device configuration, Connected Limited device configuration, Profiles, Anatomy of MIDP applications, Advantages of MIDP.

	Total Hours	60 Hours

Text Book(s)

1.	GNU/Linux application programming, Jones, M Tim, Dream tech press, New Delhi.
2.	Embedded / Real-Time Systems : concepts, Design and Programming -The Ultimate Reference, Prasad K.V.K.K, Dream tech Press, New Delhi.
3.	Beginning J2ME-From Novice to Professional-3rd Edition , Sing Li and Jonathan Knudsen, Dreamtech Press, New Delhi
4.	The Complete reference Java2, 5th Edition, Herbert Schildt, TMH
5.	Data structures Through 'C' Language, Samiran Chattopadhyay, Debarata Ghosh Dastidar, Matangini Chattopadhyay, DOEACC Society.
6.	C Programming Language, Kernighan, Brian W, Ritchie, Dennis M, PHI publications.
7.	C and the 8051 Programming Volume II, Building efficient applications, Thomas W Schultz, PHI.

Reference Book(s)

1	Unix Network Programming, Stevens, W Richard, PH, New Jersey **ACC.NO: B126496**
2.	Linux Device Drivers, 2nd Edition, By Alessandro Rubini & Jonathan Corbet, O'Reilly **ACC.NO: B65039**
3	Data Structures Using C- ISRD group, TMH
4.	Data structures –Seymour Lipschutz, Schaums Outlines
5.	Let us C, Yashwant Kanetkar **ACC.NO: B113351**
6.	C Programming for Embedded systems, Zurell, Kirk
7.	C and the 8051 Programming for Multitasking – Schultz, Thomas W
8.	C with assembly language, Steven Holzner, BPB publication **ACC.NO: B59951**
9.	C and the 8051: Hardware, Modular Programming and Multitasking Vol i – Schultz, Thomas W
10.	Art of C Programming, Jones, Robin, Stewart, Ian **ACC.NO: B56037**
11.	Kelley, A & Pohl, I;, " A Book on C", Addison – Wesley
12.	Advanced Linux Programming Mark Mitchell, Jeffrey Oldham, and Alex Samuel, Techmedia.
13.	Embedded/ real-time systems: concepts, design and programming black book, Prasad, K V K K, Dreamtech press, New Delhi. **ACC.NO: B127888.**

Course Code								
Course Name	**REAL TIME OPERATING SYSTEM**	3	1	0	3	40	60	100
Course Category		**Syllabus Revision**					V.1.0	
Pre-requisite								

Course Objectives:

The course should enable the students -

1. To expose the students to the fundamentals of interaction of OS with a computer and User computation.
2. To teach the fundamental concepts of how process are created and controlled with OS.
3. To study on programming logic of modelling Process based on range of OS features.
4. To compare types and Functionalities in commercial OS.
5. To discuss the application development using RTOS.

Course Outcomes:

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

Course Outcomes	Description
CO1	Develop knowledge on the operating system, modelling process based on the OS and how to develop the application using operating systems.
CO2	Develop knowledge on the operating system, modelling process based on the OS and how to develop the application using RTOS.
CO3	Develop knowledge on the operating system, modelling process based on the OS and how to develop the application using real time kernel.
CO4	Develop knowledge on the operating system, modelling process based on the OS and how to develop the application using real time models and languages.
CO5	Develop knowledge on the operating system, modelling process based on the OS and how to develop the application using RTOS application domains.

UNIT-I	**REVIEW OF OPERATING SYSTEMS**	**12 Hours**

Basic Principles - Operating System structures – System Ca lls – Files – Processes – Design and Implementation of processes – Communication between processes – Introduction to Distributed operating system – issues in distributed system: states, events , clocks-Distributed scheduling-Fault & recovery.

UNIT-II	**RTOS**	**12 Hours**

Real-time concepts, Hard Real time and Soft Real-time, Differences between General Purpose OS & RTOS, Basic architecture of an RTOS, Scheduling Systems, Inter-process communication, Performance Matric in scheduling models, Interrupt management in RTOS environment, Memory management. File systems, I/O Systems, Advantage and disadvantage of RTOS. POSIX standards RTOS Issues - Selecting a Real Time Operating System, RTOS

comparative study.		
UNIT-III	**REAL TIME KERNEL**	**12 Hours**
VxWorks Scheduling and Task Management - Real-time scheduling, Task Creation, Intertask Communication, Pipes, Semaphore, Message Queue, Signals, Sockets, Interrupts I/O Systems - General Architecture, Device Driver Studies, Driver Module explanation, Implementation of Device Driver for a peripheral Case study using Vxworks.		
UNIT-IV	**REAL TIME MODELS AND LANGUAGES**	**12 Hours**
Event Based – Process Based and Graph based Models – Real Time Languages – RTOS Tasks – RT scheduling - Interrupt processing – Synchronization – Control Blocks – Memory Requirements.		
UNIT-V	**RTOS APPLICATION DOMAINS**	**12 Hours**
Case studies- RTOS for Image Processing – Embedded RTOS for Network Communication – RTOS for fault-Tolerant Applications – RTOS for Control Systems.		
	Total Hours	**60 Hours**

Text Book(s)

1.	Silberschatz, Galvin, Gagne "Operating System Concepts", 6th ed, John. Wiley,2003 **ACC.NO: B132752.**
2.	D.M.Dhamdhere," Operating Systems, A Concept-Based Approch,TMH,2008
3.	Raj Kamal, "Embedded Systems- Architecture, Programming and Design" Tata McGraw Hill, 2006. **ACC.NO: B133063.**
4.	Herma K., "Real Time Systems – Design for distributed Embedded Applications", Kluwer Academic, 1997.
5.	Charles Crowley, "Operating Systems-A Design Oriented approach" McGraw Hill,1997.
6.	C.M. Krishna, Kang, G.Shin, "Real Time Systems", McGraw Hill, 1997.
7.	Raymond J.A.Bhur, Donald L.Bailey, "An Introduction to Real Time Systems", PHI1999.
8.	Mukesh Sighal and N G Shi "Advanced Concepts in Operating System", McGraw Hill **ACC.NO: B132360**.
9.	VxWorks Programmers Guide.
10.	VxWorks Reference Manual.

SYLLABUS (2023-24)
M.E (EMBEDDED SYSTEM TECHNOLOGIES)

Course Code		L	T	P	C	IA	EA	TM
Course Name	SOFTWARE TECHNOLOGY FOR EMBEDDED SYSTEMS	3	1	0	3	40	60	100
Course Category		Syllabus Revision					V.1.0	
Pre-requisite								

Course Objectives:
The course should enable the students -

1. Use of C language for embedded applications, concepts, co-design methods.

Course Outcomes:
On completion of the course, the student will be able to

Course Outcomes	Description
CO1	Develop knowledge in using of Programming Embedded Systems.
CO2	Develop knowledge in using of C and Assembly .
CO3	Develop knowledge in using of Embedded Program and Software Development Process.
CO4	Develop knowledge in using of C language and UML Language for a real time application.
CO5	Develop knowledge in using of web architectural framework for embedded system.

UNIT-I	PROGRAMMING EMBEDDED SYSTEMS	12 Hours

Embedded Program – Role of Infinite loop – Compiling, Linking and locating – downloading and debugging – Emulators and simulators processor – External peripheral s – Toper of memory – Memory testing – Flash Memory.

UNIT-II	C AND ASSEMBLY	12 Hours

Overview of Embedded C - Compilers and Optimization - Programming and 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	EMBEDDED PROGRAM AND SOFTWARE DEVELOPMENT PROCESS	12 Hours

Program Elements – Queues – Stack- List and ordered lists- Embedded programming in C++ - Inline Functions and Inline Assembly - Portability Issues - Embedded Java- Software Development process: Analysis – Design- Implementation – Testing – Validation- Debugging - Software maintenance.

UNIT-IV	UNIFIED MODELLING LANGUAGE	12 Hours

Course Code		L	T	P	C	IA	EA	TM

	Object State Behaviour – UML State charts – Role of Scenarios in the Definition of Behaviour – Timing Diagrams – Sequence Diagrams – Event Hierarchies – Types and Strategies of Operations – Architectural Design in UML Concurrency Design – Representing Tasks – System Task Diagram – Concurrent State Diagrams – Threads. Mechanistic Design – Simple Patterns.	
UNIT-V	**WEB ARCHITECTURAL FRAMEWORK FOR EMBEDDED SYSTEM**	**12 Hours**
	Basics – Client/Server model- Domain Names and IP address – Internet Infrastructure and Routing – URL – TCP/IP protocols - Embedded as Web Client - Embedded Web servers - HTML - Web security - Case study: Web-based Home Automation system.	
	Total Hours	**60 Hours**

Text Book(s)

1.	David E.Simon: "An Embedded Software Primer", Pearson Educat ion, 2003 **ACC.NO: B102775.**
2.	Michael Barr, "Programming Embedded Systems in C and C+ +" Oreilly, 2003.
3.	H.M. Deitel , P.J.Deitel, A.B. Golldberg " Internet a nd World Wide Web – How to Program" Third Edition, Pearson Education, 2001. **ACC.NO: B111693.**
4.	Bruce Powel Douglas, "Real-Time UML, Second Edition: Developing Efficient Object for Embedded Systems, 2nd edition ,1999, Addison-Wesley.
5.	Daniel W.lewis "Fundamentals of Embedded Software where C and Assembly meet" PHI 2002. **ACC.NO: B100506.**
6.	Raj Kamal, "Embedded Systems- Architecture, Programming and Design" TMH, 2006. **ACC.NO: B133063.**

Course Name	EMBEDDED NETWORKING	3	1	0	3	40	60	100
Course Category		Syllabus Revision					V.1.0	
Pre-requisite								

Course Objectives:

The course should enable the students -

1. To impart knowledge on Serial and parallel communication protocols
2. Application Development using USB and CAN bus for PIC microcontrollers
3. Application development using Embedded Ethernet for Rabbit processors. Wireless sensor network communication protocols.

Course Outcomes:

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

Course Outcomes	Description
CO1	Develop knowledge in the protocols, embedded communication protocols.
CO2	Develop knowledge in USB and CAN bus.
CO3	Develop knowledge in controller area network.
CO4	Develop knowledge in embedded ethernet.
CO5	Develop knowledge in wireless embedded networking related application.

UNIT-I	EMBEDDED COMMUNICATION PROTOCOLS	12 Hours

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

UNIT-II	USB AND CAN BUS	12 Hours

USB bus – Introduction – Speed Identification on the bus – USB States – USB bus communication: Packets –Data flow types –Enumeration –Descriptors –PI C 18 Microcontroller

USB Interface – C Programs –CAN Bus – Introduction - Frames –Bit stuffing –Types of errors –

Nominal Bit Timing – PIC microcontroller CAN Interface –A simple application with CAN.

UNIT-III	CONTROLLER AREA NETWORK	12 Hours

Controller Area Network – Underlying Technology, CAN Overview – Selecting a CAN Controller – CAN development tools. Implementing CAN open Communication layout and requirements – Comparison of implementation methods – Micro CAN open – CAN open source code – Conformance test – Entire design life cycle.

UNIT-IV	EMBEDDED ETHERNET	12 Hours

Exchanging messages using UDP and TCP – Serving web pages with Dynamic Data – Serving web pages that respond to user Input – Email for Embedded Systems – Using FTP – Keeping Devices and Network secure.

UNIT-V	WIRELESS EMBEDDED NETWORKING	12 Hours
Wireless sensor networks – Introduction – Applications – Network Topology – Localization – Time Synchronization - Energy efficient MAC protocols –SMAC – Energy Efficient and robust routing – Data Centric routing.		
	Total Hours	**60 Hours**
Text Book(s)		
1.	Frank Vahid, Givargis 'Embedded Systems Design: A Unified Hardware/ Software Introduction', Wiley Publications	
2.	Jan Axelson, 'Parallel Port Complete', Penram publications.	
3.	Dogan Ibrahim, 'Advanced PIC microcontroller projects in C' , Elsevier 2008.	
4.	Jan Axelson 'Embedded Ethernet and Internet Complete', Penram publications.	
5.	Bhaskar Krishnamachari, 'Networking wireless sensors', Cambridge press, 2005.	
6.	Glaf P.Feiffer, Andrew Ayre and Christian Keyold, "Embedded networking with CAN and CAN open", Embedded System Academy 2005.	

Course Code		L	T	P	C	IA	EA	TM
Course Name	EMBEDDED COMMUNICATION SOFTWARE DESIGN	3	1	0	3	40	60	100
Course Category		Syllabus Revision					V.1.0	
Pre-requisite								

Course Objectives:
The course should enable the students -

1. To know about the OSI Model for Embedded Communication.
2. To know about the software design for the communication.

Course Outcomes:
On completion of the course, the student will be able to

Course Outcomes	Description
CO1	Develop knowledge and understanding the various aspects of OSI reference model.
CO2	Develop knowledge and understanding the various aspects of software partitioning.
CO3	Develop knowledge and understanding the various aspects tables & other data structures.
CO4	Develop knowledge and understanding the various aspects of management software.
CO5	Develop knowledge and understanding the various aspects of multi board communication software design.

UNIT-I	OSI REFERENCE MODEL	12 Hours

Communication Devices – Communication Echo System – Design Consideration – Host Based Communication – Embedded Communication System – OS Vs RTOS.

UNIT-II	SOFTWARE PARTITIONING	12 Hours

Limitation of strict Layering – Tasks & Modules – Modules and Task Decomposition –Layer2 Switch – Layer3 Switch / Routers – Protocol Implementation – Management Types – Debugging Protocols.

UNIT-III	TABLES & OTHER DATA STRUCTURES	12 Hours

Partitioning of Structures and Tables – Implementation – Speeding Up access – Table Resizing – Table access routines – Buffer and Timer Management – Third Party Protocol Libraries.

UNIT-IV	MANAGEMENT SOFTWARE	12 Hours

Device Management – Management Schemes – Router Management – Management of Sub System Architecture – Device to manage configuration – System Start up and configuration.

UNIT-V	**MULTI BOARD COMMUNICATION SOFTWARE DESIGN**	**12 Hours**
Multi Board Architecture – Single control Card and Multiple line C and Architecture –Interface for Multi Board software – Failures and Fault – Tolerance in Multi Board Systems – Hardware independent development – Using a COTS Board – Development Environment – Test Tools.		
	Total Hours	**60 Hours**
Text Book(s)		
1.	Sridhar .T, “Designing Embedded Communication Software” CMP Books, 2003.	
2.	Comer.D, "Computer networks and Internet”, Third Edition, Prentice Hall, 2001.	

Course Code		L	T	P	C	IA	EA	TM
Course Name	EMBEDDED SYSTEMS LABORATORY	3	1	0	3	40	60	100
Course Category		Syllabus Revision					V.1.0	
Pre-requisite								

Course Objectives:

The course should enable the students -

1. To design 8051,PIC and 16 bit processors for I/O programming, serial port programming for PWM generation, motor control , LCD, RTC and Sensor interfacing.
2. To design and analyse wired/wireless networks using NS2 simulator.

Course Outcomes:

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

Course Outcomes	Description
CO1	Design 8-bit Microcontrollers.
CO2	Design 16-bit Microcontrollers.
CO3	Design ARM Processor.
CO4	Design Xilinx/Altera FPGA and CPLD.
CO5	Design Network Simulators.

LIST OF EXPERIMENTS

1. Design with 8 bit Microcontrollers 8051/PIC Microcontrollers.
   i)I/O Programming, Timers, Interrupts, Serial port programming.
   ii) PWM Generation, Motor Control, ADC/DAC, LCD and RTC Interfacing, Sensor Interfacing.
   iii) Both Assembly and C programming.
2. Design with 16 bit processors. I/O programming, Timers, Interrupts, Serial Communication.
3. Design with ARM Processors. I/O programming, ADC/DAC, Timers, Interrupts.
4. Study of one type of Real Time Operating Systems (RTOS).
5. Electronic Circuit Design of sequential, combinational digital circuits using CAD Tools.
6. Simulation of digital controllers using MATLAB/LabVIEW.
7. Programming with DSP processors for Correlation, Convolution, Arithmetic adder, Multiplier, Design of Filters - FIR based IIR based.
8. Design with Programmable Logic Devices using Xilinx/Altera FPGA and CPLD.
9. Design and Implementation of simple Combinational/Sequential Circuit
10. Network Simulators Simple wired/ wireless network simulation using NS2.
11. Programming of TCP/IP protocol stack.

Total Hours	60 Hours

Course Code		L	T	P	C	IA	EA	TM
Course Name	ADVANCED DIGITAL SIGNAL PROCESSING	3	1	0	3	40	60	100
Course Category		Syllabus Revision					V.1.0	
Pre-requisite								

Course Objectives:

The course should enable the students -

1. To make the student learn: theory of DSP, design of digital signal processing applications and an introduction to DSP processors.

Course Outcomes:

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

Course Outcomes	Description
CO1	Develop knowledge of discrete random signal used in the embedded system.
CO2	Develop knowledge of estimation and prediction techniques used in the embedded system.
CO3	Develop knowledge of digital signal processor used in the embedded system.
CO4	Develop knowledge of application of VLSI implementation techniques used in the embedded system.
CO5	Develop knowledge of VLSI implementation used in the embedded system.

UNIT-I	DISCRETE RANDOM SIGNAL	12H|ours

Discrete Random Processing – Expectations – Variance – Co-Variance – Scalar Product – Energy of Discrete Signals – Parseval's Theorem – Wiener Khintchine Relation – Power Spectral Density – Periodogram. Autocorrelation – Sum Decomposition Theorem – Spectral Factorization Theorem – Discrete Random Signal Processing by Linear Systems – Simulation of White Noise – Low Pass Filtering of White Noise.

UNIT-II	ESTIMATION AND PREDICTION TECHNIQUES	12Hours

Discrete Random Processes – Ensemble averages, Stationary processes, Autocorrelation and Auto covariance matrices. Parseval's Theorem, Wiener-Khintchine Relation – Power Spectral Density **.** AR, MA, ARMA model based spectral estimation. Parameter Estimation, Linear prediction – Forward and backward predictions, Least mean squared error criterion – Wiener filter for filtering and prediction, Discrete Kalman filter.

UNIT-III	DIGITAL SIGNAL PROCESSOR	12Hours

Basic Architecture – Computational building blocks, MAC, Bus Arc hitecture and memory, Data Addressing, Parallelism and pipelining, Parallel I/O interface, Memory Interface, Interrupt, DMA.

UNIT-IV	**APPLICATION OF VLSI IMPLEMENTATION**	**12Hours**
Basics on DSP system architecture design using VHDL programming, Mapping of DSP algorithm onto hardware, Realization of MAC & Filter structure.		
UNIT-V	**VLSI IMPLEMENTATION**	**12Hours**
Basics on DSP system architecture design using VHDL programming, Mapping of DSP algorithm onto hardware, Realization of MAC & Filter structure.		
	Total Hours	**60Hours**

Text Book(s)

1.	Bernard Widrow, Samuel D. Stearns, "Adaptive Signal Processing", Pearson Education, third edition, 2004. **ACC.NO: B130380.**
2.	Dionitris G. Manolakis, Vinay K. Ingle, Stepen M. Kogon,"Statistical & Adaptive signal processing, spectral estimation, signal modeling, Adaptive filtering & Array processing", McGraw-Hill International edition 2000.
3.	Monson H. Hayes, "Statistical Digital Signal Processing and Modelling", John Wiley and Sons, Inc.,
4.	John G. Proaks, Dimitris G. Manolakis, "Digital Signal Pr ocessing", Pearson Education 2002.
5.	S. Salivahanan, A. Vallavaraj and C. Gnanapriya "Digital Signal Processing", TMH,2000. **ACC.NO: B124703**
6.	Avatar Sing, S. Srinivasan, "Digital Signal Processing- Implementation using DSP Microprocessors with Examples from TMS320C54xx", Thomson India, 2004.
7.	Lars Wanhammer, "DSP Integrated Circuits", Academic pres s, 1999,New York.
8.	Ashok Ambardar,"Digital Signal Processing: A Modern Introduction",Thomson India edition, 2007.
9.	Lars Wanhammer, "DSP Integrated Circuits", Academic pres s, 1999,New York.

Course Code		L	T	P	C	IA	EA	TM
Course Name	RISC PROCESSOR ARCHITECTURE AND PROGRAMMING	3	1	0	3	40	60	100
Course Category		Syllabus Revision				V.1.0		
Pre-requisite								

Course Objectives:
The course should enable the students -

1. To teach the architecture of 8 bit RISC processor.
2. To teach the architecture and programming of 16 bit RISC processor.
3. To teach the implementation of DSP in ARM processor.
4. To discuss on memory management in RISC processor.
5. To teach the application development with ARM processor.

Course Outcomes:
On completion of the course, the student will be able to

Course Outcomes	Description
CO1	Develop knowledge in AVR microcontroller architecture and their implementation in various field.
CO2	Develop knowledge in 8 and 16 bit RISC processor and their implementation in various field.
CO3	Develop knowledge in ARM application development and their implementation in various field.
CO4	Develop knowledge in memory protection and management and their implementation in various field.
CO5	Develop knowledge in design with arm microcontrollers and their implementation in various field.

UNIT-I	AVR MICROCONTROLLER ARCHITECTURE	12Hours

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	12Hours

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	ARM APPLICATION DEVELOPMENT	12Hours

Introduction to DSP on ARM –FIR Filter – IIR Filter – Discrete Fourier transform –

Exception Handling – Interrupts – Interrupt handling schemes- Firmware and bootloader – Example: Standalone - Embedded Operating Systems – Fundamental Components - Example Simple little Operating System.		
UNIT-IV	**MEMORY PROTECTION AND MANAGEMENT**	**12Hours**
Protected Regions-Initializing MPU, Cache and Write Buffer-MPU to MMU-Virtual Memory-Page Tables-TLB-Domain and Memory Access Permission-Fast Context Switch Extension.		
UNIT-V	**DESIGN WITH ARM MICROCONTROLLERS**	**12Hours**
Assembler Rules and Directives- Simple ASM/C programs- Hamming Code- Division- Negation-Simple Loops –Look up table- Block copy- subroutines.		
	Total Hours	**60Hours**

Text Book(s)

1.	Steve Furber, 'ARM system on chip architecture', Addision Wesley.
2.	Andrew N. Sloss, Dominic Symes, Chris Wright, John Rayfield 'ARM System Developer's Guide Designing and Optimizing System Software', Elsevier 2007.
3.	Trevor Martin, 'The Insider's Guide To The Philips ARM7-Based Microcontrollers, An Engineer's Introduction To The LPC2100 Series' Hitex (UK) Ltd.,
4.	Dananjay V. Gadre 'Programming and Customizing the AVR microcontroller', McGraw Hill 2001.
5.	William Hohl, ' ARM Assembly Language' Fundamentals and Techniques.
6.	ARM Architecture Reference Manual.
7.	LPC213x User Manual.

Course Code		L	T	P	C	IA	EA	TM
Course Name	WIRELESS AND MOBILE COMMUNICATION	3	1	0	3	40	60	100
Course Category		Syllabus Revision					V.1.0	
Pre-requisite								

Course Objectives:

The course should enable the students -

1. To expose the students to the fundamentals of wireless communication technologies.
2. To teach the fundamentals of wireless mobile network protocols.
3. To study on wireless network topologies.
4. To introduce network routing protocols.

Course Outcomes:

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

Course Outcomes	Description
CO1	Develop knowledge in the basic of technologies, protocol and simulation software.
CO2	Develop knowledge in the basic of technologies and mobile networks.
CO3	Develop knowledge in the basic of wireless networks.
CO4	Develop knowledge in the basic of routing.
CO5	Develop knowledge in the basic of transport and application layers.

UNIT-I	INTRODUCTION	12 Hours

Wireless Transmission – signal propagation – Free space and two ray models – spread spectrum – Satellite Networks –Capacity Allocation –FDMA–TDMA-SDMA-DAMA.

UNIT-II	MOBILE NETWORKS	12 Hours

Cellular Wireless Networks – GSM – Architecture – Protocols – Connection Establishment – Frequency Allocation – Handover – Security – GPRS.

UNIT-III	WIRELESS NETWORKS	12 Hours

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

UNIT-IV	ROUTING	12 Hours

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

UNIT-V	TRANSPORT AND APPLICATION LAYERS	12 Hours
TCP over Adhoc Networks – WAP – Architecture – WWW Programming Model – WDP – WTLS – WTP – WSP – WAE – WTA Architecture – WML – WML scripts.		
	Total Hours	**60 Hours**

Text Book(s)	
1.	Kaveh Pahlavan, Prasanth Krishnamoorthy, "Principles of Wireles s Networks' PHI/Pearson Education, 2003 **ACC.NO: B122027**.
2.	C. Siva Ram Murthy and B.S. Manoj, Adhoc Wireless Networks: Architectures and protocols, Prentice Hall PTR, 2004
3.	Uwe Hansmann, Lothar Merk, Martin S. Nicklons and Thomas Stober, " Principles of Mobile computing", Springer, New york, 2003. **ACC.NO: B129477.**
4.	C.K.Toh, " AdHoc mobile wireless networks", Prentice Hal l, Inc, 2002.
5.	Charles E. Perkins, "Adhoc Networking", Addison-Wesley, 2001.
6.	Jochen Schiller, "Mobile communications", PHI/Pearson Educati on, Second Edition, 2003 **ACC.NO: B132742.**
7.	William Stallings, "Wireless communications and Networks", PHI/Pearson Education, 2002.

Course Code		L	T	P	C	IA	EA	TM
Course Name	BIG DATA ANALYTICS	3	1	0	3	40	60	100
Course Category		Syllabus Revision					V.1.0	
Pre-requisite								

Course Objectives:

The course should enable the students -

1. To understand big data analytics as the next wave for businesses looking for competitive advantage.
2. To understand the financial value of big data analytics.
3. To explore tools and practices for working with big data.
4. To understand how big data analytics can leverage into a key component .
5. To understand how to mine the data.
6. To learn about stream computing.
7. To know about the research that requires the integration of large amounts of data.

Course Outcomes:

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

Course Outcomes	Description
CO1	Identify the need for big data analytics for a domain.
CO2	Identify the need for Data analysis for a domain.
CO3	Contextually integrate and correlate large amounts of information automatically to gain faster insights**.**
CO4	Suggest areas to apply big data to increase business outcome.
CO5	Use Hadoop, Map Reduce Framework Apply big data analytics for a given problem.

UNIT-I	INTRODUCTION TO BIG DATA	12 Hours

Analytics – Nuances of big data – Value – Issues – Case for Big data – Big data options Team challenge – Big data sources – Acquisition – Nuts and Bolts of Big data. Features of Big Data - Security, Compliance, auditing and protection - Evolution of Big data – Best Practices for Big data Analytics - Big data characteristics - Volume, Veracity, Velocity, Variety – Data Appliance and Integration tools – Green plum – Informatics.

UNIT-II	DATA ANALYSIS	12 Hours

Evolution of analytic scalability – Convergence – parallel processing systems – Cloud computing – grid computing – map reduce – enterprise analytic sand box – analytic data sets – Analytic methods – analytic tools – Cognos – Microstrategy - Pentaho. Analysis approaches – Statistical significance – business approaches – Analytic innovation – Traditional approaches – Iterative

UNIT-III	STREAM COMPUTING	12 Hours

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 - Real time Analytics Platform (RTAP) applications IBM Infosphere – Big data at rest – Infosphere streams – Data stage – Statistical analysis – Intelligent scheduler – Infosphere Streams.		
UNIT-IV	**PREDICTIVE ANALYTICS AND VISUALIZATION**	**12 Hours**
Predictive Analytics – Supervised – Unsupervised learning – Neural networks – Kohonen models – Normal – Deviations from normal patterns – Normal behaviours – Expert options – Variable entry - Mining Frequent item sets - Market based model – A priori Algorithm – Handling large data sets in Main memory – Limited Pass algorithm – Counting frequent item sets in a stream – Clustering Techniques – Hierarchical– K-Means – Clustering high dimensional data Visualizations -Visual data analysis techniques, interaction techniques; Systems and applications.		
UNIT-V	**FRAMEWORKS AND APPLICATIONS**	**12 Hours**
IBM for Big Data – Map Reduce Framework - Hadoop – Hive – Sharding – NoSQL Databases - S3 - Hadoop Distributed file systems – Hbase – Impala – Analyzing big data with twitter – Big data for ECommerce – Big data for blogs.		
	Total Hours	**60 Hours**

Text Book(s)

1	Frank J Ohlhorst, “Big Data Analytics: Turning Big Data into Big Money”, Wiley and SAS Business Series, 2012.
2.	Colleen Mccue, “Data Mining and Predictive Analysis: Intelligence Gathering and Crime Analysis”, Elsevier, 2007
3.	Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer, 2007.
4.	Anand Rajaraman and Jeffrey David Ullman, Mining of Massive Datasets, Cambridge University Press, 2012.
5.	Bill Franks, “Taming the Big Data Tidal Wave: Finding Opport unities in Huge Data Streams with Advanced Analytics”, Wiley and SAS Business Series, 2012.
6.	Paul Zikopoulos, Chris Eaton, Paul Zikopoulos, “Understanding Big Data : Analytics for Enterprise Class Hadoop and Streaming Data”, McGraw Hill, 2011.
7.	Paul Zikopoulos, Dirk deRoos, Krishnan Parasuraman, Thomas Deutsch , James Giles, David Corrigan, “Harness the Power of Big data – The big data plat form”, McGraw Hill, 2012.
8.	Glenn J. Myatt, Making Sense of Data, John Wiley & Sons, 2007
9.	Pete Warden, Big Data Glossary, O’Reilly, 2011.
10.	Jiawei Han, Micheline Kamber “Data Mining Concepts and Techniques”, Second Edition, Elsevier, Reprinted 2008.

Course Code		L	T	P	C	IA	EA	TM
Course Name	ASIC DESIGN	3	1	0	3	40	60	100
Course Category		Syllabus Revision				V.1.0		
Pre-requisite								

Course Objectives:
The course should enable the students -

1. To Develop knowledge in basic transistor logic.
2. To Develop knowledge in various programming platform like Altera, Xilinx.

Course Outcomes:
On completion of the course, the student will be able to

Course Outcomes	Description
CO1	Develop knowledge in Introduction TO ASICS, CMOS Logic and ASIC Library Design.
CO2	Develop knowledge in programmable ASICS, programmable ASIC logic cells and programmbale ASIC I/O cells.
CO3	Develop knowledge in programmable ASIC interconnect, programmable asic design software and low level design entry.
CO4	Develop knowledge in logic synthesis, simulation and testing.
CO5	Develop knowledge in ASIC construction, floor planning, placement and routing.

UNIT-I	INTRODUCTION TO ASICS, CMOS LOGIC AND ASIC LIBRARY DESIGN	12 Hours

Types of ASICs – Design Flow – CMOS transistors, CMOS design rules – Combinational Logic Cell – Sequential logic cell – Data path logic cell – Transistors as Resistors – Transistor Parasitic Capacitance – Logical effort – Library cell design – Library architecture.

UNIT-II	PROGRAMMABLE ASICS, PROGRAMMABLE ASIC LOGIC CELLS AND PROGRAMMBALE ASIC I/O CELLS	12 Hours

Anti fuse – static RAM – EPROM and EEPROM technology – PREP bench marks – Actel ACT – Xilinx LCA – Altera FLEX – Altera MAX DC & AC inputs and output s – Clock and power inputs – Xilinx I/O blocks.

UNIT-III	PROGRAMMABLE ASIC INTERCONNECT, PROGRAMMABLE ASIC DESIGN SOFTWARE AND LOW LEVEL DESIGN ENTRY	12 Hours

Actel ACT – Xilinx LCA – Xilinx EPLD – Altera MAX 5000 and 7000 – Altera MAX 9000 Altera FLEX – Design systems – Logic Synthesis – Half Gate ASIC – Schematic entry –

Low level design language – PLA tools – EDIF – CFI design representation.		
UNIT-IV	**LOGIC SYNTHESIS, SIMULATION AND TESTING**	**12 Hours**
Verilog and logic synthesis – VHDL and logic synthesis - Types of simulation – Boundary scan test – Fault simulation – Automatic test pattern generation.		
UNIT-V	**ASIC CONSTRUCTION, FLOOR PLANNING, PLACEMENT AND ROUTING**	**12 Hours**
System partition – FPGA partitioning – partitioning methods – physical design flow – global routing – detailed routing – specific DRC. floor planning – placement – al routing – circuit extraction.		
	Total Hours	**60 Hours**

Text Book(s)

1.	M.J.S. SMITH, "Application – Specific Integrated Circuits" Addison-Wesley Longman Inc., 1997.
2.	Andrew Brown, "VLSI Circuits and Systems in Silicon", Mc Graw Hill, 1991.
3.	S.D.Brown, R.J.Francis, J.Rox, Z.G.Uranesic, "Field Programmable Gate Arrays" – Kluever Academic Publishers, 1992.
4.	Mohammed Ismail and Terri Fiez, "Analog VLSI Signal and Information Processing", McGraw Hill, 1994.
5.	S.Y. Kung, H.J.Whilo House, T.Kailath, "VLSI and Modern Signal Processing", Prentice Hall,1985.
6.	Jose E.France, Yannis Tsividis, "Design of Analog – Digital VLSI Circuits for Telecommunication and Signal Processing", Prentice Hall, 1994.

Course Code		L	T	P	C	IA	EA	TM
Course Name	EMBEDDED LINUX	3	1	0	3	40	60	100
Course Category		Syllabus Revision				V.1.0		
Pre-requisite								

Course Objectives:
The course should enable the students -

1. To Develop knowledge of usage of LINUX in Embedded Systems.

Course Outcomes:
On completion of the course, the student will be able to

Course Outcomes	Description
CO1	Understand how fundamentals of operating systems is used for embedded application.
CO2	Understand how linux fundamentals is used as an OS for embedded application.
CO3	Understand how embedded linux is used as an OS for embedded application.
CO4	Understand how board support package and embedded storage is used as an OS for embedded application.
CO5	Understand the how embedded drivers and application porting is used as an OS for embedded application.

UNIT-I	FUNDAMENTALS OF OPERATING SYSTEMS	12Hours

Overview of operating systems – Process and threads – Processes and Programs – Programmer view of processes – OS View of processes – Threads - Scheduling – Non preemptive and preemptive scheduling – Real Time Scheduling – Process Synchronization – Semaphores – Message Passing – Mailboxes – Deadlocks – Synchronization and scheduling in multiprocessor Operating Systems.

UNIT-II	LINUX FUNDAMENTALS	12Hours

Introduction to Linux – Basic Linux commands and concepts – Logging in - Shell s -Basic text editing - Advanced shells and shell scripting – Linux File System –Linux Programming - Processes and threads in Linux - Inter process communication – Devi ces – Linux System calls.

UNIT-III	INTRODUCTION TO EMBEDDED LINUX	12Hours

Embedded Linux – Introduction – Advantages- Embedded Linux Distributions - Architecture - Linux kernel architecture - User space – linux startup sequence - GNU cross platform Tool chain.

UNIT-IV	**BOARD SUPPORT PACKAGE AND EMBEDDED STORAGE**	**12Hours**
Inclusion of BSP in kernel build procedure - The boot loader Interface – Memory Map – Interrupt Management – PCI Subsystem – Timers – UART – Power Management – Embedded Storage – Flash Map – Memory Technology Device (MTD) –MTD Architecture - MTD Driver for NOR Flash – The Flash Mapping drivers – MTD Block and character dev ices – mtdutils package – Embedded File Systems – Optimizing storage space – Turning kernel memory.		
UNIT-V	**EMBEDDED DRIVERS AND APPLICATION PORTING**	**12Hours**
Linux serial driver – Ethernet driver – I2C subsystem – USB gadgets – Watchdog timer – Kernel Modules – Application porting roadmap - Programming with threads – Operating System Porting Layer – Kernel API Driver - Case studies - RT Linux – uClinux.		
	Total Hours	**60Hours**

Text Book(s)

1.	Dhananjay M. Dhamdhere, ‘Operating Systems A concept based Approach’, Tata Mcgraw-Hill Publishing Company Ltd.
2.	Matthias Kalle Dalheimer, Matt Welsh, ’Running Linux’, O’Reilly Publications 2005.
3.	Mark Mitchell, Jeffrey Oldham and Alex Samuel ‘Advanced Linux Programming’ New Riders Publications.
4.	P. Ragavan ,Amol Lad , Sriram Neelakandan, ‘Embedded Linux System Design and Development’, Auerbach Publications, 2006.
5.	Karim Yaghmour, ‘Building Embedded Linux Systems’, O'Reilly Publications 2003.

Course Code		L	T	P	C	IA	EA	TM
Course Name	VLSI ARCHITECTURE AND DESIGN METHODOLOGIES	3	1	0	3	40	60	100
Course Category		Syllabus Revision					V.1.0	
Pre-requisite								

Course Objectives:
The course should enable the students -

1. To have a knowledge in CMOS Design.
2. To Develop knowledge in PLD Devices.
3. To have in floor plan design in VLSI.

Course Outcomes:
On completion of the course, the student will be able to

Course Outcomes	Description
CO1	Develop knowledge and the understanding about the various aspects involved in the CMOS design.
CO2	Develop knowledge and the understanding about the various aspects involved in the programable logic devices.
CO3	Develop knowledge and the understanding about the various aspects involved in the ASIC construction, floor planning, placement and routing.
CO4	Develop knowledge and the understanding about the various aspects involved in the analog VLSI design.
CO5	Develop knowledge and the understanding about the various aspects involved in the logic synthesis and simulation.

UNIT-I	CMOS DESIGN	12 Hours

Overview of digital VLSI design Methodologies- Logic design with CMOS-transmission gate circuits-Clocked CMOS-dynamic CMOS circuits, Bi-CMOS circuits- Layout diagram, Stick diagram-IC fabrications – Trends in IC technology.

UNIT-II	PROGRAMABLE LOGIC DEVICES	12 Hours

Programming Techniques-Anti fuse-SRAM-EPROM and EEPROM technology – Re-Programmable Devices Architecture- Function blocks, I/O blocks, Interconnects, Xilinx-XC9500,Cool Runner - XC-4000,XC5200, SPARTAN, Virtex - Altera MAX 7000-Flex 10KStratix.

UNIT-III	ASIC CONSTRUCTION, FLOOR PLANNING,PLACEMENT AND ROUTING	12 Hours

System partition – FPGA partitioning – Partitioning methods- floor planning – placement physical design flow – global routing – detailed routing – special routing- circuit extraction – DRC		
UNIT-IV	**ANALOG VLSI DESIGN**	**12 Hours**
Introduction to analog VLSI- Design of CMOS 2stage-3 stage Op-Amp –High Speed and High frequency op-amps-Super MOS-Analog primitive cells-realization of neural networks.		
UNIT-V	**LOGIC SYNTHESIS AND SIMULATION**	**12 Hours**
Overview of digital design with Verilog HDL, hierarchical modelling concepts, modules and port definitions, gate level modelling, data flow modelling, behavioural modelling, task & functions, Verilog and logic synthesis-simulation-Design examples, Ripple carry Adders, Carry Look ahead adders, Multiplier, ALU, Shift Registers, Multiplexer, Comparator, Test Bench.		
	Total Hours	**60 Hours**
Text Book(s)		
1.	M.J.S Smith, "Application Specific integrated circuits", Addition Wesley Longman Inc.1997.	
2.	Kamran Eshraghian, Douglas A.pucknell and Sholeh Eshraghian," Essentials of VLSI circuits and system", Prentice Hall India,2005.	
3.	Wayne Wolf, "Modern VLSI design " Prentice Hall India,2006. **ACC.NO: B134477**	
4.	Mohamed Ismail, Terri Fiez, "Analog VLSI Signal and information processing",McGraw Hill International Editions,1994.	
5.	Samir Palnitkar, "VeriLog HDL, A Design guide to Digital and Synthesis" 2 nd Ed, Pearson,2005.	

Course Code		L	T	P	C	IA	EA	TM
Course Name	PRINCIPLES OF ROBOTICS	3	1	0	3	40	60	100
Course Category		Syllabus Revision					V.1.0	
Pre-requisite								

Course Objectives:

The course should enable the students -

1. To have basic knowledge about robotics.
2. To Develop knowledge in image processing and Vision.

Course Outcomes:

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

Course Outcomes	Description
CO1	Understanding the various aspects of robotics and how image and vision systems are processed.
CO2	Understanding the various aspects of kinematics.
CO3	Understanding the various aspects of differential motion & velocities.
CO4	Understanding the various aspects of robot control system.
CO5	Understanding the various aspects of image processing & vision systems.

UNIT-I	INTRODUCTION AND TERMINOLOGIES	12Hours

Definition-Classification-History- Robots components-Degrees of freedom-Robot joints coordinates- Reference frames-workspace-Robot languages-actuators-sensors-Position, velocity and acceleration sensors-Torque sensors-tactile and touch sensors proximity and range sensors-social issues.

UNIT-II	KINEMATICS	12Hours

Mechanism-matrix representation-homogenous transformation-DH representation- Inverse kinematics-solution and programming-degeneracy and dexterity.

UNIT-III	DIFFERENTIAL MOTION & VELOCITIES	12Hours

Jacobian-differential motion of frames-Interpretation-calculation of Jacobian - Inverse Jacobian - Design - Lagrangian mechanics-dynamic equations-static force analysis.

UNIT-IV	ROBOT CONTROL SYSTEM	12Hours

Sensor characteristics- Hydraulic, Pneumatic and electric actuators-trajectory planning decentralised PID control- non-linear decoupling control.

UNIT-V	IMAGE PROCESSING & VISION SYSTEMS	12Hours

Two and three dimensional images-spatial and frequency domain representation-noise and

edges-convolution masks-Processing techniques - thresholding - noise reduction edge detection-segmentation-Image analysis and object recognition.	
Total Hours	**60Hours**
Text Book(s)	
1.	Saeed B. Niku ,"Introduction to Robotics ", Pearson Education, 2002 **ACC.NO: B66274.**
2.	Fu, Gonzalez and Lee Mcgrahill ,"Robotics ", international **ACC.NO: B135132.**
3.	R.D. Klafter, TA Chmielewski and Michael Negin, "Robotic Engineering, An Integrated approach", Prentice Hall of India, 2003. **ACC.NO: B19966.**

Course Code		L	T	P	C	IA	EA	TM
Course Name	APPLICATIONS OF MEMS TECHNOLOGY	3	1	0	3	40	60	100
Course Category		Syllabus Revision					V.1.0	
Pre-requisite								

Course Objectives:
The course should enable the students -

1. To Develop knowledge in the basic of MEMS fabrication.
2. To Develop knowledge about sensors in MEMS.

Course Outcomes:
On completion of the course, the student will be able to

Course Outcomes	Description
CO1	Develop knowledge in basic of MEMS: Micro-Fabrication, Materials and Electro Mechanical Concepts.
CO2	Develop knowledge in basic of electrostatic sensors and actuation.
CO3	Develop knowledge in basic of Thermal Sensing and Actuation.
CO4	Develop knowledge in basic of Piezoelectric Sensing and Actuation.
CO5	Develop knowledge in Sensors used for the application development.

UNIT-I	MEMS: MICRO-FABRICATION, MATERIALS AND ELECTRO MECHANICAL CONCEPTS	12 Hours

Overview of micro fabrication – Silicon and other material based fabrication processes – Concepts: Conductivity of semiconductors-Crystal planes and orientation-stress and strain-flexural beam bending analysis-torsional deflections-Intrinsic stress- resonant frequency and quality factor.

UNIT-II	ELECTROSTATIC SENSORS AND ACTUATION	12 Hours

Principle, material, design and fabrication of parallel plate capacitors as electrostatic sensors and actuators-Applications.

UNIT-III	THERMAL SENSING AND ACTUATION	12 Hours

Principle, material, design and fabrication of thermal couples, thermal bimorph sensors, thermal resistor sensors-Applications.

UNIT-IV	PIEZOELECTRIC SENSING AND ACTUATION	12 Hours

Piezoelectric effect-cantilever Piezoelectric actuator model-properties of piezoelectric materials-Applications.

UNIT-V	CASE STUDIES	12 Hours
Piezoresistive sensors, Magnetic actuation, Microfluidics applications, Medical applications, Optical MEMS.		
	Total Hours	**60 Hours**
Text Book(s)		
1.	Chang Liu, "Foundations of MEMS", Pearson International Edition, 2006. **ACC.NO: B127890.**	
2.	Marc Madou , "Fundamentals of microfabrication", CRC Press, 1997. **ACC.NO: B130141**	
3.	Boston , "Micromachined Transducers Sourcebook", WCB McGraw Hill, 1998.	
4.	M.H.Bao "Micromechanical transducers :Pressure sensors, accelerometers and gyroscopes", Elsevier, New york, 2000.	

Course Code		L	T	P	C	IA	EA	TM
Course Name	DIGITAL IMAGE PROCESSING	3	1	0	3	40	60	100
Course Category		Syllabus Revision				V.1.0		
Pre-requisite								

Course Objectives:

The course should enable the students -

1. To have a knowledge in basic of Image Processing.
2. To have a knowledge in various analysis of image.
3. To Develop knowledge in application where image processing is used.

Course Outcomes:

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

Course Outcomes	Description
CO1	Develop knowledge and understanding the basic concepts of image processing, image analysis and the application fundamentals of image processing.
CO2	Develop knowledge and understanding the basic concepts image enhancement.
CO3	Develop knowledge and understanding the basic concepts image segmentation and feature analysis.
CO4	Develop knowledge and understanding the basic concepts multi resolution analysis and compressions.
CO5	Develop knowledge and understanding the basic concepts application of image processing.

UNIT-I	FUNDAMENTALS OF IMAGE PROCESSING	12Hours

Introduction – Steps in image processing systems – Image acquisition – Sampling and Quantization – Pixel relationships – Color fundamentals and models, File formats, Image operations – Arithmetic, Geometric and Morphological.

UNIT-II	IMAGE ENHANCEMENT	12Hours

Spatial Domain: Gray level Transformations – Histogram processing – Spatial filtering smoothing and sharpening. Frequency Domain: Filtering in frequency domain – DFT ,FFT, DCT – Smoothing and sharpening filters – Homomorphic Filtering.

UNIT-III	IMAGE SEGMENTATION AND FEATURE ANALYSIS	12Hours

Detection of Discontinuities – Edge operators – Edge linking and Boundary Detection – Thresholding – Region based segmentation – Morphological Watersheds – Motion Segmentation, Feature Analysis and Extraction.

UNIT-IV	**MULTI RESOLUTION ANALYSIS AND COMPRESSIONS**	**12Hours**
Multi Resolution Analysis: Image Pyramids – Multi resolution expansion – Wavelet Transforms, Image compression: Fundamentals – Models – Elements of Information Theory – Error free compression – Lossy Compression – Compression Standards.		
UNIT-V	**APPLICATION OF IMAGE PROCESSING**	**12Hours**
Image classification – Image recognition – Image understanding – Video motion analysis – Image fusion – Steganography – Digital compositing Mosaics – Colour Image Processing.		
	Total Hours	**60Hours**
Text Book(s)		
1.	Rafael C.Gonzalez and Richard E.Woods, "Digital Image Processing", 2nd Edition, Pearson Education, 2003. **ACC.NO: B134341.**	
2.	Milan Sonka, Valclav Halavac and Roger Boyle, "Image Processing, Analysis and Machine Vision", 2nd Edition, Thomson Learning, 2001.	
3.	Anil K.Jain, "Fundamentals of Digital Image Processing" Pearson Education, 2003. **ACC.NO: B130746.**	

Course Code		L	T	P	C	IA	EA	TM
Course Name	EMBEDDED ANALOG INTERFACING	3	1	0	3	40	60	100
Course Category		Syllabus Revision					V.1.0	
Pre-requisite								

Course Objectives:
The course should enable the students -

1. To have a basic knowledge in measurement system design.
2. To have a knowledge in Analog to Digital Converters.
3. To have a knowledge in Sensors used in interfacing.

Course Outcomes:
On completion of the course, the student will be able to

Course Outcomes	Description
CO1	Develop knowledge and understanding measurement system design.
CO2	Develop knowledge and understanding in analog-to-digital converters.
CO3	Develop knowledge and understanding in sensors & peripherals.
CO4	Develop knowledge and understanding in output control methods.
CO5	Develop knowledge and understanding in microcontroller interfacing.

UNIT-I	MEASUREMENT SYSTEM DESIGN	12Hours

Characteristics of Instrumentation – Measurement accuracy – Measurement standards – Dynamic Range – Calibration – Bandwidth – Digital interfacing advantages.

UNIT-II	ANALOG-TO-DIGITAL CONVERTERS	12Hours

Types of ADCs - ADC Comparison - Sample and Hold - ADC Types - Flash ADC - Successive Approximation ADC - Dual-Slope (Integrating) ADC - Sigma - Delta ADC - Microprocessor Interfacing - Clocked Interfaces - Serial Interfaces – Integrated ADC Embedded Controllers.

UNIT-III	SENSORS & PERIPHERALS	12Hours

Temperature Sensors - Optical Sensors – CCDs - Magnetic Sensor s - Motion/Acceleration Sensors - Strain Gauges - Solenoids – Heaters – Coolers – LEDs – DACs – Digital Potentiometers - Analog Switches - Stepper Motors - DC Motors.

UNIT-IV	OUTPUT CONTROL METHODS	12Hours
Measuring Period versus Frequency - Voltage-to-Frequency Converters - Open-Loop Control - Negative Feedback and Control - Microprocessor-Based Systems- On-Off Control – Proportional Control - Proportional, Integral, Derivative Control - Motor Control - Predictive Control - Measuring and Analyzing Control Loops.		
UNIT-V	**MICROCONTROLLER INTERFACING**	**12Hours**
Standard Interfaces - IEEE 1451.2 - 4–20 ma Current Loop – Field bus - Microcontroller Supply and Reference - Resistor Networks - Multiple Input Control -AC Control - Voltage Monitors and Supervisory Circuits - Driving Bipolar Transistors/ MOSFET- Reading Negative Voltages – PWM based control.		
	Total Hours	**60Hours**

Text Book(s)

1.	Stuart R. Ball, Analog Interfacing to Embedded Microprocessor Systems, Newnes, 2nd Edition ,2003.
2.	John G. Webster , Handbook of measurement, Instrumentation, & sensors, John Wiley &Sons Inc, New York-1998.
3.	Dogan Ibrahim, Microcontroller-Based Temperature Monitoring and Control, Newnes, 2nd Edition ,2002.

Course Code		L	T	P	C	IA	EA	TM
Course Name	EMBEDDED AUTOMOTIVE NETWORKING WITH CAN	3	1	0	3	40	60	100
Course Category		Syllabus Revision					V.1.0	
Pre-requisite								

Course Objectives:
The course should enable the students -

1. To Develop knowledge in basic of data communication.
2. To have a knowledge in Layers of CAN Network.

Course Outcomes:
On completion of the course, the student will be able to

Course Outcomes	Description
CO1	Develop knowledge and understand the basic of data communication.
CO2	Develop knowledge and understand the basic of CAN data link layer.
CO3	Develop knowledge and understand the basic of CAN physical layer.
CO4	Develop knowledge and understand the basic of CAN protocol controllers.
CO5	Develop knowledge and understand the basic of CAN higher layer protocols.

UNIT-I	DATA COMMUNICATION BASICS	12Hours

Data communication basics - Network communication protocol – Medium access control – Error checking & control – Requirements & applications of field bus systems- Characteristics of CAN.

UNIT-II	CAN DATA LINK LAYER	12Hours

CAN data link layer – Principles of bus arbitration – Frame formats – Error detection & error handling – Extended frame format – Time triggered multiplexing.

UNIT-III	CAN PHYSICAL LAYER	12Hours

Physical signaling – Transmission media – Network topology – Bus medium access – Physical layer standards.

UNIT-IV	CAN PROTOCOL CONTROLLERS	12Hours

CAN protocol controllers – Functions of a CAN controller – Message filtering – Message handling - Standalone CAN controllers – Integrated CAN controller s – CAN transceivers.

UNIT-V	CAN HIGHER LAYER PROTOCOLS	12Hours

CAN application layer – Protocol architecture – CAN message specification – Allocation of message identifiers – Network management – Layer management – Higher layer

protocols - CAN open – Device Net – SAEJ1939 – Time triggered CAN.	
Total Hours	**60Hours**
Text Book(s)	
1.	Konrad Etschberger, Controller Area Network , IXXAT Automation GmbH, 2001.
2.	Wolfhard Lawrenz, CAN System Engineering: From Theory to Practical Applications, Springer,1997.
3.	Glaf P.Feiffer, Andrew Ayre and Christian Keyold “Embedded Networking with CAN and CAN open”. Embedded System Academy 2005.
4.	Francoise Simonot-Lion, Handbook of Automotive Embedded Systems ,CRC Press,2007.
5.	http://www.can-cia.org/can/.
6.	http://www.semiconductors.bosch.de/en/20/can/3-literature.asp.

Course Code		L	T	P	C	IA	EA	TM
Course Name	EMBEDDED SYSTEM DESIGN USING ARM PROCESSOR	3	1	0	3	40	60	100
Course Category		Syllabus Revision					V.1.0	
Pre-requisite								

Course Objectives:
The course should enable the students -

1. To have a knowledge about ARM fundamentals.
2. To have a knowledge of writing codes.

Course Outcomes:
On completion of the course, the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Develop knowledge in the fundamentals of principles of embedded system.	
CO2	Develop knowledge in the fundamentals of ARM processor fundamentals.	
CO3	Develop knowledge in the fundamentals of caches and MMU.	
CO4	Develop knowledge in the fundamentals of optimized primitives.	
CO5	Develop knowledge in the fundamentals of ARM processor and understand how to write the assembly code in ARM.	

UNIT-I	PRINCIPLES OF EMBEDDED SYSTEM	12 Hours

Introduction - Embedded systems description, definition, design considerations & requirements - Overview of Embedded system Architecture - Categories of Embedded Systems – Product specifications - hardware/software partitioning - iterations and implementation – hardware software integration - product testing techniques. Wired Communication Protocols: UART – Inter Integrated Circuit (I2C) - Serial Peripheral Interface (SPI) - Controller Area Network (CAN).Wireless communication Protocols: Zigbee Protocols – Bl ue tooth Protocols - IrDA.

UNIT-II	ARM PROCESSOR FUNDAMENTALS	12 Hours

ARM core Introduction – Registers – Current Program Status Register – Pipeline – Exception – Interrupts – Vector Table – Core Extension – Architecture Revisions – ARM Processor Families – ARM Instruction Set – Thumb Instruction set – Thumb Register Usage – ARM – Thumb Interworking – Stack Instruction – Software Interrupt Instruction.

UNIT-III	CACHES AND MMU	12 Hours

The Memory Hierarchy and Cache Memory – Cache Architecture - Cache Policy – Co

Processor and Caches – Flushing and Cleaning Cache Memory – Cache Lockdown – Caches and Software Performance. MMU: Moving from an MPU to an MMU – Virtual Memory – Details of ARM MMU – The Caches and Write Buffer – Co Processor and MMU configuration.		
UNIT-IV	**OPTIMIZED PRIMITIVES**	**12 Hours**
Double Precision Integer Multiplication – Integer Normalization and count Leading Zeros – Division – Square Roots – Transcendental Functions : Log,, exp, sin, cos – Endian Reversal and Bit Operations – Saturated and Rounded Arithmetic – Random Number Gene ration.		
UNIT-V	**WRITING AND OPTIMIZING ARM ASSEMBLY CODE**	**12 Hours**
Writing Assembly Code – Profiling and Cycle Counting – Instruct ion Scheduling – Register Allocation – Conditional Execution – Looping Constructs – Bit Manipulation – Efficient Switches – Handling Unaligned Data.		
	Total Hours	**60 Hours**
Text Book(s)		
1.	Andrew N.Sloss, Dominic Symes, Chris Wright, "ARM System Developer's Guide", Morgan Kaufmann Series in Computer Architecture and Design, 2004.	
2.	Tammy Noergaard, "Embedded Systems Architecture", Newnes, 2005. **ACC.NO: B127886**	
3.	David Seal, "ARM Architecture Reference Manual", 2005.	
4.	Steve Furbe, "ARM System-on-Chip Architecture", Addison-Wesley Professional, 2nd Edition, 2000, **ACC.NO: B129645.**	

Course Code		L	T	P	C	IA	EA	TM
Course Name	DISTRIBUTED EMBEDDED COMPUTING	3	1	0	3	40	60	100
Course Category		Syllabus Revision					V.1.0	
Pre-requisite								

Course Objectives:

The course should enable the students -

1. To have a knowledge of the Hardware Infrastructure.
2. To have a knowledge the concept of Internet.
3. To have a knowledge of the using of JAVA in Distributed Embedded Computing.
4. To have a knowledge of embedded computing architectures.

Course Outcomes:

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

Course Outcomes	Description
CO1	Develop knowledge and understand the concept of hardware infrastructure.
CO2	Develop knowledge and understand the concept of internet concepts.
CO3	Develop knowledge and understand the concept of distributed computing using java.
CO4	Develop knowledge and understand the concept of embedded agent.
CO5	Develop knowledge and understand the concept of embedded computing architecture.

UNIT-I	THE HARDWARE INFRASTRUCTURE	12Hours

Broad Band Transmission facilities – Open Interconnection standards – Local Area Networks – Wide Area Networks – Network management – Network Security – Cluster computers.

UNIT-II	INTERNET CONCEPTS	12Hours

Capabilities and limitations of the internet – Interfacing Internet server applications to corporate databases HTML and XML Web page design and the use of active components.

UNIT-III	DISTRIBUTED COMPUTING USING JAVA	12Hours

IO streaming – Object serialization – Networking – Threading – RM I – multicasting – distributed databases – embedded java concepts – case studies.

UNIT-IV	EMBEDDED AGENT	12Hours

Introduction to the embedded agents – Embedded agent design criteria – Behaviour based, Functionality based embedded agents – Agent co-ordination mechanisms and benchmarks embedded-agent. Case study: Mobile robots.

UNIT-V	**EMBEDDED COMPUTING ARCHITECTURE**	**12Hours**
Synthesis of the information technologies of distributed embedded systems – analog/digital co-design – optimizing functional distribution in complex system design – validation and fast prototyping of multiprocessor system-on-chip – a new dynamic scheduling algorithm for real-time multiprocessor systems.		
	Total Hours	**60Hours**
Text Book(s)		
1.	Dietel & Dietel, "JAVA how to program", Prentice Hall 1999. **ACC.NO: B112846**	
2.	Sape Mullender, "Distributed Systems", Addison-Wesley, 1993.	
3.	George Coulouris and Jean Dollimore, "Distributed Systems – con cepts and design",Addison – Wesley 1988.	
4.	"Architecture and Design of Distributed Embedded Systems", edited by Bernd Kleinjohann C-lab, Universitat Paderborn, Germany, Kluwer Academic Publishers, Boston, April 2001.	

Course Code		L	T	P	C	IA	EA	TM
Course Name	SMART METERS AND SMART GRID COMMUNICATION OBJECTIVES	3	1	0	3	40	60	100
Course Category		Syllabus Revision					V.1.0	
Pre-requisite								

Course Objectives:

The course should enable the students -

1. To teach the fundamentals of automated meters and Grids.
2. To teach on functional components of Smart meters.
3. To discuss on need of smart grid for power systems.
4. To teach the significance of microgrid and its needs.
5. To teach the communication and protocols for power system.

Course Outcomes:

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

Course Outcomes	Description
CO1	Understandable knowledge in the automated grid and meters fundamental, significance of micro grid and the protocols used for the communication as well as power system.
CO2	Understandable knowledge in the smart meters.
CO3	Understandable knowledge in the smart grid and applications.
CO4	Understandable knowledge in the microgrids.
CO5	Understandable knowledge in the information and communication technology for smart grid and meters.

UNIT-I	INTRODUCTION	12 Hours

Introduction to Smart grid and metering technology- Smart energy management technical architecture-Functions of Smart Grid and smart meters, Opportunities and challenges- Difference between conventional and smart grid-meters, Concept of Resilient and Self Healing Grid, recent developments and International policies in Smart Grid. IEC 61850 protocol standards.

UNIT-II	SMART METERS	12 Hours

Smart metering-Smart Meters types- hardware architecture- software architecture requirements- communication protocols- Real Time Prizing, Smart Appliances, Automatic Meter Reading- MEMS, Smart Sensors- Smart actuators- Advanced metering infrastructure- spectrum analyzer.

UNIT-III	SMART GRID AND APPLICATIONS	12 Hours

Outage Management System, Plug in Hybrid Electric Vehicles, Vehicle to Grid, Home and Building Automation- Smart Substations, Substation Automation, Feeder Automation-Geographic Information System(GIS), Intelligent Electronic Devices and their application for monitoring and protection- -Smart city- Wide Area Measurement System, Phase Measurement Unit- Power

Quality and EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring and Power Quality Audit.

Course Code		L	T	P	C	IA	EA	TM

UNIT-IV	MICROGRIDS	12 Hours

Concept of microgrid, need and applications of microgrid, formation of microgrid, Issues of interconnection, protection and control of microgrid. Plastic and Organic solar cells, Thin film solar cells, Variable speed wind generators, fuel cells, microturbines, Captive power plants, Integration of renewable energy sources.

UNIT-V	INFORMATION AND COMMUNICATION TECHNOLOGY FOR SMART GRID AND METERS	12 Hours

Home Area Networks for smart grid - IEEE 802.15.4 - ITU G.hn-IEEE 802.11, Field Area Networks -power-line communications- IEEE P1901 / Home Plug, RF mesh, Wide-area Networks for Smart Grid- Fiber Optics, Wi-MAX, sensor networks, Information Management in Smart Grid -SCADA, CIM. Networking Issues in Smart Grid -Wireless Mesh Network- Cloud Computing -Security and Privacy in Smart Grid and smart meters -Broadband over Power line.

	Total Hours	60 Hours

Text Book(s)

1.	Ali Keyhani, Mohammad N. Marwali, Min Dai “Integration of Green and Renewable Energy in Electric Power Systems”, Wiley.
2.	Stuart Borlase, “ Smart Grid: infrastructure, technology and Solutions”, 2012 CRC.
3.	Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, “Smart Grid: Technology and Applications”, Wiley.
4.	Jean Claude Sabonnadière, Nouredine Hadjsaïd, “Smart Grids”, Wiley Blackwell.
5.	Peter S. Fox Penner, “Smart Power: Climate Changes, the Smart Grid, and the Future of Electric Utilities”, Island Press; 1 edition 8 Jun 2010.
6.	S. Chowdhury, S. P. Chowdhury, P. Crossley, “Microgrids and Active Distribution Networks.” Institution of Engineering and Technology, 30 Jun 2009.
7.	Stuart Borlase, “Smart Grids (Power Engineering)”, CRC Press.

Reference Book(s)

1	Andres Carvallo, John Cooper, “The Advanced Smart Grid: Edge Power Driving Sustainability: 1”, Artech House Publishers July 2011.
2.	James Northcote, Green, Robert G. Wilson “Control and Automation of Electric Power Distribution Systems (Power Engineering)”, CRC Press.
3	Mladen Kezunovic, Mark G. Adamiak, Alexander P. Apostolov, Jeffrey George Gilbert “Substation Automation (Power Electronics and Power Systems)”, Springer.
4.	R. C. Dugan, Mark F. McGranghan, Surya Santoso, H. Wayne Beaty, “Electrical Power System Quality”, 2nd Edition, McGraw Hill Publication.
5.	Yang Xiao, “Communication and Networking in Smart Grids”, CRC Press.

Course Name	SOFT COMPUTING TECHNIQUES	3	1	0	3	40	60	100
Course Category		Syllabus Revision					V.1.0	
Pre-requisite								

Course Objectives:

The course should enable the students -

1. To review the fundamentals of ANN and fuzzy set theory.
2. To make the students understand the use of ANN for modeling and control of non-linear system and to get familiarized with the ANN and FLC tool box.
3. To make the students to understand the use of optimization techniques.
4. To familiarize the students on various hybrid control schemes, P.S.O and get familiarized with the ANFIS tool box.

Course Outcomes:

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

Course Outcomes	Description
CO1	Develop knowledge and understand the various aspects of soft computing techniques. overview of artificial neural network (ANN) & fuzzy logic.
CO2	Develop knowledge and understand the various aspects of neural networks for modelling and control.
CO3	Develop knowledge and understand the various aspects of fuzzy logic for modelling and control.
CO4	Develop knowledge and understand the various aspects of genetic algorithm.
CO5	Develop knowledge and understand the various aspects of hybrid control schemes.

UNIT-I	OVERVIEW OF ARTIFICIAL NEURAL NETWORK (ANN) & FUZZY LOGIC	12 Hours

Review of fundamentals - Biological neuron, Artificial neuron, Activation function, Single Layer Perceptron – Limitations – Multi Layer Perceptron – Back propagation algorithm (BPA); Fuzzy set theory – Fuzzy sets – Operation on Fuzzy sets - Scalar cardinality, fuzzy cardinality, union and intersection, complement (yager and sugeno), equilibrium points, aggregation, projection, composition, decomposition, cylindrical extension, fuzzy relation – Fuzzy membership functions.

UNIT-II	NEURAL NETWORKS FOR MODELLING AND CONTROL	12 Hours

Modeling of non linear systems using ANN- NARX,NNSS,NARMAX - Generation of training data - optimal architecture – Model validation- Control of non line ar system using ANN Direct and Indirect neuro control schemes- Adaptive neuro controller – Case study - Familiarization of Neural Network Control Tool Box.

UNIT-III	FUZZY LOGIC FOR MODELLING AND CONTROL	12 Hours
Modeling of non linear systems using fuzzy models (Mamdani and Sugeno) – TSK model - Fuzzy Logic controller – Fuzzification – Knowledge base – Decision making logic – Defuzzification-Adaptive fuzzy systems - Case study - Familiarization of Fuzzy Logic Tool Box.		
UNIT-IV	**GENETIC ALGORITHM**	**12 Hours**
Basic concept of Genetic algorithm and detail algorithmic steps, adjustment of free parameters. Solution of typical control problems using genetic algorithm. Concept on some other search techniques like Tabu search, Ant-colony search and Particle Swarm Optimization.		
UNIT-V	**HYBRID CONTROL SCHEMES**	**12 Hours**
Fuzzification and rule base using ANN–Neurofuzzy systems - ANFIS – Optimization of membership function and rule base using Genetic Algorithm and Particle Swarm Optimization - Case study–Introduction to Support Vector Regression – Familiarization of ANFIS Tool Box.		
	Total Hours	**60 Hours**

Text Book(s)

1.	Laurene V.Fausett, “Fundamentals of Neural Networks, Architecture, Algorithms, and Applications”, Pearson Education, 2008.
2.	Timothy J.Ross, “Fuzzy Logic with Engineering Applications”, Wiley.
3.	George J.Klir and Bo Yuan, “Fuzzy Sets and Fuzzy Logic: Theory and Applications”, Prentice HalI, First Edition, 1995. **ACC.NO: B132844**
4.	David E.Goldberg, “Genetic Algorithms in Search, Optimization, and Machine Learning”, Pearson Education, 2009.
5.	W.T.Miller, R.S.Sutton and P.J.Webrose, “Neural Networks for Control”, MIT Press, 1996.
6.	C.Cortes and V.Vapnik, "Support-Vector Networks, Machine Learning”, 1995.