# CURRICULUM FOR FULL TIME M.E

# EMBEDDED SYSTEM TECHNOLOGIES

Sri Chandrasekharendra Saraswathi Viswa Maha Vidyalaya University
Department of Electronics and Communication Engineering
CURRICULUM I TO IV SEMESTERS (FULL TIME)

## M.E. EMBEDDED SYSTEM TECHNOLOGIES

### SEMESTER I

| SL. 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 | | Micro Controller 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

| SL. 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 |
| **PRACTICAL** | | | | | | |
| 7 | | Embedded System Lab | 0 | 0 | 3 | 2 |
| **TOTAL** | | | **24** | **12** | **3** | **26** |

### SEMESTER III

| SL. 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 |
| **PRACTICAL** | | | | | | |
| 4 | | Project Phase-I | 0 | 0 | 12 | 6 |
| **TOTAL** | | | **12** | **6** | **12** | **18** |

### SEMESTER IV

| COURSE CODE | COURSE ITLE | L | T | P | C |
|---|---|---|---|---|---|
| **Practical** | | | | | |
| | Project Work (Phase II) | | 0 | 24 | 12 |
| | **TOTAL CREDITS** | **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:**

| SL. 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:**

| SL. 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:**

| SL. 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 |

# CURRICULUM FOR PART TIME M.E

# EMBEDDED SYSTEM TECHNOLOGIES

Sri Chandrasekharendra Saraswathi Viswa Maha Vidyalaya University
Department of Electronics and Communication Engineering

CURRICULUM I TO IV SEMESTERS (PART TIME)

M.E. EMBEDDED SYSTEM TECHNOLOGIES

## SEMESTER I

| SL. 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 | | Micro Controller Based System Design & Analysis | 4 | 2 | 0 | 4 |
| | | **TOTAL** | **12** | **6** | **0** | **12** |

## SEMESTER II

| SL. No | COURSE CODE | COURSE TITLE | L | T | P | C |
|---|---|---|---|---|---|---|
| 1 | | Design of Embedded Systems | 4 | 2 | 0 | 4 |
| 2 | | Embedded Programming | 4 | 2 | 0 | 4 |
| 3 | | Elective I | 4 | 2 | 0 | 4 |
| **PRACTICAL** | | | | | | |
| 7 | | Embedded System Lab | 0 | 0 | 3 | 2 |
| | | **TOTAL** | **12** | **6** | **3** | **14** |

## SEMESTER III

| SL. 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 |
| | | **TOTAL** | **12** | **6** | **0** | **12** |

## SEMESTER IV

| SL. No | COURSE CODE | COURSE TITLE | L | T | P | C |
|---|---|---|---|---|---|---|
| 1 | | Embedded Communication And Software Design | 4 | 2 | 0 | 4 |
| 2 | | Elective –II | 4 | 2 | 0 | 4 |
| 3 | | Elective –III | 4 | 2 | 0 | 4 |
| | | **TOTAL** | **12** | **6** | **0** | **12** |

**SEMESTER V**

| SL. 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 |
| **PRACTICAL** | | | | | | |
| 4 | | Project Phase-I | 0 | 0 | 12 | 6 |
| | | **TOTAL** | **12** | 6 | **12** | **18** |

**SEMESTER VI**

| COURSE CODE | COURSE ITLE | L | T | P | C |
|---|---|---|---|---|---|
| **Practical** | | | | | |
| | Project Work (Phase II) | 0 | 0 | 24 | 12 |
| | **TOTAL CREDITS** | **0** | **0** | **24** | **12** |

**Total Credit to be earned for the award of degree is: 80**

# SYLLABUS FOR FULL TIME & PART TIME M.E EMBEDDED SYSTEM TECHNOLOGIES

**ADVANCED MATHEMATICS FOR ELECTRONIC ENGINEERS**

| L | T | P | C |
|---|---|---|---|
| 4 | 2 | 0 | 4 |

**OBJECTIVES:**

- To encourage students to develop a working knowledge of the central ideas of linear algebra;
- To study and understand the concepts of probability and random variable of the various functions;
- 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;
- To formulate and construct a mathematical model for a linear programming problem in real life situation;
- Introduce the Fourier Transform as an extension of Fourier techniques on periodic functions and to solve partial differential equations;
- To develop the use of matrix algebra techniques this is needed by engineers for practical applications.

**UNIT I LINEAR ALGEBRA**

Vector spaces – norms – Inner Products – Eigenvalues using QR transformations – 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**

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**

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

**UNIT IV QUEUEING MODELS**

Poisson Process – Markovian queues – Single and Multi-server Models – Little's formula - Machine Interference Model – Steady State analysis – Self Service queue.

**UNIT V FOURIER TRANSFORM FOR PARTIAL DIFFERENTIAL EQUATIONS**

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.

**OUTCOMES:**

- On successful completion of this course, all students will have developed knowledge and understanding in the fields of linear algebra, probability, stochastic process, matrix and Fourier transform.

**TEXTBOOKS:**

1. Bronson, R.Matrix Operation, Schaum's outline series, Mc Graw Hill, Newyork (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 Edition, 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 Asia 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**

## ADVANCED DIGITAL SYSTEM DESIGN

| L | T | P | C |
|---|---|---|---|
| 4 | 2 | 0 | 4 |

**OBJECTIVES**

To impart knowledge on

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

**UNIT- I SEQUENTIAL & ASYNCHRONOS CIRCUIT DESIGN**

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 – Races 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**

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**

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**

Foldback 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**

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.

**OUTCOMES:**

- On successful completion of this course, all students will have developed 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.

**TEXTBOOKS:**

1. Donald G. Givone, "Digital principles and Design", Tata McGraw Hill 2002. ACC.NO: B100970
2. Stephen Brown and Zvonk Vranesic, "Fundamentals of Digital Logic with VHDL Deisgn", Tata McGraw Hill, 2002
3. Mark Zwolinski, "Digital System Design with VHDL", Pearson Education, 2004
4. Parag K Lala, "Digital System design using PLD", BS Publications, 2003

5. John M Yarbrough, “Digital Logic applications and Design”, Thomson Learning, 2001
6. Nripendra N Biswas, “Logic Design Theory”, Prentice Hall 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.

## MICROCONTROLLER BASED SYSTEM DESIGN

| L | T | P | C |
|---|---|---|---|
| 4 | 2 | 0 | 4 |

**OBJECTIVES:**

❖ The main objective of this course is to provide the student with the 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.

**UNIT 1 REVIEW OF 8051**

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**

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**

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**

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**

Software and Hardware tools like Cross Assembler, Compiler, Debugger, Simulator, In-Circuit Emulator (ICE), Logic Analyser.

**TEXT BOOKS:**


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 DDI 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", 1st Edition, Penram International Publishing

7.Steve Furber, "ARM System-on-Chip Architecture", 2nd 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 Multitasking", 1st Edition, Prentice Hall

11. Stewart, James W, Miao, Kai X, "8051 Microcontroller: Hardware, Software and Interfacing", 2nd Edition, Prentice Hall

12. Arnold. S. Berger, "Embedded Systems Design - An introduction to Processes, Tools and Techniques", Easwer Press

13. Raj Kamal, "Microcontroller - Architecture Programming Interfacing and System Design" 1st Edition, Pearson Education

14. P.S Manoharan, P.S. Kannan, "Microcontroller based System Design", 1st Edition, Scitech Publications **ACC.NO: B113621**

15.David Calcutt, Fred Cowan, Hassan Parchizadeh, "8051 Microcontrollers – An Application based Introduction", Elsevier

16. Ajay Deshmukh, "Microcontroller - Theory & Applications", Tata McGraw Hill

**OUTCOMES:**

On successful completion of this course, all students will have developed knowledge and understanding on the 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.

## DESIGN OF EMBEDDED SYSTEMS

| L | T | P | C |
|---|---|---|---|
| 4 | 2 | 0 | 4 |

**.OBJECTIVES**

To impart knowledge on

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

**UNIT- I EMBEDDED DESIGN LIFE CYCLE**

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**

Partitioning decision – Hardware / Software duality – coding 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**

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**

In circuit emulators – Buller proof run control – Real time trace – Hardware break points – Overlay memory – Timing constraints – Usage issues – Triggers.

**UNIT- V TESTING**

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.

**OUTCOMES:**

- On successful completion of this course, all students will have developed knowledge and understanding on the basics embedded systems design and the Testing procedure to be done for the embedded applications

**TEXTBOOKS:**

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.

## EMBEDDED PROGRAMMING

| L | T | P | C |
|---|---|---|---|
| 4 | 2 | 0 | 4 |

**OBJECTIVE:**

- ❖ To impart the knowledge of the Embedded Programming
- ❖ To Impart the knowledge in the Application with Data Structures

**UNIT I INTRODUCTION**

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**

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**

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**

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**

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

**OUTCOME:**

- ❖ On successful completion of this course, all students will have a knowledge and understanding on the various programming concepts used in the field of Embedded

**TEXT BOOKS:**


1. GNU/Linux application programming, Jones, M Tim, Dreamtech press, New Delhi
2. Embedded / Real-Time Systems: concepts, Design and Programming—The Ultimate Reference, Prasad K.V.K.K, DREAMTECH 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

**REFERENCES:**


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. Embedded C, Pont, Michael J **ACC.NO: B133054 (CD)**
11. Art of C Programming, Jones, Robin, Stewart, Ian **ACC.NO: B56037**
12. Kelley, A & Pohl, I;, " A Book on C", Addison – Wesley
13. Advanced Linux Programming Mark Mitchell, Jeffrey Oldham, and Alex Samuel, Techmedia
14. Embedded/ real-time systems: concepts, design and programming black book, Prasad, K V K K, Dreamtech press, New Delhi. **ACC.NO: B127888**


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## REAL TIME OPERATING SYSTEM

| L | T | P | C |
|---|---|---|---|
| 4 | 2 | 0 | 4 |

**OBJECTIVES**

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

**UNIT I REVIEW OF OPERATING SYSTEMS**

Basic Principles - Operating System structures – System Calls – 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**

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**

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**

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**

Case studies- RTOS for Image Processing – Embedded RTOS for Network Communication – RTOS for fault-Tolerant Applications – RTOS for Control Systems.

**Outcome:**

- On successful completion of this course, all students will have knowledge on the Operating System, modelling process based on the OS and how to develop the application using RTOS.

**TEXTBOOKS:**

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

## SOFTWARE TECHNOLOGY FOR EMBEDDED SYSTEMS

| L | T | P | C |
|---|---|---|---|
| 4 | 2 | 0 | 4 |

**OBJECTIVES:**

- To make the student learn: use of C language for embedded applications, real time UML concepts, co-design methods.

**UNIT I PROGRAMMING EMBEDDED SYSTEMS**

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

**UNIT II C AND ASSEMBLY**

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 inpass by value – temporary variables

**UNIT III. EMBEDDED PROGRAM AND SOFTWARE DEVELOPMENT PROCESS**

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**

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**

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.

**OUTCOMES:**

- By the completion of the course the students will be in a better knowledge in using of C language and UML Language for a real time application.

**TEXTBOOKS:**

1. David E.Simon: “An Embedded Software Primer”, Pearson Education, 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 and 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

## EMBEDDED NETWORKING

| L | T | P | C |
|---|---|---|---|
| 4 | 2 | 0 | 4 |

**OBJECTIVES**

To impart knowledge on

- Serial and parallel communication protocols
- Application Development using USB and CAN bus for PIC microcontrollers
- Application development using Embedded Ethernet for Rabbit processors.
- Wireless sensor network communication protocols.

**UNIT I EMBEDDED COMMUNICATION PROTOCOLS**

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

**UNIT - II USB AND CAN BUS**

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

**UNIT III CONTROLLER AREA NETWORK**

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**

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

**UNIT - V WIRELESS EMBEDDED NETWORKING**

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

**TEXT BOOKS**

1. Frank Vahid, 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.

**OUTCOME:**

- On the successful completion of the course work students will have knowledge in the Protocols, Network Related Application

## EMBEDDED COMMUNICATION SOFTWARE DESIGN

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**OBJECTIVES:**

- To know about the OSI Model for Embedded Communication
- To know about the software design for the communication

**UNIT I OSI REFERENCE MODEL**

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

**UNIT II SOFTWARE PARTITIONING**

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**

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**

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**

Multi Board Architecture – Single control Card and Multiple line Card 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.

**TEXTBOOKS:**

1. Sridhar .T, “Designing Embedded Communication Software” CMP Books, 2003.
2. Comer.D,”Computer networks and Internet”, Third Edition, Prentice Hall, 2001.

**OUTCOMES:**

- On the successful completion of the course the students will have knowledge and understanding the various aspects of developing the Software for the Embedded Communication.

## EMBEDDED SYSTEMS LABORATORY

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**OBJECTIVES:**

- 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
- To design and analyse wired/wireless networks using NS2 simulator

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
Design and Implementation of simple Combinational/Sequential Circuits
9. Network Simulators
Simple wired/ wireless network simulation using NS2
10. Programming of TCP/IP protocol stack.

**OUTCOMES:** At the end of the course, the student will be able to:

- Design 8-bit, 16-bit and PIC microcontrollers for various applications
- Design wired/wireless networks using NS2 simulator

## ADVANCED DIGITAL SIGNAL PROCESSING

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**OBJECTIVE:**

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

**UNIT – I DISCRETE RANDOM SIGNAL**

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**

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**

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

**UNIT IV APPLICATION OF VLSI IMPLEMENTATION**

Basics on DSP system architecture design using VHDL programming, Mapping of DSP algorithm onto hardware, Realisation of MAC & Filter structure.

**UNIT V VLSI IMPLEMENTATION**

Basics on DSP system architecture design using VHDL programming, Mapping of DSP algorithm onto hardware, Realisation of MAC & Filter structure.

**OUTCOMES:**

On the successful completion of the course students will have knowledge of DSP used in the embedded system

**TEXTBOOKS**

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 Processing", 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 press, 1999,New York.

8. Ashok Ambardar,"Digital Signal Processing: A Modern Introduction",Thomson India edition, 2007.
9. Lars Wanhammer, "DSP Integrated Circuits", Academic press, 1999,New York.

## RISC PROCESSOR ARCHITECTURE AND PROGRAMMING

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**OBJECTIVES**

- To teach the architecture of 8 bit RISC processor
- To teach the architecture and programming of 16 bit RISC processor
- To teach the implementation of DSP in ARM processor
- To discuss on memory management in RISC processor
- To teach the application development with ARM processor

**UNTI I AVR MICROCONTROLLER ARCHITECTURE**

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 `**

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**

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 Simplelittle Operating System

**UNIT IV MEMORY PROTECTION AND MANAGEMENT**

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**

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

**OUTCOMES:**

On the successful completion of the course students will have knowledge in 8 and 16 bit RISC Processor and their implementation in various Field.

**TEXTBOOKS**

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 Assebly Language' Fundamentals and Techniques.
5. ARM Architecture Reference Manual
6. LPC213x User Manual

## WIRELESS AND MOBILE COMMUNICATION

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**OBJECTIVES**

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

**UNIT I INTRODUCTION**

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

**UNIT II MOBILE NETWORKS**

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

**UNIT III WIRELESS NETWORKS**

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

**UNIT IV ROUTING**

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

**UNIT V TRANSPORT AND APPLICATION LAYERS**

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

**OUTCOMES:**

On the successful completion of the course work students will have a indepth knowledge in the basic of technologies, protocol and simulation software

**TEXTBOOKS**

1. Kaveh Pahlavan, Prasanth Krishnamoorthy, “Principles of Wireless 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 Hall, Inc, 2002.
5. Charles E. Perkins, “Adhoc Networking”, Addison-Wesley, 2001.
6. Jochen Schiller, “Mobile communications”, PHI/Pearson Education, Second Edition, 2003 ACC.NO: B132742
7. William Stallings, “Wireless communications and Networks”, PHI/Pearson Education, 2002.

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# BIG DATA ANALYTICS

**OBJECTIVES:**

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

**UNIT I INTRODUCTION TO BIG DATA**

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 – Greenplum – Informatica

**UNIT II DATA ANALYSIS**

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**

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 IBM Infosphere – Big data at rest – Infosphere streams – Data stage – Statistical analysis – Intelligent scheduler – Infosphere Streams

**UNIT IV PREDICTIVE ANALYTICS AND VISUALIZATION**

Predictive Analytics – Supervised – Unsupervised learning – Neural networks – Kohonen models – Normal – Deviations from normal patterns – Normal behaviours – Expert options – Variable entry - Mining Frequent itemsets - Market based model – Apriori Algorithm – Handling large data sets in Main memory – Limited Pass algorithm – Counting frequent itemsets 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**

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.

**OUTCOMES**: Upon Completion of the course, the students will be able to

- Identify the need for big data analytics for a domain
- Use Hadoop, Map Reduce Framework
- Apply big data analytics for a give problem

- ❖ Suggest areas to apply big data to increase business outcome
- ❖ Contextually integrate and correlate large amounts of information automatically to gain faster insights.

**REFERENCES:**

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 Opportunities 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 platform”, 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.

## ASIC DESIGN

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**OBJECTIVE:**

- To have knowledge in basic transistor logic
- To have knowledge in various programming platform like Altera, Xilinx

**UNIT – I INTRODUCTION TO ASICS, CMOS LOGIC AND ASIC LIBRARY DESIGN**

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**

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

**UNIT – III PROGRAMMABLE ASIC INTERCONNECT, PROGRAMMABLE ASIC DESIGN SOFTWARE AND LOW LEVEL DESIGN ENTRY.**

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**

Verilog and logic synthesis – VHDL and logic synthesis - Types of simulation – Boundary scan test – Fault simulation – Automatic test pattern generation.

**UNIT – V ASIC CONSTRUCTION, FLOOR PLANNING, PLACEMENT AND ROUTING**

System partition – FPGA partitioning – partitioning methods – floor planning – placement – physical design flow – global routing – detailed routing – special routing – circuit extraction – DRC.

**OUTCOMES:**

On the successful completion of the course, the students will have better knowledge in various programming platform and also in testing.

**TEXTBOOKS:**

1. M.J.S. SMITH, “Application – Specific Integrated Circuits” – Addison – Wesley Longman Inc., 1997.
2. Andrew Brown, “VLSI Circuits and Systems in Silicon”, McGraw 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.

## EMBEDDED LINUX

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**.OBJECTIVE:**

- To have knowledge of usage of LINUX in Embedded Systems

**UNIT I FUNDAMENTALS OF OPERATING SYSTEMS**

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**

Introduction to Linux – Basic Linux commands and concepts – Logging in - Shells -Basic text editing - Advanced shells and shell scripting – Linux File System –Linux Programming - Processes and threads in Linux - Inter process communication – Devices – Linux System calls

**UNIT III INTRODUCTION TO EMBEDDED LINUX**

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**

Inclusion of BSP in kernel build procedure - The bootloader 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 devices – mtdutils package – Embedded File Systems – Optimizing storage space – Turning kernel memory

**UNIT V EMBEDDED DRIVERS AND APPLICATION PORTING**

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.

**OUTCOMES:**

On the successful completion of the course, the students will understand the how linux is used as an OS for Embedded Application

**TEXTBOOKS**

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. Raghavan ,Amol Lad , Sriram Neelakandan, ‘Embedded Linux System Design and Development’, Auerbach Publications 2006
5. Karim Yaghmour, ‘Building Embedded Linux Systems’, O'Reilly Publications 2003

## VLSI ARCHITECTURE AND DESIGN METHODOLOGIES

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**OBJECTIVE:**

- To have a knowledge in CMOS Design
- To have knowledge in PLD Devices
- To have in floor plan design in VLSI

**UNIT I CMOS DESIGN**

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**

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**

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**

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**

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.

**OUTCOMES:**

- On the successful completion of the course, students will have knowledge and the understanding about the various aspects involved in the VLSI Design.

**TEXTBOOKS**

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” 2nd Ed,Pearson,2005

## PROGRAMMING WITH VHDL

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**OBJECTIVES:**

- To have a knowledge in VHDL Fundamentals
- To have a knowledge in subprogram and files

**UNIT I VHDL FUNDAMENTALS**

Fundamental concepts- Modeling digital system-Domain and levels of modelling languages-VHDL modeling concepts-Scalar Data types and operations constants and Variable-Scalar Types-Type Classification-Attributes and scalar types expression and operators-Sequential statements.

**UNIT II DATA TYPES AND BASIC MODELING CONSTRUCTS**

Arrays- unconstrained array types-array operations and referencing- records - Access Types-Abstract Date types- -basic modeling constructs-entity declarations-Architecture bodies-behavioral description-structural descriptions- design Processing, case study: A pipelined Multiplier accumulator.

**UNIT III SUBPROGRAMS, PACKAGES AND FILES**

Procedures-Procedure parameters- Concurrent procedure call statements –Functions –Overloading –visibility of Declarations-packages and use clauses- Package declarations package bodies-use clauses-Predefined aliases-Aliases for Data objects-Aliases for Non-Data items-Files- I/O-Files. Case study: A bit vector arithmetic Package.

**UNIT IV SIGNALS, COMPONENTS, CONFIGURATIONS**

Basic Resolved Signals-IEEE std_Logic_1164 resolved subtypes- resolved Signal Parameters - Generic Constants- Parameterizing behavior- Parameterizing structure components and configurations-Generate Statements-Generating Iterative structure- Conditionally generating structure-Configuration of generate statements-case study: DLX computer Systems.

**UNIT V DESIGN WITH PROGRAMMABLE LOGIC DEVICES**

Realization of -Micro controller CPU.- Memories- I/O devices-MAC Design, synthesis, simulation and testing.

**OUTCOMES:**

On Completion of the course the students will have knowledge and understanding the concept of VHDL programming.

**TEXTBOOKS**

1. Peter J.Ashenden, “The Designer’s guide to VHDL”, Morgan Kaufmann publishers,San Francisco,Second Edition, May 2001.
2. Zainalabedin navabi, “VHDL Analysis anD modelling of Digital Systems”, McGraw Hill International Editions, Second Editions, 1998.
3. Charles H Roth, Jr. “Digital system Design using VHDL”, Thomson, 2006.ACC.NO: B94878
4. Douglas Perry, “VHDL Programming by Example”, Tata McGraw Hill, 4th Edition 2002 ACC.NO: B101456
5. Navabi.Z., “VHDL Analysis and Modelling of Digital Systems”, McGraw International,1998.
6. Peter J.Ashendem, “The Designers Guide to VHDL”, Harcourt India Pvt Ltd, 2002
7. Skahill. K, “VHDL for Programmable Logic”, Pearson education, 1996. ACC.NO: B131040

## PRINCIPLES OF ROBOTICS

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**OBJECTIVES:**

- To have basic knowledge about robotics
- To have knowledge in image processing and Vision

**UNIT I INTRODUCTION AND TERMINOLOGIES**

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**

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

**UNIT III DIFFERENTIAL MOTION & VELOCITIES**

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

**UNIT IV ROBOT CONTROL SYSTEM**

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

**UNIT V IMAGE PROCESSING & VISION SYSTEMS**

Two and three dimensional images-spatial and frequency domain representation-noise and edges-convolution masks-Processing techniques-thersholding-noise reduction edge detection-segmentation-Image analysis and object recognition.

**OUTCOMES**:

On Successful completion of the course the students will have better understanding the various aspects of Robotics and how image and vision systems are processed.

**TEXTBOOKS:**

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

## APPLICATIONS OF MEMS TECHNOLOGY

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**OBJECTIVE:**

- To have knowledge in the basic of MEMS fabrication
- To have knowledge about sensors in MEMS

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

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**

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

**UNIT III THERMAL SENSING AND ACTUATION**

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

**UNIT IV PIEZOELECTRIC SENSING AND ACTUATION**

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

**UNIT V CASE STUDIES**

Piezoresistive sensors, Magnetic actuation, Micro fluidics applications, Medical applications, Optical MEMS.

**OUTCOME:**

On completion of the course successfully, the students will have knowledge in basic of MEMS and the Sensors used for the application development.

**TEXTBOOKS:**

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, Newyork, 2000.

## DIGITAL IMAGE PROCESSING

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**OBJECTIVE:**

- To have a knowledge in basic of Image Processing
- To have a knowledge in various analysis of image
- To have knowledge in application where image processing is used.

**UNIT I FUNDAMENTALS OF IMAGE PROCESSING**

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**

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**

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**

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**

Image classification – Image recognition – Image understanding – Video motion analysis – Image fusion – Steganography – Digital compositing Mosaics – Colour Image Processing.

**OUTCOMES:**

On completion of the course successfully, the students will have knowledge and understanding the basic concepts of Image Processing, image analysis and the application

**TEXTBOOKS**

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

## EMBEDDED ANALOG INTERFACING

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**OBJECTIVE:**

- To have a basic knowledge in measurement system design
- To have a knowledge in Analog to Digital Converters
- To have a knowledge in Sensors used in interfacing

**UNIT - I MEASUREMENT SYSTEM DESIGN**

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

**UNIT - II ANALOG-TO-DIGITAL CONVERTERS**

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**

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

**UNIT - IV OUTPUT CONTROL METHODS**

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**

Standard Interfaces - IEEE 1451.2 - 4–20 ma Current Loop – Fieldbus - 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

**OUTCOME:**

- On Successful Completion of the course, the students will have a knowledge and understanding in measurement, A to D Converter and Sensors used for interfacing.

**TEXTBOOKS:**

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.

## EMBEDDED AUTOMOTIVE NETWORKING WITH CAN

**OBJECTIVES:**

- To have knowledge in basic of data communication
- To have a knowledge in Layers of CAN Network

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**UNIT - I DATA COMMUNICATION BASICS**

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**

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**

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

**UNIT - IV CAN PROTOCOL CONTROLLERS**

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

**UNIT - V CAN HIGHER LAYER PROTOCOLS**

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

**OUTCOMES:**

On successful completion of the course the students will have knowledge and understand the basic of data communication and the layers of the CAN.

**TEXTBOOKS:**

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

## EMBEDDED SYSTEM DESIGN USING ARM PROCESSOR

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**OBJECTIVE:**

- To have a knowledge about ARM fundamentals
- To have a knowledge of writing codes

**UNIT – I PRINCIPLES OF EMBEDDED SYSTEM**

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 – Blue tooth Protocols - IrDA.

**UNIT – II ARM PROCESSOR FUNDAMENTALS**

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 Usuage – ARM – Thumb Interworking – Stack Instruction – Software Interrupt Instruction.

**UNIT - III CACHES AND MMU**

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**

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 Generation.

**UNIT – V WRITING AND OPTIMIZING ARM ASSEMBLY CODE**

Writing Assembly Code – Profiling and Cycle Counting – Instruction Scheduling – Register Allocation – Conditional Execution – Looping Constructs – Bit Manipulation – Efficient Switches – Handling Unaligned Data.

**OUTCOME:**

- On the successful completion of the course students will have knowledge in the fundamentals of ARM Processor and understand how to write the Assembly Code in ARM

**TEXTBOOKS:**

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

## DISTRIBUTED EMBEDDED COMPUTING

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**OBJECTIVE:**

- To have a knowledge of the Hardware Infrastructure
- To have a knowledge the concept of Internet
- To have a knowledge of the using of JAVA in Distributed Embedded Computing
- To have a knowledge of embedded computing architectures

**UNIT I THE HARDWARE INFRASTRUCTURE**

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

**UNIT II INTERNET CONCEPTS**

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**

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

**UNIT IV EMBEDDED AGENT**

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**

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.

**OUTCOME:**

- On successful completion of the course the students will have knowledge and understand the concept of distributed computing infrastructure, concept of Internet and programing language used.

**TEXTBOOKS**

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 – concepts 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, 248 pp.

**SMART METERS AND SMART GRID COMMUNICATION**

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**OBJECTIVES**

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

**UNIT I INTRODUCTION:**

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**

Smart metering-Smart Meters types- hardware architecture- software architecturerequirements-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**

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.

**UNIT IV MICROGRIDS**

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, fuelcells, microturbines, Captive power plants, Integration of renewable energy sources.

**UNIT V INFORMATION AND COMMUNICATION TECHNOLOGY FOR SMART GRID AND METERS**

Home Area Networks for smart grid - IEEE802.15.4- ITU G.hn-IEEE 802.11, Field Area Networks -power-line communications- IEEE P1901 /HomePlug, RF mesh, Wide-area Networks for Smart Grid- Fiber Optics, WiMAX, 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.

**OUTCOME:**

- On the successful completion of the course students will have a 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

**TEXT BOOKS:**

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 Press
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

**REFERENCES:**

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

## SOFT COMPUTING TECHNIQUES

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**OBJECTIVES:**

- To review the fundamentals of ANN and fuzzy set theory
- 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.
- To make the students to understand the use of optimization techniques.
- To familiarize the students on various hybrid control schemes, P.S.O and get
- familiarized with the ANFIS tool box

**UNIT I OVERVIEW OF ARTIFICIAL NEURAL NETWORK (ANN) & FUZZY LOGIC**

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**

Modeling of non linear systems using ANN- NARX,NNSS,NARMAX - Generation of training data - optimal architecture – Model validation- Control of non linear 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**

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**

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**

Fuzzification and rule base using ANN–Neuro fuzzy 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.

**OUTCOMES:**

- On the successful completion of the course student will have a knowledge and understand the various aspects of Soft Computing Techniques.

**TEXTBOOKS**

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, Third Edition, 2010. ACC.NO: B134447
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