

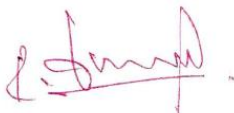
**ANNA UNIVERSITY
AFFILIATED INSTITUTIONS
REGULATIONS – 2017
CHOICE BASED CREDIT SYSTEM
M.E. EMBEDDED SYSTEM TECHNOLOGIES**

Programme Educational Objective

- 1) To prepare students for successful careers in industry that meets the needs of Indian and global industries as employable professionals.
- 2) To develop the ability among students to synthesize data and technical concepts for application to product design, system development of societal importance.
- 3) To provide opportunity for students to work as part of teams on multi disciplinary projects to solve engineering, technical issues of societal demands.
- 4) To provide the P.G students with a sound foundation in the mathematical, scientific and engineering fundamentals necessary to formulate, solve and analyze engineering problems and to prepare them for employability and higher studies.
- 5) To promote student awareness of the life long learning and to introduce them to professional ethics and codes of professional practice.

Program Outcomes

- a) To Offer the P.G Program in Embedded System Technology with imparting domain knowledge in Electrical circuits, electronic devices, information technology and communication engineering to develop inter-process communication techniques based on hardware– software approaches for real time process automations.
- b) To enhance teaching & research contributions in Embedded System Technology with an ability to design and construct hardware and software systems, component or process keeping in tune with the latest developments and Industry requirements particularly for electrical and allied consumer electronics industries.
- c) An ability to design and conduct experiments as well as to organize, analyze and interpret data on multidisciplinary domains onto role of electronics, computer science, communication engineering for electrical applications.
- d) Be able to identify problems in major issues of Electrical Systems , analyse problems, coordinate through all options in design & developments and solve them using the knowledge base of Embedded Technology.
- e) To extend advanced teaching & training sessions with promoting industry based internships, leading to development of self-employable entrepreneurs and globally employable professionals.
- f) To provide guidance and supervision in identified domains of Embedded Application Development for Electrical & related Industries with realistic concerns such as economic, environmental, ethical, health and safety, manufacturability and technology sustainability.
- g) An ability to effectively communicate technical information in speech, presentation, and in writing.



- h) An understanding of professional, legal and ethical issues and responsibilities as it pertains to engineering profession with engaging in life-long learning with knowledge of contemporary issues.

| Programme Educational Objectives | Programme Outcomes | | | | | | | |
|----------------------------------|--------------------|---|---|---|---|---|---|---|
| | a | b | c | d | e | f | g | h |
| 1 | ✓ | ✓ | | | ✓ | ✓ | | |
| 2 | | | | ✓ | ✓ | ✓ | ✓ | |
| 3 | | | | | ✓ | | ✓ | ✓ |
| 4 | ✓ | ✓ | ✓ | | | ✓ | | ✓ |
| 5 | | | | | ✓ | ✓ | | ✓ |

MAPPING – PG- EMBEDDED SYSTEM TECHNOLOGIES

| | | | POa | POb | POc | POd | POe | POf | POg | POh | |
|-------------------|-------|--|-----|-----|-----|-----|-----|-----|-----|-----|---|
| YEAR 1 | SEM 1 | Applied Mathematics for Electrical Engineers | ✓ | | | | ✓ | | | | |
| | | Advanced Digital Principles and Design | ✓ | ✓ | ✓ | ✓ | | | | | |
| | | Microcontroller Based System Design | ✓ | ✓ | ✓ | ✓ | | | | | |
| | | Design of Embedded Systems | | ✓ | ✓ | ✓ | ✓ | ✓ | | | |
| | | Software for Embedded Systems | | ✓ | ✓ | ✓ | ✓ | ✓ | | | |
| | | Elective I | | | | | | | | | |
| | | Embedded System Lab I | | | | | | | | | |
| | SEM 2 | Real Time Operating System | | | | | | | | | |
| | | Pervasive Devices and Technology | | ✓ | ✓ | ✓ | ✓ | ✓ | | | |
| | | RISC Processor Architecture and Programming | | | | | | | | | |
| | | Internet of Things | | | | | | | | | |
| | | Elective II | | | | | | | | | |
| | | Elective III | | | | | | | | | |
| | | Embedded System Lab II | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ |
| Technical Seminar | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | | |
| YEAR 2 | SEM 3 | Elective IV | ✓ | ✓ | ✓ | ✓ | | | | | |
| | | Elective V | | | | | | | | | |
| | | Elective VI | | | | | | | | | |
| | | Technical Seminar | | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | |
| | | Project Work Phase I | | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | |
| | SEM 4 | Project Work Phase II | | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | |

ANNA UNIVERSITY, CHENNAI
AFFILIATED INSTITUTIONS
REGULATIONS – 2017
CHOICE BASED CREDIT SYSTEM
M.E. EMBEDDED SYSTEM TECHNOLOGIES (FULL TIME)
CURRICULUM AND SYLLABUS I TO IV SEMESTERS

SEMESTER I

| S.No | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|-------------------|-------------|--|----------|-----------------|-----------|----------|----------|-----------|
| THEORY | | | | | | | | |
| 1. | MA5155 | Applied Mathematics for Electrical Engineers | FC | 4 | 4 | 0 | 0 | 4 |
| 2. | ET5101 | Advanced Digital Principles and Design | PC | 5 | 3 | 2 | 0 | 4 |
| 3. | ET5151 | Microcontroller Based System Design | PC | 3 | 3 | 0 | 0 | 3 |
| 4. | ET5152 | Design of Embedded Systems | PC | 3 | 3 | 0 | 0 | 3 |
| 5. | ET5191 | Software for Embedded Systems | PC | 3 | 3 | 0 | 0 | 3 |
| 6. | | Professional Elective I | PE | 3 | 3 | 0 | 0 | 3 |
| PRACTICALS | | | | | | | | |
| 7. | ET5111 | Embedded System Lab I | PC | 4 | 0 | 0 | 4 | 2 |
| TOTAL | | | | 25 | 19 | 2 | 4 | 22 |

SEMESTER II

| S.No | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|-------------------|-------------|---|----------|-----------------|-----------|----------|----------|-----------|
| THEORY | | | | | | | | |
| 1. | ET5251 | Real Time Operating Systems | PC | 3 | 3 | 0 | 0 | 3 |
| 2. | ET5201 | Pervasive Devices and Technology | PC | 3 | 3 | 0 | 0 | 3 |
| 3. | ET5202 | RISC Processor Architecture and Programming | PC | 5 | 3 | 2 | 0 | 4 |
| 4. | ET5203 | Internet of Things | PC | 3 | 3 | 0 | 0 | 3 |
| 5. | | Professional Elective II | PE | 3 | 3 | 0 | 0 | 3 |
| 6. | | Professional Elective III | PE | 3 | 3 | 0 | 0 | 3 |
| PRACTICALS | | | | | | | | |
| 7. | ET5211 | Embedded System Lab II | PC | 4 | 0 | 0 | 4 | 2 |
| TOTAL | | | | 24 | 18 | 2 | 4 | 21 |

SEMESTER III

| S.No | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|-------------------|-------------|--------------------------|----------|-----------------|----------|----------|-----------|-----------|
| THEORY | | | | | | | | |
| 1. | | Professional Elective IV | PE | 3 | 3 | 0 | 0 | 3 |
| 2. | | Professional Elective V | PE | 3 | 3 | 0 | 0 | 3 |
| 3. | | Professional Elective VI | PE | 3 | 3 | 0 | 0 | 3 |
| PRACTICALS | | | | | | | | |
| 4. | ET5311 | Project Work Phase I | EEC | 12 | 0 | 0 | 12 | 6 |
| 5. | ET5312 | Technical Seminar | EEC | 2 | 0 | 0 | 2 | 1 |
| TOTAL | | | | 23 | 9 | 0 | 14 | 16 |

SEMESTER IV

| SI.No | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|-------------------|-------------|-----------------------|----------|-----------------|----------|----------|-----------|-----------|
| PRACTICALS | | | | | | | | |
| 1. | ET5411 | Project Work Phase II | EEC | 24 | 0 | 0 | 24 | 12 |
| TOTAL | | | | 24 | 0 | 0 | 24 | 12 |

TOTAL NO. OF CREDITS : 71

FOUNDATION COURSES (FC)

| S.No | Course Code | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|------|-------------|--|----------|-----------------|---|---|---|---|
| 1. | MA5155 | Applied Mathematics for Electrical Engineers | FC | 4 | 4 | 0 | 0 | 4 |

PROFESSIONAL CORE (PC)

| S.No | Course Code | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|------|-------------|---|----------|-----------------|---|---|---|---|
| 1. | ET5101 | Advanced Digital Principles and Design | PC | 5 | 3 | 2 | 0 | 4 |
| 2. | ET5151 | Microcontroller Based System Design | PC | 3 | 3 | 0 | 0 | 3 |
| 3. | ET5152 | Design of Embedded Systems | PC | 3 | 3 | 0 | 0 | 3 |
| 4. | ET5191 | Software for Embedded Systems | PC | 3 | 3 | 0 | 0 | 3 |
| 5. | ET5111 | Embedded System Lab I | PC | 4 | 0 | 0 | 4 | 2 |
| 6. | ET5251 | Real Time Operating Systems | PC | 3 | 3 | 0 | 0 | 3 |
| 7. | ET5201 | Pervasive Devices and Technology | PC | 3 | 3 | 0 | 0 | 3 |
| 8. | ET5202 | RISC Processor Architecture and Programming | PC | 5 | 3 | 2 | 0 | 4 |
| 9. | ET5203 | Internet of Things | PC | 3 | 3 | 0 | 0 | 3 |
| 10. | ET5211 | Embedded System Lab II | PC | 4 | 0 | 0 | 4 | 2 |

PROFESSIONAL ELECTIVES (PE)*

SEMESTER I

ELECTIVE I

| S.No | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|------|-------------|--|----------|-----------------|---|---|---|---|
| 1. | ET5091 | MEMS Technology | PE | 3 | 3 | 0 | 0 | 3 |
| 2. | ET5001 | Advanced Computer Architecture and Parallel Processing | PE | 3 | 3 | 0 | 0 | 3 |
| 3. | IN5092 | Digital Instrumentation | PE | 3 | 3 | 0 | 0 | 3 |

**SEMESTER II
ELECTIVE II AND III**

| | | | | | | | | |
|----|--------|---|----|---|---|---|---|---|
| 1. | ET5002 | Embedded Linux | PE | 3 | 3 | 0 | 0 | 3 |
| 2. | ET5071 | Advanced Digital Signal Processing | PE | 3 | 3 | 0 | 0 | 3 |
| 3. | ET5003 | Python Programming | PE | 3 | 3 | 0 | 0 | 3 |
| 4. | ET5004 | Embedded Product Development | PE | 3 | 3 | 0 | 0 | 3 |
| 5. | ET5005 | Automotive Embedded System | PE | 3 | 3 | 0 | 0 | 3 |
| 6. | ET5006 | Reconfigurable Processor and SoC Design | PE | 3 | 3 | 0 | 0 | 3 |

**SEMESTER III
ELECTIVE IV, V AND VI**

| | | | | | | | | |
|-----|--------|---|----|---|---|---|---|---|
| 1. | ET5092 | Digital Image Processing | PE | 3 | 3 | 0 | 0 | 3 |
| 2. | ET5007 | Embedded Networking and Automation of Electrical System | PE | 3 | 3 | 0 | 0 | 3 |
| 3. | ET5008 | Smart System Design | PE | 3 | 3 | 0 | 0 | 3 |
| 4. | ET5009 | Entrepreneurship Development | PE | 3 | 3 | 0 | 0 | 3 |
| 5. | ET5010 | Nano Electronics | PE | 3 | 3 | 0 | 0 | 3 |
| 6. | ET5011 | Distributed Embedded Computing | PE | 3 | 3 | 0 | 0 | 3 |
| 7. | PS5091 | Smart Grid | PE | 3 | 3 | 0 | 0 | 3 |
| 8. | PS5073 | Electric Vehicles and Power Management | PE | 3 | 3 | 0 | 0 | 3 |
| 9. | ET5012 | Soft Computing and Optimization Techniques | PE | 3 | 3 | 0 | 0 | 3 |
| 10. | ET5013 | Wireless And Mobile Communication | PE | 3 | 3 | 0 | 0 | 3 |
| 11. | ET5014 | Cryptography And Network Security | PE | 3 | 3 | 0 | 0 | 3 |
| 12. | IN5079 | Robotics and Control | PE | 3 | 3 | 0 | 0 | 3 |

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

| S.No | Course Code | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|------|-------------|-----------------------|----------|-----------------|---|---|----|----|
| 1. | ET5311 | Project Work Phase I | EEC | 12 | 0 | 0 | 12 | 6 |
| 2. | ET5312 | Technical Seminar | EEC | 2 | 0 | 0 | 2 | 1 |
| 3. | ET5411 | Project Work Phase II | EEC | 24 | 0 | 0 | 24 | 12 |

OBJECTIVES :

- The main objective of this course is to demonstrate various analytical skills in applied mathematics and extensive experience with the tactics of problem solving and logical thinking applicable for the students of electrical engineering. This course also will help the students to identify, formulate, abstract, and solve problems in electrical engineering using mathematical tools from a variety of mathematical areas, including matrix theory, calculus of variations, probability, linear programming and Fourier series.

UNIT I MATRIX THEORY**12**

Cholesky decomposition - Generalized Eigenvectors - Canonical basis - QR Factorization - Least squares method - Singular value decomposition.

UNIT II CALCULUS OF VARIATIONS**12**

Concept of variation and its properties – Euler’s equation – Functional dependant on first and higher order derivatives – Functionals dependant on functions of several independent variables – Variational problems with moving boundaries – Isoperimetric problems - Direct methods : Ritz and Kantorovich methods.

UNIT III PROBABILITY AND RANDOM VARIABLES**12**

Probability – Axioms of probability – Conditional probability – Baye’s theorem - 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 IV LINEAR PROGRAMMING**12**

Formulation – Graphical solution – Simplex method – Big M method - Two phase method - Transportation and Assignment models.

UNIT V FOURIER SERIES**12**

Fourier trigonometric series : Periodic function as power signals – Convergence of series – Even and odd function : Cosine and sine series – Non periodic function : Extension to other intervals - Power signals : Exponential Fourier series – Parseval’s theorem and power spectrum – Eigenvalue problems and orthogonal functions – Regular Sturm - Liouville systems – Generalized Fourier series.

TOTAL : 60 PERIODS**OUTCOMES :**

After completing this course, students should demonstrate competency in the following skills:

- Apply various methods in matrix theory to solve system of linear equations.
- Maximizing and minimizing the functional that occur in electrical engineering discipline.
- Computation of probability and moments, standard distributions of discrete and continuous random variables and functions of a random variable.
- Could develop a fundamental understanding of linear programming models, able to develop a linear programming model from problem description, apply the simplex method for solving linear programming problems.
- Fourier series analysis and its uses in representing the power signals.

REFERENCES :

1. Andrews L.C. and Phillips R.L., "Mathematical Techniques for Engineers and Scientists", Prentice Hall of India Pvt. Ltd., New Delhi, 2005.
2. Bronson, R. "Matrix Operation", Schaum's outline series, 2nd Edition, McGraw Hill, 2011.
3. Elsgolc, L. D. "Calculus of Variations", Dover Publications, New York, 2007.
4. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.
5. O'Neil, P.V., "Advanced Engineering Mathematics", Thomson Asia Pvt. Ltd., Singapore, 2003.
6. Taha, H.A., "Operations Research, An Introduction", 9th Edition, Pearson education, New Delhi, 2016.

ET5101

ADVANCED DIGITAL PRINCIPLES AND DESIGN

**LT P C
3 2 0 4**

COURSE OBJECTIVES:

- To expose the students to the fundamentals of sequential system design, Asynchronous circuits, switching errors .
- To teach the fundamentals of modeling through comparative study on the classification of commercial family of Programmable Device
- To study on Fault identification in digital switching circuits
- To introduce logics for design of Programmable Devices
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

UNIT I SEQUENTIAL CIRCUIT DESIGN

12

Analysis of Clocked Synchronous Sequential Networks (CSSN) Modeling of CSSN – State table Assignment and Reduction – Design of CSSN – ASM Chart – ASM Realization.

UNIT II ASYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN

12

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 – Designing Hazard free circuits

UNIT III FAULT DIAGNOSIS AND TESTABILITY ALGORITHMS

12

Fault Table Method – Path Sensitization Method – Boolean Difference Method – Kohavi Algorithm – Tolerance Techniques –Built-in Self Test.

UNIT IV ARCHITECTURES & DESIGN USING PROGRAMMABLE DEVICES

12

Realize combinational, Arithmetic, Sequential Circuit with Programmable Array Logic; Architecture and application of Field Programmable Logic Sequence. Architecture of EPLD, Programmable Electrically Erasable Logic – Programming Techniques -Re-Programmable Devices Architecture-Function blocks, I/O blocks, Interconnects- Xilinx FPGA – Xilinx 2000 - Xilinx 4000 family.

UNIT V HDL PROGRAMMING

12

Overview of digital design with VHDL, hierarchical modelling concepts, gate level modelling, data flow modelling, behavioural modelling, task & functions, logic synthesis-simulation-Design examples, Ripple carry Adders, Carry Look ahead adders, Multiplier, ALU, Shift Registers, Multiplexer, Comparator, Test Bench

Note: Class room discussions and tutorials can include the following guidelines for improved teaching /learning process: Discussions / Practice on Workbench : Logic Synthesis and Simulation for digital designs

TOTAL : 45+ 30=75 PERIODS

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

- Analyze and design sequential digital circuits
- Design and use programming tools for implementing digital circuits of industry standards
- Identify the requirements and specifications of the system required for a given application
- Learners can acquire knowledge about HDL programming.
- Improved Employability and entrepreneurship capacity due to knowledge upgradation on recent trends in digital design for embedded systems.

REFERENCES:

1. Donald G. Givone, "Digital principles and Design", Tata McGraw Hill 2002.
2. Stephen Brown and Zvonk Vranesic, "Fundamentals of Digital Logic with VHDL Deisgn", Tata McGraw Hill, 2002
3. William J. Dally / Curtis Harting / Tor M. Aamodt," Digital Design Using VHDL:A Systems Approach, Cambridge Univerity Press,2015.
4. Charles H. Roth Jr., "Digital Systems design using VHDL", Cengage Learning, 2010.
5. Mark Zwolinski, "Digital System Design with VHDL", Pearson Education, 2004
6. Parag K Lala, "Digital System design using PLD", BS Publications, 2003
7. Stephen M. Trimberger, FPGA Technology, Springer, 1994
8. Nripendra N Biswas, "Logic Design Theory", Prentice Hall of India, 2001
9. Charles H. Roth Jr., "Fundamentals of Logic design", Thomson Learning, 2004.
10. John V.Oldfeild ,Richard C.Dorf,"Field Programmable Gate Arrays",Wiley India Edition,2008

ET5151

MICROCONTROLLER BASED SYSTEM DESIGN

L T P C
3 0 0 3

COURSE OBJECTIVES

- To introduce the fundamentals of microcontroller based system design.
- To teach I/O and RTOS role on microcontroller.
- To know Microcontroller based system design, applications.
- To teach I/O interface in system Design
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

| | | |
|---|--|----------|
| UNIT I | 8051 ARCHITECTURE | 9 |
| Architecture – memory organization – addressing modes – instruction set – Timers - Interrupts - I/O ports, Interfacing I/O Devices – Serial Communication. | | |
| UNIT II | 8051 PROGRAMMING | 9 |
| Assembly language programming – Arithmetic Instructions – Logical Instructions –Single bit Instructions – Timer Counter Programming – Serial Communication Programming, Interrupt Programming, LCD digital clock, thermometer – Significance of RTOS for 8051 | | |
| UNIT III | PIC MICROCONTROLLER | 9 |
| Architecture – memory organization – addressing modes – instruction set – PIC programming in Assembly & C –I/O port, Data Conversion, RAM & ROM Allocation, Timer programming, practice in MP-LAB. | | |
| UNIT IV | PERIPHERAL OF PIC MICROCONTROLLER | 9 |
| Timers – Interrupts, I/O ports- I2C bus-A/D converter-UART- CCP modules -ADC, DAC and Sensor Interfacing –Flash and EEPROM memories. | | |
| UNIT V | SYSTEM DESIGN – CASE STUDY | 9 |
| Interfacing LCD Display – Keypad Interfacing - Generation of Gate signals for converters and Inverters - Motor Control – Controlling DC/ AC appliances – Measurement of frequency - Stand alone Data Acquisition System. | | |

Note: Class room discussions and tutorials can include the following guidelines for improved teaching /learning process :

Discussions/Practice on Workbench : 8051/PIC/ATMEL/other Microcontroller based Assembly/C language programming – Arithmetic Programming– Timer Counter Programming – Serial Communication- Programming Interrupt –RTOS basis in Task creation and run – LCD digital clock/thermometer- Motor Control

TOTAL : 45 PERIODS

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

- 8-bit microcontrollers, learn assembly and C-programming of PIC.
- learn Interfacing of Microcontroller.
- Learners will study about PIC microcontroller and system design.
- The course would enable students to enrich their knowledge with hands on experiments and project based learning
- Effectively utilize microcontroller software development tools such as a compiler, make files, or compile scripts

REFERENCES:

1. Muhammad Ali Mazidi, Rolin D. Mckinlay, Danny Causey ‘ PIC Microcontroller and Embedded Systems using Assembly and C for PIC18’, Pearson Education 2008
2. Rajkamal,”Microcontrollers Architecture, Programming Interfacing,& System Design, Pearson,2012.
3. Muhammad Ali Mazidi, Sarmad Naimi ,Sepehr Naimi‘ AVR Microcontroller and Embedded Systems using Assembly and C”, Pearson Education 2014.
4. Muhammad Ali Mazidi, Janice G. Mazidi and Rolin D. McKinlay, ‘The 8051 Microcontroller and Embedded Systems’ Prentice Hall, 2005.
5. John Iovine, ‘PIC Microcontroller Project Book ’, McGraw Hill 2000
6. Senthil Kumar,Saravanan,Jeevanathan,”microprocessor & microcontrollers,Oxford,2013.
7. Myke Predko, “Programming and customizing the 8051 microcontroller”, TMcGraw Hill 2001.

COURSE OBJECTIVES

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

UNIT I INTRODUCTION TO EMBEDDED SYSTEMS**9**

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

UNIT II EMBEDDED NETWORKING AND INTERRUPTS SERVICE MECHANISM**9**

Embedded Networking: Introduction, I/O Device Ports & Buses– Serial Bus communication protocols - RS232 standard – RS485 –USB – Inter Integrated Circuits (I²C) – interrupt sources , Programmed-I/O busy-wait approach without interrupt service mechanism- ISR concept– multiple interrupts – context and periods for context switching, interrupt latency and deadline -Introduction to Basic Concept Device Drivers.

UNIT III RTOS BASED EMBEDDED SYSTEM DESIGN**9**

Introduction to basic concepts of RTOS- Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Preemptive and non-preemptive scheduling, Task communication-shared memory, message passing-, Interprocess Communication – synchronization between processes-semaphores, Mailbox, pipes, priority inversion, priority inheritance-comparison of commercial RTOS features - RTOS Lite, Full RTOS, VxWorks, µC/OS-II, RT Linux,

UNIT IV SOFTWARE DEVELOPMENT TOOLS**9**

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

UNIT V EMBEDDED SYSTEM APPLICATION DEVELOPMENT**9**

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

Note: Class Room Discussions and Tutorials can include the following Guidelines for improved Teaching /Learning Process: Practice through any of Case studies through Exercise/Discussions on Design , Development of embedded Products like : Smart card -Adaptive Cruise control in a Car - Mobile Phone -Automated Robonoid

TOTAL: 45 PERIODS

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

- An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- Describe the differences between the general computing system and the embedded system, also recognize the classification of embedded systems
- Design real time embedded systems using the concepts of RTOS.
- Foster ability to understand the role of embedded systems in industry

REFERENCES

1. Rajkamal, 'Embedded system-Architecture, Programming, Design', TMH,2011.
2. Peckol, "Embedded system Design",JohnWiley&Sons,2010
3. Shibu.K.V, "Introduction to Embedded Systems", TataMcgraw Hill,2009
4. Lyla B Das," Embedded Systems-An Integrated Approach",Pearson2013
5. Elicia White,"Making Embedded Systems",O'Reilly Series,SPD,2011
6. Bruce Powel Douglass,"Real-Time UML Workshop for Embedded Systems,Elsevier,2011
7. Simon Monk, "Make: Action, Movement, Light and Sound with Arduino and Raspberry Pi", O'Reilly Series ,SPD,2016.
8. Tammy Noergaard, "Embedded System Architecture, A comprehensive Guide for Engineers and Programmers", Elsevier, 2006
9. Jonathan W.Valvano,"Embedded Microcomputer Systems ,Real Time Interfacing",Cengage Learning,3rd edition,2012
10. Michael Margolis,"Arduino Cookbook, O'Reilly Series ,SPD,2013.

ET5191

SOFTWARE FOR EMBEDDED SYSTEMS

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

COURSE OBJECTIVES

- To expose the students to the fundamentals of embedded Programming.
- To Introduce the GNU C Programming Tool Chain in Linux.
- To study basic concepts of embedded C , Embedded OS&Python Programming
- To introduce time driven architecture, Serial Interface with a case study.
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

UNIT I EMBEDDED PROGRAMMING

9

C and Assembly - Programming Style - Declarations and Expressions - Arrays, Qualifiers and Reading Numbers - Decision and Control Statements - Programming Process - More Control Statements - Variable Scope and Functions - C Preprocessor - Advanced Types - Simple Pointers - Debugging and Optimization – In-line Assembly.

UNIT II. C PROGRAMMING TOOL CHAIN IN LINUX

9

C preprocessor - Stages of Compilation - Introduction to GCC - Debugging with GDB - The Make utility - GNU Configure and Build System - GNU Binary utilities - Profiling - using *gprof* - Memory Leak Detection with *valgrind* - Introduction to GNU C Library

UNIT III EMBEDDED C

9

Adding Structure to 'C' Code: Object oriented programming with C, Header files for Project and Port, Examples. Meeting Real-time constraints: Creating hardware delays - Need for timeout mechanism - Creating loop timeouts - Creating hardware timeouts.

UNIT IV EMBEDDED OS

9

Creating embedded operating system: Basis of a simple embedded OS, Introduction to sEOS, Using Timer 0 and Timer 1, Portability issue, Alternative system architecture, Important design considerations when using sEOS- Memory requirements - embedding serial communication & scheduling data transmission - Case study: Intruder alarm system.

UNIT V PYTHON PROGRAMMING

9

Basics of PYTHON Programming Syntax and Style – Python Objects– Dictionaries – comparison with C programming on Conditionals and Loops – Files – Input and Output – Errors and Exceptions – Functions – Modules – Classes and OOP – Execution Environment.

Note: Class room discussions and tutorials can include the following guidelines for improved teaching /learning process:

Discussions/Practice on Workbench : Program Development and practice in exercises with C, C++ Linux and Python Programming Environments.

TOTAL : 45 PERIODS

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

- Ability to use GNU C to develop embedded software.
- knowledge and understanding of fundamental embedded systems design paradigms, architectures, possibilities and challenges, both with respect to software and hardware
- Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design.

REFERENCES

1. Steve Oualline, 'Practical C Programming 3rd Edition', O'Reilly Media, Inc, 2006.
2. Michael J Pont, "Embedded C", Pearson Education, 2007.
3. Christian Hill, Learning Scientific Programming with Python , CAMBRIDGE UNIVERSITY PRESS ,2016.
4. Wesley J.Chun, "Core python application Programming 3rd Edition", Pearson Educat, 2016.
5. Mark J.Guzdial," introduction to computing and programming in python – a Multimedia approach ,4th edition, Pearson Education, 2015.
6. Stephen Kochan, "Programming in C", 3rd Edition, Sams Publishing, 2009.
7. Mark Lutz,"Learning Python,Powerful OOPs,O'reilly,2011.
8. Peter Prinz, Tony Crawford, "C in a Nutshell",O'Reilly,2016.
9. Dr.Bandu Meshram, "Object Oriented Paradigm C++ BeginnersGuide C&C++",SPD, 2016.
10. David Griffiths, Dawn Griffiths, "Head First C", O'reilly,2015.

| Sl.No | Experiment Detail | Equipment/ Supports Required | Training outcomes | Related programme outcomes |
|-------|---|---|--|----------------------------|
| 1. | Programming in Higher Level Languages/ Platforms | C/C++/Java/Embedded C/Embedded Java/ Compilers&Platforms | The students will learn design with simulators/ programming environments | a,b,c,d |
| 2. | Programming with 8 bit Microcontrollers : <ul style="list-style-type: none"> ✓ Assembly programming Study on incircuit Emulators, crosscompilers, debuggers | 8051 Microcontrollors with peripherals; ;IDE, Board Support Software Tools /C Compiler/others | The students will learn design with simulators/experiments,in programming processor boards, processor interfacing/ designing digital controllers | 2,3,4,a,c,d |
| 3. | I/O Programming with 8 bit Microcontrollers I/O Interfacing : Timers/ Interrupts/ Serial port programming/PW M Generation/ Motor Control/ADC/DAC / LCD/ RTC Interfacing/ Sensor Interfacing | 8051 Microcontrollors with peripherals;Board Support Software Tools, peripherals with interface | | a,f |
| 4. | Programming with AVR/ PIC Microcontrollers : <ul style="list-style-type: none"> ✓ Assembly programming ✓ C programming ✓ programming ✓ Interfacing peripherals Study on incircuit Emulators, crosscompilers, | AVR/ PIC Microcontrollors with peripherals; ;IDE, Board Support Software Tools /C Compiler/others | The students will learn design with simulators/experiments,in | a,b,c,d |

| | | | | |
|-------|---|--|--|-------------|
| | debuggers | | programming | |
| 5. . | I/O Programming with AVR/ PIC Microcontrollers I/O Interfacing : Timers/ Interrupts/ Serial port programming/PW M Generation/ Motor Control/ADC/DAC / LCD/ RTC Interfacing/ Sensor Interfacing | AVR/ PIC Microcontrollers with peripherals; Board Support Software Tools, peripherals with interface | processor boards, processor interfacing/ designing digital controllers | 2,3,4,a,c,d |
| 6. | Programming with Arduino Microcontroller Board : Study on incircuit Emulators, crosscompilers, debuggers | Arduino Boards with peripherals ;IDE, Board Support Software Tools /Compiler/others | | a,f |
| 7. . | VHDL Programming in FPGA processors | Processor Boards with Board Support Tools & Interfaces | The students will learn design ,modeling & simulation of Combinational, Sequential, Synchronous, Asynchronous circuits with simulators/experiments ,in programming processor boards, processor interfacing/designing reprogrammable system | a,f |
| 8. | Verilog HDL Programming in FPGA processors | Processor Boards with Board Support Tools & Interfaces | The students will learn design ,modeling & simulation of Combinational, Sequential, Synchronous, Asynchronous circuits with simulators/experiments ,in programming processor boards, processor interfacing/designing reprogrammable system | a,f |
| 9. .. | Programming & Simulation in Simulators /Tools/others | Simulation Tools as Proteus/ ORCAD | The students will learn design with experiments,in programming | a,b,c.d |
| 10. . | Programming & | Simulation Tools as Matlab | suites/ simulators/Tool | 2,3,4,a,c,d |

| | | | | |
|--|--|---------|--------|--|
| | Simulation in Simulators /Tools/others | /others | Bench. | |
|--|--|---------|--------|--|

TOTAL : 60 PERIODS

Note: Note:Laboratory training, discussions can include the given guidelines for improved teaching /learning process :Hands on experiences can be with Case specific experiments in domains on range of processors,programmes,simulators,circuits that support theory subjects.

REFERENCE:

1. Mohamammad Ali Mazidi & Mazidi ‘ 8051 Microcontroller and Embedded Systems’, Pearson Education
2. Mohammad Ali Mazidi, Rolind Mckinley and Danny Causey, ‘PIC Microcontroller and Embedded Systems’ Pearson Education
3. Simon Monk,” Make Action-with Arduino and Raspberry Pi,SPD ,2016.
4. Wesley J.Chun,”Core Python Applications Programming,3rd ed,Pearson,2016
5. Kraig Mitzner, ‘Complete PCB Design using ORCAD Capture and Layout’, Elsevier
6. Vinay K.Ingle,John G.Proakis,”DSP-A Matlab Based Approach”,Cengage Learning,2010
7. Taan S.Elali,”Discrete Systems and Digital Signal Processing with Matlab”,CRC Press2009.
8. *Jovitha Jerome, ”Virtual Instrumentation using Labview”PHI,2010.*
9. Woon-Seng Gan, Sen M. Kuo, ‘Embedded Signal Processing with the Micro Signal Architecture’, John Wiley & Sons, Inc., Hoboken, New Jersey 2007
10. Dogan Ibrahim, ‘Advanced PIC microcontroller projects in C’, Elsevier 2008

ET5251

REAL TIME OPERATING SYSTEMS

**LT P C
3 0 0 3**

COURSE 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 modeling Process based on range of OS features
- To compare types and Functionalities in commercial OS, application development using RTOS
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

UNIT I REVIEW OF OPERATING SYSTEMS

9

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 OVERVIEW OF RTOS 9

RTOS Task and Task state –Multithreaded Preemptive scheduler- Process Synchronisation- Message queues– Mail boxes -pipes – Critical section – Semaphores – Classical synchronisation problem – Deadlocks

UNIT III REAL TIME MODELS AND LANGUAGES 9

Event Based – Process Based and Graph based Models – Real Time Languages – RTOS Tasks – RT scheduling - Interrupt processing – Synchronization – Control Blocks – Memory Requirements.

UNIT IV REAL TIME KERNEL 6

Principles – Design issues – RTOS Porting to a Target – Comparison and Basic study of various RTOS like – VX works – Linux supportive RTOS – C Executive.

UNIT V INTRODUCTION TO EMBEDDED OS 12

Discussions on Basics of Linux supportive RTOS – uCOS-C Executive for development of RTOS Application –introduction to Android Environment -The Stack – Android User Interface – Preferences, the File System, the Options Menu and Intents, with one Case study

Note: Class room discussions and tutorials can include the following guidelines for improved teaching /learning process: Discussions/Practice on Workbench :on understanding the scheduling techniques, timing circuitary, memory allotment scheme , overview of commercial Embedded OS.

TOTAL : 45 PERIODS

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

- Real-time scheduling and schedulability analysis, including clock-driven and priority-driven scheduling
- Theoretical background (specification/verification) and practical knowledge of real-time operating systems.
- After completing the course students will appreciate the use of multitasking techniques in real-time systems, understand the fundamental concepts of real-time operating systems
- Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design.

REFERENCES:

1. Silberschatz, Galvin, Gagne” Operating System Concepts, 6th ed, John Wiley, 2003
2. Charles Crowley, “Operating Systems-A Design Oriented approach” McGraw Hill, 1997
3. Raj Kamal, “Embedded Systems- Architecture, Programming and Design” Tata McGraw Hill, 2006.
4. Karim Yaghmour, Building Embedded Linux System”, O’reilly Pub, 2003
5. C.M. Krishna, Kang, G. Shin, “Real Time Systems”, McGraw Hill, 1997.
6. Marko Gargenta, ”Learning Android “, O’reilly 2011.
7. Herma K., “Real Time Systems – Design for distributed Embedded Applications”, Kluwer Academic, 1997.
8. Corbet Rubini, Kroah-Hartman, “Linux Device Drivers”, O’reilly, 2016.
9. Mukesh Sigal and N G Shi “Advanced Concepts in Operating System”, McGraw Hill, 2000
10. D.M.Dhamdhare, ” Operating Systems, A Concept-Based Approach, TMH, 2008

COURSE OBJECTIVES

- To expose the fundamentals of wireless sensor technology, classification
- To teach the infrastructure of WSN processor and its functions in networking
- To study on challenges in on interconnectivity of networks & Network communication
- To discuss on commercial wireless technology
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

UNIT I WIRELESS SENSOR DEVICES & NETWORKING**12**

Challenges for Wireless Sensor Networks- Characteristic requirements for WSN ,WSN vs Adhoc Networks - introduction to Sensor node networking with any Commercially available sensor nodes – Physical layer and transceiver design considerations in WSNs, -Applications of sensor networks

UNIT II BUILDING PERVASIVE SENSOR NETWORK**12**

Single-Node Architecture - Hardware Components, constraints & challenges in resources- Energy Consumption of Sensor Nodes, Operating Systems for Wireless Sensor Networks – Introduction - Operating System Design Issues - Network Architecture -Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts. Data Dissemination-Flooding and Gossiping-Data gathering Sensor Network Scenarios –Optimization, Goals and Figures of Merit – Design Principles for WSNs- Gateway Concepts – Need for gateway

UNIT III. WIRELESS TECHNOLOGY**6**

Wireless LAN – IEEE 802.11 System Architecture , protocol Architecture – Services , AdHoc Networks, Hiper LAN , Bluetooth , Wireless PAN, Wireless MAN, Wireless Backbone Networks , Wireless Access Technology

UNIT IV OVERVIEW OF SENSOR NETWORK PROTOCOLS**9**

Introduction to fundamentals of Wireless sensor network MAC Protocols - Low duty cycle protocols and wakeup concepts - Contention-based protocols - Schedule-based protocols - IEEE 802.15.4 MAC protocol- Energy usage profile, Choice of modulation scheme-basic principle for data transfer and energy management for SMAC , Leach & Zigbee communication

UNIT V WIRELESS NETWORKING OF DEVICES**6**

Classification of Wireless Networking of Devices, introduction to RF WPAN 802.15.1 &Bluetooth - protocol stack,frame, link manager layer –Bluetooth piconet–application.

Note:Class room discussions and tutorials can include the following guidelines for improved teaching /learning process : Discussions/Exercise/Practice on Workbench : on the basics of Zigbee protocols, sensor motes, role of special microcontrollers for Zigbee communication etc

TOTAL : 45 PERIODS

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

- Relate to current trends in pervasive computing and develop a sense of their practicality
- Identify distinguishing features of the different mobile device categories, namely, Pocket PCs, Personal Digital Assistants (PDAs), and wireless phones.

- Recognize the difference between writing code for workstations and servers on one hand and for resource-constrained devices on the other hand.
- The learning process delivers insight onto building of sensor networks, communication in zigbee network and sensor networks protocols are studied.
- Design and develop a pervasive computing device for a specific need.
- Develop a framework for pervasive computing.

REFERENCES

1. Holger Karl, Andreas Willig, "Protocols & Architectures for WSN", John Wiley, 2012
2. Mark Ciampa, Jorge Olenewa, "Wireless Communications, Cengage Learning, 2009.
3. Frank Adelstein, Sandeep K.S Gupta et al, "Fundamentals of Mobile & Pervasive Computing, TMcHill, 2010.
4. Jaganathan Sarangapani, Wireless AdHoc & Sensor N/Ws-Protocols&Control, CRC 2007.
5. Kaveh Pahlavan, Prasanth Krishnamoorthy, "Principles of Wireless Networks' PHI/Pearson Education, 2003
6. Natalia Olifer and Victor Olifer, "Computer Networks principles. technologies and protocols for network design", Wiley, 2015
7. Feng Zhao, Leonidas Guibas "Wireless Sensor Networks", Elsevier, 2005.
8. William Stallings, "Wireless communications and Networks", PHI/Pearson Education, 2002.
9. Mullet, "Introduction to wireless telecommunications systems and networks", cengage learning, 2010
10. Feng Zhao & Leonidas J. Guibas, "Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007.

ET5202 RISC PROCESSOR ARCHITECTURE AND PROGRAMMING

LT P C
3 2 0 4

COURSE OBJECTIVES

- To teach the architecture of general AVR processor
- To teach the architecture and programming of 8/16 bit RISC processor
- To teach the implementation of DSP in ARM processor
- To discuss on memory management, application development in RISC processor
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

UNIT I AVR MICROCONTROLLER ARCHITECTURE

12

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

12

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

12

Introduction to RT implementation with ARM – Exception Handling – Interrupts – Interrupt handling schemes- Firmware and bootloader – Free RTOS Embedded Operating Systems concepts – example on ARM core like ARM9 processor

UNIT IV MEMORY PROTECTION AND MANAGEMENT

12

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

12

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

Note: Class room discussions and tutorials can include the following guidelines for improved teaching /learning process: Discussions/Exercise/Practice on Workbench : on Programming practices on the KEIL Work Bench for Simple ASM/C / Input & output interfacing programs with ARM 7/ARM 9/Nuvoton Processors

TOTAL : 60 PERIODS

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

- Describe the programmer's model of ARM processor and create and test assembly level programming.
- Analyze various types of coprocessors and design suitable co-processor interface to ARM processor.
- Identify the architectural support of ARM for operating system and analyze the function of memory Management unit of ARM.
- Students will develop more understanding on the concepts ARM Architecture, programming and application development.
- The learning process delivers insight into various embedded processors of RISC architecture / computational processors with improved design strategies.

REFERENCES

1. Steve Furber, 'ARM system on chip architecture', Addison Wesley
2. Andrew N. Sloss, Dominic Symes, Chris Wright, John Rayfield 'ARM System Developer's Guide Designing and Optimizing System Software', Elsevier 2007.
3. Muhammad Ali Mazidi, Sarmad Naimi ,Sepehr Naimi' AVR Microcontroller and Embedded Systems using Assembly and C", Pearson Education 2014.
4. ARM Architecture Reference Manual, LPC213x User Manual
5. www.Nuvoton .com/websites on Advanced ARM Cortex Processors
6. Trevor Martin, 'The Insider's Guide To The Philips ARM7-Based Microcontrollers,
7. An Engineer's Introduction To The LPC2100 Series' Hitex (UK) Ltd.,

ET5203

INTERNET OF THINGS

L T P C
3 0 0 3

COURSE OBJECTIVES

- To Study about **Internet of Things** technologies and its role in real time applications
- To familiarize the accessories and communication techniques for IOT.
- To familiarize the different platforms and Attributes for IOT

UNIT I INTRODUCTION TO INTERNET OF THINGS

6

Overview, Technology drivers , Business drivers,Typical IoT applications , Trends and implications

UNIT II IOT ARCHITECTURE: 12
Node Structure - Sensing, Processing, Communication, Powering, Networking - Topologies, Layer/Stack architecture ,IoT standards,Cloud computing for IoT,Bluetooth, Bluetooth Low Energy, beacons.

UNIT III PROTOCOLS AND WIRELESS TECHNOLOGY FOR IOT 9
Protocols : NFC,RFID, Zigbee MIPI, M-PHY, UniPro, SPMI, SPI, M-PCle Wired vs. Wireless communication,GSM, CDMA, LTE, GPRS, small cell.

Wireless technologies for IoT: WiFi (IEEE 802.11), Bluetooth/Bluetooth Smart, ZigBee/ZigBee Smart, UWB (IEEE 802.15.4), 6LoWPAN, Proprietary systems.

UNIT IV DATA ANALYSTICS FOR IOT 9
Services/Attributes: Big-Data Analytics and Visualization,Dependability,Security,Maintainability.

Data analytics for IoT: A framework for data-driven decision making , Descriptive, Predictive and Prescriptive Analytics , Business Intelligence and Artificial Intelligence Importance of impact and open innovation in data-driven decision making.

UNIT V CASE STUDIES 9
Home Automation, smart cities, Smart Grid, Electric vehicle charging, Environment, Agriculture, Productivity Applications

TOTAL : 45 PERIODS

OUTCOMES

- Students will develop more understanding on the concepts of IOT and its present developments.
- Students will study about different IOT technologies.
- Students will acquire knowledge about different platforms and Infrastructure for IOT
- Students will learn the art of implementing IOT for smart applications and control

Note: Class Room Discussions and Tutorials can include the following Guidelines for improved Teaching /Learning Process: Practice through any of Case studies through Exercise/Discussions on Design , Development of embedded solutions using wireless communication by processor support

REFERENCES:

1. Arshdeep Bahga and Vijai Madiseti : A Hands-on Approach “Internet of Things”,Universities Press 2015.
2. Oliver Hersent , David Boswarthick and Omar Elloumi “ The Internet of Things”, Wiley,2016.
3. Samuel Greengard, “ The Internet of Things”, The MIT press, 2015
4. Adrian McEwen and Hakim Cassimally “Designing the Internet of Things “Wiley,2014.
5. Jean- Philippe Vasseur, Adam Dunkels, “Interconnecting Smart Objects with IP: The Next Internet” Morgan Kuffmann Publishers, 2010.
6. Adrian McEwen and Hakim Cassimally, “Designing the Internet of Things”, John Wiley and sons, 2014
7. Lingyang Song/Dusit Niyato/ Zhu Han/ Ekram Hossain,” Wireless Device-to-Device Communications and Networks, CAMBRIDGE UNIVERSITY PRESS,2015
8. OvidiuVermesan and Peter Friess (Editors), “Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems”, River Publishers Series in Communication, 2013
9. Vijai Madiseti , ArshdeepBahga, “Internet of Things (A Hands on-Approach)”, 2014

10. Zach Shelby, Carsten Bormann, "6LoWPAN: The Wireless Embedded Internet", John Wiley and sons, 2009
11. Lars T. Berger and Krzysztof Iniewski, "Smart Grid applications, communications and security", Wiley, 2015
12. Janaka Ekanayake, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama and Nick Jenkins, "Smart Grid Technology and Applications", Wiley, 2015.
13. Upena Dalal, "Wireless Communications & Networks, Oxford, 2015

ET5211

EMBEDDED SYSTEM LAB II

**LT P C
0 0 4 2**

| Sl. No | Experiment Detail | Equipment/ Supports Required | Training outcomes | Related programme outcomes |
|--------|--|---|---|----------------------------|
| 1. | Programming ARM processor : ARM7 / ARM9/ARM Cortex Study on incircuit Emulators, crosscompilers, debuggers | Microcontrollers with peripherals; IDE, Board Support Software Tools /Keil/uCOS Compiler/others | | a,b,c,d |
| | I/O Programming with ARM processor : ARM7 / ARM9/ARM Cortex Microcontrollers I/O Interfacing : Timers/ Interrupts/ Serial port programming/PWM Generation/ Motor Control/ADC/DAC/ LCD/ RTC Interfacing/ Sensor Interfacing | ARM processor : ARM7 / ARM9/ARM Cortex Microcontrollers with peripherals; Board Support Software Tools, peripherals with interface | The students will learn design with simulators/experiments, in programming processor boards, processor interfacing/ designing digital controllers | 2,3,4,a,c,d |
| 2. | Programming with Raspberry Pi Microcontroller Board : Study on incircuit Emulators, crosscompilers, debuggers | Raspberry Pi Boards with peripherals ; IDE, Board Support Software Tools /Compiler/others | | a,f |
| 3. | I/O Programming with Arduino ,Raspberry Pi Microcontroller Boards I/O Interfacing : Timers/ Interrupts/ Serial port programming/PWM Generation/ Motor Control/ADC/DAC/ LCD/ RTC Interfacing/ Sensor Interfacing | Arduino, Raspberry Pi Microcontroller Boards with peripherals; Board Support Software Tools, peripherals with interface | | a,f |
| 4. | Programming with DSP | Processor Boards with Board | | The students |

| | | | | |
|----|--|---|---|-------------|
| | processors | Support Tools & Interfaces | will learn design & simulation of Arithmetic ,Logic programs, Filters, Signal anaysis with simulators/ex periments ,in programming processor boards, processorint erfacing/ Tools | |
| 5. | Programming in Freeware softwares/ Platforms | Programming Compilers&Platforms on freeware | The students will learn programming , compiling in various tools & software domains | 2,3,4,a,c,d |
| 6. | <u>Software & Modelling tools</u> <ul style="list-style-type: none"> ✓ Study on MEMS Tools ✓ Study on process Controller modeling ✓ PLC/SCADA/PCB ✓ one type CAD Tool | Personal Computers, Licenced software & programming/modelling tools | | a,f |
| 7. | Programming & Simulation in GUI Simulators /Tools/others <ul style="list-style-type: none"> ✓ Graphical User interface simulations & modeling of instrumentation & controllers | Simulation Tools as Labview /others | The students will learn programming , compiling in various tools & software domains | a,f |
| 8. | Study of one type of Real Time Operating Systems (RTOS) | Compilers & Platforms with VXWorks/ Keil/ Android/ Tiny OS/ Linux Support/any RTOS | | a,b,c.d |
| 9. | Programming & Simulation in Python Simulators/Tools/others | Programming in Python Platform | | 2,3,4,a,c,d |
| 10 | Programming with wired/wireless communication protocol/Network Simulators | Learning Communication Protocols & Support Software Tools for BUS & network communication | Learning Communicati on Protocols & Experimentin g with Support Software Tools for communicati on interfaces | a,f |

TOTAL : 60 PERIODS

Note: Laboratory training, discussions can include the given guidelines for improved teaching /learning process :Hands on experiences with Case specific experiments in domains on range of work Benches,programmable Test suites,simulators,circuit boards that support the practical skill training supportive to theory subjects .

REFERENCES:

1. Mohamammad Ali Mazidi & Mazidi ‘ 8051 Microcontroller and Embedded Systems’, Pearson Education
2. Mohammad Ali Mazidi, Rolind Mckinley and Danny Causey, ‘PIC Microcontroller and Embedded Systems’ Pearson Education
3. Simon Monk,” Make Action-with Arduino and Raspberry Pi,SPD ,2016.
4. Wesley J.Chun,”Core Python Applications Programming,3rd ed,Pearson,2016
5. Kraig Mitzner, ‘Complete PCB Design using ORCAD Capture and Layout’, Elsevier
6. Vinay K.Ingle,John G.Proakis,”DSP-A Matlab Based Approach”,Cengage Learning,2010
7. Taan S.Elali,”Discrete Systems and Digital Signal Processing with Matlab”,CRC Press2009.
8. *Jovitha Jerome, ”Virtual Instrumentation using Labview”PHI,2010.*
9. Woon-Seng Gan, Sen M. Kuo, ‘Embedded Signal Processing with the Micro Signal Architecture’, John Wiley & Sons, Inc., Hoboken, New Jersey 2007
10. Dogan Ibrahim, ‘Advanced PIC microcontroller projects in C’, Elsevier 2008

ET5311

PROJECT WORK PHASE I

L T P C
0 0 12 6

Pre-requisites: choice of project title for project can also be done as per broad domain of research topic listed.

| domains | Course objectives : to expose to many of the following by choice for learning | Training outcomes | Related programme outcomes |
|---------|---|--|----------------------------|
| 1.0 | <ul style="list-style-type: none"> ✓ Programming in C/ Embedded C / C++ / JAVA ✓ Network Simulators ✓ Network programming ✓ Python programming ✓ Programming on Pervasive Computing ✓ Java for Wireless Devices | Skill development in software programming/working in simulators, emulators, learn using the commercial packages for wired, wireless communications | a,b,c,d |
| 2.0 | <ul style="list-style-type: none"> Embedded Processors ✓ uC, ARM processors ✓ DSP / Image / Video Processors ✓ VHDL Programming in processors | The students will learn design with simulators/experiments,in programming processor boards, processor interfacing/designing reprogrammable system | 2,3,4,a,c,d |
| 3.0 | <ul style="list-style-type: none"> ✓ Android / LINUX OS Internals/VxWorks/Keil ✓ MPLAB/Os/any RTOS tool suite | The students will skill through OS programming through API, libraries | a,f |

| | | | |
|-----|--|---|------------|
| 4.0 | <ul style="list-style-type: none"> ✓ Virtual Instrumentation programming ✓ Simulink/Matlab Tools ✓ Study on MEMS Tools ✓ Study on process Controller modeling ✓ PLC/SCADA/PCB/ORCAD ✓ one CAD Tool | The students will apply programming logic for modeling/simulating for embedded application /products & service development | a,f |
| 5.0 | <ul style="list-style-type: none"> ✓ Entrepreneurship development | Skill The students will know to pickup skills for product development/establish consultancy services with an outlook into selecting commercially viable market for technical demands | d,e,f,g,h, |

Guidelines onto Topics:

1. Network Simulators-Design and Implement many processor based network deployment /involve IOT or sensor network with use of monitoring tool to record sensor values, establish communication,get network statistics like packets sent and received, percentage errors, desktop grabbing, remote monitoring etc.
2. Embedded Processors- Implement an IO peripheral interface ARM/ PIC / MSP 430 /Arduino/RPi/ other advanced embedded Processor through Study of CAN / I2C / Ethernet/any serial bus communication /any other communication protocol for IO interface
3. Virtual Instrumentation programming to design smart metering Design and Implement though GUI suite /tool to record Sensor data recording with signal analysis to discuss on system performance and implement controller scheme.
4. Study on process Controller modelling -with math lab suite with modeling, analysis for Embedded control of systems/vehicle modeling/communication of systems
5. VHDL Programming on Programmable Logic Devices -Design and Implementation with using Xilinx/Altera FPGA / CPLD on Design ,verification of simple Combinational/Sequential Circuits
6. Study on CAD Tool- device modeling, codesign ,verification,analysis on Tools.
7. DSP / Image / Video Processing - Simulation / Implementation of any fewof its algorithms
8. Network simulation- using NS2/ Programming of TCP/IP protocol stack /any network simulator tools -Network Deployment /Design and Implement a GUI or text based network monitoring tool to record network statistics like packets sent and received, percentage errors,, security concepts,.
9. Programming in C/ Embedded C / Python/C++ / JAVA/others- Embedded Application development
10. Android / LINUX OS Internals/VxWorks/Keil -Study on programming of the OS through one API for Driver interfaces, Disk driver and Terminal drivers

11. Programming on Pervasive Computing on mobile device application Platform through any one Operating System /Palm OS / Windows CE/ Embedded Linux -J2ME / Symbian /Android/others
12. Java for Wireless Devices to Set up the development environment with Basic Data types, Libraries ,Wireless Messaging,Architecture for messaging application,Messaging API, Making a device connection using HTTP
13. Study on MEMS –device,structural modeling & analysis using CAD lab SUITE
14. PLC/SCADA/PCB study-develop one Case Study as Application with suitable platform.
15. Entrepreneurship Skill development through Product Design with Cost Estimation – Learn through survey on : project/product identification, development plan and execution, the Activity planning, schedule development ,Integration Management configuration management, Time management-,Cost estimation, Service&Quality Management planning , Human Resource Management- Organizational planning , staff acquisition, Communication - Information distribution , reporting, Risk Management,Environment Safety Management Procurement Management- contract, Ethics,Legal & Government rules on administration.

ET5091

MEMS TECHNOLOGY

L T P C
3 0 0 3

COURSE OBJECTIVES

- To teach the students properties of materials ,microstructure and fabrication methods.
- To teach the design and modeling of Electrostatic sensors and actuators.
- To teach the characterizing thermal sensors and actuators through design and modeling
- To teach the fundamentals of piezoelectric sensors and actuators through exposure to different MEMS and NEMS devices
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

UNIT I MICRO-FABRICATION, MATERIALS AND ELECTRO-MECHANICAL CONCEPTS 9

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 9

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

UNIT III THERMAL SENSING AND ACTUATION 9

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

UNIT IV PIEZOELECTRIC SENSING AND ACTUATION 9

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

UNIT V CASE STUDIES

9

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

Note: Class room discussions and tutorials can include the following guidelines for improved teaching /learning process: Discussions/Exercise/Practice on Workbench: on the basics /device model design aspects of thermal/peizo/resistive sensors etc.

TOTAL : 45 PERIODS

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

- Understand basics of microfabrication, develop models and simulate electrostatic and electromagnetic sensors and actuators
- Understand material properties important for MEMS system performance, analyze dynamics of resonant micromechanical structures
- The learning process delivers insight onto design of micro sensors, embedded sensors & actuators in power aware systems like grid.
- Understand the design process and validation for MEMS devices and systems, and learn the state of the art in optical microsystems
- Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design.

REFERENCES

1. Chang Liu, "Foundations of MEMS", Pearson International Edition, 2006.
2. Marc Madou , "Fundamentals of microfabrication",CRC Press, 1997.
3. Boston , "Micromachined Transducers Sourcebook",WCB McGraw Hill, 1998.
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ET5001

**ADVANCED COMPUTER ARCHITECTURE AND
PARALLEL PROCESSING**

**LT P C
3 0 0 3**

COURSE OBJECTIVES

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

UNIT I THEORY OF PARALLELISM

9

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

| | | |
|--|--|-----------|
| UNIT II | SYSTEM INTERCONNECT ARCHITECTURES | 9 |
| System interconnect Architectures-Network Properties and routing-Static Interconnection Networks-Dynamic Interconnection Networks-Multiprocessor System Interconnects-interprocessor communication network-Structure of Parallel Computers; Hierarchical bus systems-Crossbar switch and multiport memory-multistage and combining network | | |
| UNIT III | PIPELINING AND SUPERSCALAR TECHNOLOGIES | 6 |
| Pipeline principle and implementation-classification of pipeline processor-introduction of arithmetic,instruction,processor pipelining-pipeline mechanisms-hazards | | |
| UNIT IV | HARDWARE TECHNOLOGIES | 15 |
| Introduction to features of advanced embedded processors through Basic Comparative study : of Architectures -addressing modes -instruction types-performance of- Parallel and scalable architectures, Multiprocessor and SIMD ,MIMD computers, <i>RISC,CISC,Superscalar,VLIW , Vector, Systolic processors of their unique features</i> -Scalable, Multithreaded and data flow Architectures-inter PE communication-interconnection networks- Array & vector processors, vector instruction types-performance modeling-design of vectorising compiler- case Architecture of Itanium processor, Pentium Processor, SPARC Processor. | | |
| UNIT V | OS ISSUES FOR MULTI PROCESSOR | 6 |
| Introduction-Need for Pre emptive OS – Synchronising and Scheduling in Multiprocessor OS-, Usual Os scheduling Techniques, threads – Classification of multi processor OS – Software requirements of multiprocessor OS, Distributed scheduler – PVM – PT Threads in shared memory systems | | |

Note: Class room discussions and tutorials can include the following guidelines for improved teaching /learning process: :Discussions/Practice on Workbench : modelling of Computing Algorithms /ALU Functional Blocks

TOTAL : 45 PERIODS

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

- An ability to understand the operations of multiprocessor and multicomputer systems.
- To understand the various advanced processor technology, pipelining and scalable architectures.
- To know the working of superscalar pipeline, cache memory organization.
- To understand the principles of multithreading, multithread architecture, static and dynamic data flow.
- Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design.

REFERENCES:

1. Kai Hwang “Advanced Computer Architecture”.Tata McGraw Hill 2000
2. Advanced Computer architecture , By Rajiv Chopra, S Chand , 2010
3. John L. Hennessy, David A. Petterson, “Computer Architecture: A Quantitative Approach”, 4th Edition, Elsevier, 2007
4. Dezso Sima, Terence Fountain, Peter Kacsuk, “Advanced computer Architecture – A design Space Approach”. Pearson Education,2003.
5. Sajjan G. Shiva “Advanced Computer Architecture”, Taylor & Francis, 2008
6. Rajaraman, C.Siva Ram Murthy, “Parallel Computers- Architecture and Programming”, Prentice Hall India, 2008
7. Carl Homacher, Zvonko Vranesic, Sefwat Zaky, “Computer Organisation”, 5th Edition, TMH, 2002.

8. David E. Culler, Jaswinder Pal Singh with Anoop Gupta “Parallel Computer Architecture” ,Elsevier, 2004.
9. John P. Shen. “Modern processor design Fundamentals of super scalar processors”, Tata McGraw Hill 2003.
10. Harry F. Jordan Gita Alaghaband, “Fundamentals of Parallel Processing”. Pearson Education, 2003.
11. Richard Y. Kain, “Advanced computer architecture – A system Design Approach”, PHI, 2003.

IN5092

DIGITAL INSTRUMENTATION

**LT P C
3 0 0 3**

COURSE OBJECTIVES

- To discuss to the students on the fundamentals building blocks of a digital instrument
- To teach the digital data communication techniques
- To study on bus communication standards and working principles
- To teach Graphical programming using GUI for instrument building
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

UNIT I DATA ACQUISITION SYSTEMS

10

Overview of A/D converter, types and characteristics – Sampling, Errors. Objective – Building blocks of Automation systems -Calibration, Resolution, Data acquisition interface requirements.–Counters – Modes of operation- Frequency, Period, Time interval measurements, Prescaler, Heterodyne converter for frequency measurement, Single and Multi channel Data Acquisition systems-Digital storage Oscilloscope-digital display interface.

UNIT II INSTRUMENT COMMUNICATION

10

Introduction, Modem standards, Data transmission systems- Time Division Multiplexing (TDM) – Digital Modulation Basic requirements of Instrument Bus Communications standards, interrupt and data handshaking , serial bus- basics, Message transfer, - RS-232, USB, RS-422, Ethernet Bus- CAN standards interfaces .General considerations -advantages and disadvantages-Instrumentation network design ,advantages and limitations ,general considerations, architecture, model, and system configuration of : HART network, Mod Bus, Fieldbus

UNIT III VIRTUAL INSTRUMENTATION BASICS

12

Block diagram ,role,and Architecture for VI— tool bar,Graphical system design &programming usingGUI – Virtual Instrumentation for test, control design-modular programming-conceptual and prog approaches for creation of panels,icons-Loops-Arrays-clusters-plotting data-structures-strings and File I/O- Instrument Drivers

UNIT IV CONFIGURING PROGRAMMABLE INSTRUMENTATION

7

Microprocessor based system design –Peripheral Interfaces systems and instrument communication standards –Data acquisition with processor and with VI – Virtual Instrumentation Software and hardware simulation of I/O communication blocks-peripheral interface – ADC/DAC – Digital I/O – Counter , Timer-servo motor control-PID control.

UNIT V CASE STUDIES

6

Processor based DAS, Data loggers, VI based process measurements like temperature, pressure and level development system- DSO interface -digital controller for colour video display.

Note: Class room discussions and tutorials can include the following guidelines for improved teaching /learning process :Discussions/Exercise/Practice on Workbench for Digital Control of Relays/Solenoids, Digital I/O – Counter , Timer-servo motor control-PID control. / LCD graphics Interface/storage interface,

TOTAL : 45 PERIODS

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

- Use digital integrated circuit logic family chips.
- Perform computational and measurement activities using digital techniques, build sequential and combinational logic circuits.
- Analyse working of A/D and D/A converters, use display devices for digital circuits, use digital meters for measurements.
- Graduates will understand the fundamental principles of electrical and electronics circuits and instrumentation, enabling them to understand current technology and to adapt to new devices and technologies.
- Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design.

REFERENCES:

1. Mathivanan, “PC based Instrumentation Concepts and practice”, Prentice-Hall India, 2009
2. Jovitha Jerome, ”Virtual Instrumentation using Labview”PHI,2010.
3. Gregory J. Pottie / William J. Kaiser, Principles Of Embedded Networked Systems Design, CAMBRIDGE UNIVERSITY PRESS (CUP),2016
4. Jonathan W Valvano, “Embedded Microcomputer systems”, Brooks/Cole, Thomson, 2010.
5. Cory L.Clark, ”Labview Digital Signal Processing & Digital Communication, TMcH,2005
6. Lisa K. wells & Jeffrey Travis, Lab VIEW for everyone, Prentice Hall, New Jersey,1997.
7. H S Kalsi, “Electronic Instrumentation” Second Edition, Tata McGraw-Hill,2006.
8. K.Padmanabhan, S.Ananthi A Treatise on Instrumentation Engineering ,I K Publish,2011
9. Gary Johnson, LabVIEW Graphical Programming, Second edition, McG Hill,Newyork, 1997.

ET5002

EMBEDDED LINUX

**LT P C
3 0 0 3**

COURSE OBJECTIVES

- To expose the students to the fundamentals of Linux Operating system, its basic commands and shell programming
- To teach the history of embedded Linux, various distributions and basics of GNU Cross Platform Tool Chain.
- To study on different Host-Target setup, debug and various memory device, file systems and performance tuning .
- To introduce the concept of configuring kernel using the cross-platform tool chain.
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

UNIT I FUNDAMENTALS OF LINUX

9

Basic Linux System Concepts: Working with Files and Directories - Introduction to Linux File system - Working with Partitions and File systems - Understanding Linux Permissions; Using Command Line Tools: Executing Commands from the Command Line - Getting to a Shell - Popular Command-Line Commands - Working with the Bash Shell

UNIT II VARIOUS DISTRIBUTIONS AND CROSS PLATFORM TOOL CHAIN 9
Introduction - History of Embedded Linux - Embedded Linux versus Desktop Linux - Commercial Embedded Linux Distribution - Choosing a distribution - Embedded Linux Distributions - Architecture of Embedded Linux - Linux Kernel Architecture - Porting Roadmap - GNU Cross Platform Toolchain

UNIT III HOST-TARGET SETUP AND OVERALL ARCHITECTURE 9
Real Life Embedded Linux Systems - Design and Implementation Methodology - Types of Host/Target Development Setups - Types of Host/Target Debug Setups - Generic Architecture of an Embedded Linux System - System Startup - Types of Boot Configurations - System Memory Layout - Processor Architectures - Buses and Interfaces - I/O – Storage

UNIT IV KERNEL CONFIGURATION 9
A Practical Project Workspace - GNU Cross-Platform Development Toolchain - C Library Alternatives - Other Programming Languages - Eclipse: An Integrated Development Environment - Terminal Emulators - Selecting a Kernel - Configuring the Kernel - Compiling the Kernel - Installing the Kernel - Basic Root Filesystem Structure - Libraries - Kernel Modules and Kernel Images - Device Files - Main System Applications - System Initialization

UNIT V LINUX DRIVERS 9
Introduction in to basics on Linux drivers, introduction to GNU cross platform Toolchain- Case study on programming one serial driver for developing application using Linux Driver

Note: Class room discussions and tutorials can include the following guidelines for improved teaching /learning process: Discussions/Practice on Workbench : on design of Algorithms for Practicing Shell Programming in Linux / Developing programs in GCC and Eclipse / Learning Debugging and Profiling/Linux Driver interface

TOTAL : 45 PERIODS

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

- To use Linux desktop and GNU tool chain with Eclipse IDE
- Cross compile Linux kernel and port it to target board.
- Add applications and write customized application for the Linux kernel in the target board.
- Students will study about distributions and cross platform tool chain.
- Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design.

REFERENCES:

1. Karim Yaghmour, Jon Masters, Gilad Ben-Yossef, and Philippe Gerum, 'Building Embedded Linux Systems 2nd Edition', SPD -O'Reilly Publications, 2008
2. P.Raghavan,Amol Lad,Sriram Neelakandan,"EmbeddedLinux System Design & Development,Auerbach Publications, 2012
3. William von Hagen, 'Ubuntu Linux Bible 3rd Edition', Wiley Publishing Inc., 2010
4. Jonathan Corbet, Alessandro Rubini & Greg Kroah-Hartman, 'Linux Device Drivers 3rd Edition', SPD -O'Reilly Publications, 2011
5. Robert Love,"Linux System Programming, SPD -O'Reilly Publications, 2010

COURSE OBJECTIVES

- To expose the students to the fundamentals of digital signal processing in frequency domain & its application
- To teach the fundamentals of digital signal processing in time-frequency domain & its application
- To compare Architectures & features of Programmable DSP processors & develop logical functions of DSP processors
- To discuss on Application development with commercial family of DSP Processors
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

UNIT I FUNDAMENTALS OF DSP**12**

Frequency interpretation, sampling theorem, aliasing, discrete-time systems, constant-coefficient difference equation. Digital filters: FIR filter design – rectangular, Hamming, Hanning windowing technique. IIR filter design – Butterworth filter, bilinear transformation method, frequency transformation. Fundamentals of multirate processing – decimation and interpolation.

UNIT II TRANSFORMS AND PROPERTIES**9**

Discrete Fourier transform (DFT): - properties, Fast Fourier transform (FFT), DIT-FFT, and DIF-FFT. Wavelet transforms: Introduction, wavelet coefficients – orthonormal wavelets and their relationship to filter banks, multi-resolution analysis, and Haar and Daubechies wavelet.

UNIT III ADAPTIVE FILTERS**9**

Wiener filters – an introduction. Adaptive filters: Fundamentals of adaptive filters, FIR adaptive filter – steepest descent algorithm, LMS algorithm, NLMS, applications – channel equalization. Adaptive recursive filters – exponentially weighted RLS algorithm.

UNIT IV ARCHITECTURE OF COMMERCIAL DIGITAL SIGNAL PROCESSORS**9**

Introduction to commercial digital signal processors, Categorization of DSP processor – Fixed point and floating point, Architecture and instruction set of the TI TMS 320 C54xx and TMS 320 C6xxx DSP processors, On-chip and On-board peripherals – memory (Cache, Flash, SDRAM), codec, multichannel buffered I/O serial ports (McBSPs), interrupts, direct memory access (DMA), timers and general purpose I/Os.

UNIT V INTERFACING I/O PERIPHERALS FOR DSP BASED APPLICATIONS**6**

Introduction, External Bus Interfacing Signals, Memory Interface, I/O Interface, Programmed I/O, Interrupts, Design of Filter, FFT Algorithm, Application for Serial Interfacing, DSP based Power Meter, Position control, CODEC Interface.

TOTAL : 45 PERIODS

Note: Discussions / Exercise / practice on signal analysis, transforms, filter design concepts with simulation tools such as Matlab / Labview / CC studio will help the student understand signal processing concepts and DSP processors.

Overview of TMS320C54xx and TMS320C67xx /other DSP Starter Kits, Introduction to code composer studio (CCS), Board support library, Chip support library and Runtime support library, Generating basic signals, Digital filter design, Spectrum analysis, Adaptive filters, Speech and Audio processing applications.

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

- Students will learn the essential advanced topics in DSP that are necessary for successful Postgraduate level research.
- Students will have the ability to solve various types of practical problems in DSP
- Comprehend the DFTs and FFTs, design and Analyze the digital filters, comprehend the Finite word length effects in Fixed point DSP Systems.
- The conceptual aspects of Signal processing Transforms are introduced.
- The comparison on commercial available DSPProcessors helps to understand system design through processor interface.
- Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design.

REFERENCES:

1. John. G. Proakis, Dimitris G. Manolakis, "Digital signal processing", Pearson Edu, 2002
2. Sen M.Kuo,Woon-Seng S.Gan, "Digital Signal Processors- Pearson Edu, 2012
3. Ifeachor E. C., Jervis B. W , "Digital Signal Processing: A practical approach, Pearson-Education, PHI/ 2002
4. Shaila D. Apte, " Digital Signal Processing", Second Edition, Wiley, 2016.
5. Robert J.Schilling,Sandra L.Harris,"Intro. To Digital Signal Processing with Matlab",Cengage,2014.
6. Steven A. Tretter, "Communication System Design Using DSP Algorithms with Laboratory Experiments for the TMS320C6713™ DSK", Springer, 2008.
7. RulphChassaing and Donald Reay, "Digital Signal Processing and Applications with the TMS320C6713 and TMS320C6416 DSK", John Wiley & Sons, Inc., Hoboken, New Jersey, 2008.
8. K.P. Soman and K.L. Ramchandran,Insight into WAVELETS from theory to practice, Eastern Economy Edition, 2008
9. B Venkataramani and M Bhaskar "Digital Signal Processors", TMH, 2nd, 2010
10. Vinay K.Ingle,John G.Proakis,"DSP-A Matlab Based Approach",Cengage Learning,2010
11. Taan S.Elali,"Discrete Systems and Digital Signal Processing with Matlab",CRC Press2009.
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13. Avatar Sing, S. Srinivasan, "Digital Signal Processing- Implementation using DSP Microprocessors with Examples from TMS320C54xx", Thomson India,2004.

ET5003

PYTHON PROGRAMMING

**LT P C
3 0 0 3**

COURSE OBJECTIVES:

- Students will learn the grammar of Python programming language.
- Students will understand and be able to use the basic programming principles such as data types, variable, conditionals, loops, recursion and function calls.
- Students will learn how to use basic data structures such as List, Dictionary and be able to manipulate text files and images.
- Students will understand the process and will acquire skills necessary to effectively attempt a programming problem and implement it with a specific programming language - Python.
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

| | | |
|---|--|----------|
| UNIT I | INTRODUCTION TO PYTHON | 9 |
| Introduction to Python language – Using the interpreter – Python data types and functions – Working with Data – List, Dictionary and Set – Processing Primitives – List comprehensions – File Handling – Object model including Variables, Reference counting, Copying, and Type checking – Error handling. | | |
| UNIT II | PROGRAM ORGANIZATION AND FUNCTIONS | 9 |
| Organize Large programs into functions – Python functions including scoping rules and documentation strings – Modules and Libraries – Organize programs into modules – System administration, Text processing, Subprocesses, Binary data handling, XML parsing and Database Access – Installing third-party libraries. | | |
| UNIT III | CLASSES AND OBJECTS | 9 |
| Introduction to Object-oriented programming – Basic principles of Object-oriented programming in Python – Class definition, Inheritance, Composition, Operator overloading and Object creation – Python special modules – Python Object System – Object representation, Attribute binding, Memory management, and Special properties of classes including properties, slots and private attributes. | | |
| UNIT IV | TESTING, DEBUGGING, AND SOFTWARE DEVELOPMENT PRACTICE | 9 |
| Python Software development – Use of documentation string – Program testing using doctest and unittest modules – Effective use of assertions – Python debugger and profiler – Iterators and Generators to set up data processing pipelines – An effective technique for addressing common system programming problems (e.g. processing large datafiles, handling infinite data streams, etc.) | | |
| UNIT V | TEXT I/O HANDLING | 9 |
| Text generation, Template strings and Unicode-packages – Python Integration Primer – Network programming – Accessing C code – Survey on how Python interacts with other language programs. | | |

TOTAL: 45 PERIODS

Note: Class Room Discussions and Tutorials can include the following Guidelines for improved Teaching /Learning Process: Practice through any of Case studies through Exercise/Discussions on Design , Development of embedded solutions with improved programming skill learnt through python that can be adopted while programming on other domains.

COURSE OUTCOMES:

- Students will be able to develop skill in system administration and network programming by learning Python.
- Students will also learn how to effectively use Python’s very powerful processing primitives, modeling etc.
- Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design.

REFERENCES:

1. Mark Lutz, "Learning Python, Powerful OOPs, O’reilly, 2011
2. Robert Sedgewick, Kevin Wayne , Robert Dondero, Intr Programming in Python, Pearson, 2016.
3. Mark J. Guzdial, Barbara Ericson, "Introduction to Computing & Programming in Python, 4th Edition Pearson, 2015.
4. Budd, Timothy. Exploring Python. McGraw-Hill science, 2009.
5. Guttag, John. Introduction to Computation and Programming Using Python. MIT Press, 2013.
6. Zelle, John M. Python Programming: An Introduction to Computer Science. 1st ed. Franklin Beedle & Associates, 2003

OBJECTIVE

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

UNIT I CONCEPTS OF PRODUCT DEVELOPMENT**12**

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

UNIT II INTRODUCTION TO APPROACHES IN PRODUCT DEVELOPMENT**12**

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

UNIT III INDUSTRIAL DESIGN STRATEGIES**6**

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

UNIT IV ELECTRONIC PRODUCT DEVELOPMENT STAGES**6**

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

UNIT V EMBEDDED PRODUCTS DESIGN**9**

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

Note: Class room discussions and tutorials can include the following guidelines for improved teaching /learning process: Term Project/Presentation on specific product design can be given for Assessment

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course the student will be able to

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

REFERENCES

1. "Product Design and Development", Anita Goyal, Karl T Ulrich, Steven D Eppinger, McGraw –Hill International Edns.1999/ Tata McGrawEducation, ISBN-10-007-14679-9
2. R.G. Kaduskar and V.B. Baru, " Electronic Product Design", Wiley, 2014
3. George E.Dieter, Linda C.Schmidt, "Engineering Design", McGraw-Hill International Edition,4th Edition, 2009, ISBN 978-007-127189-9
4. Stephen Armstrong, Engineering and Product Development Management ; The Holistic Approach, CAMBRIDGE UNIVERSITY PRESS (CUP),2014
5. *Rajkamal, 'Embedded system-Architecture, Programming, Design', TMH,2011.*
6. KEVIN OTTO & KRISTIN WOOD, "Product Design and Development", 4th Edition,2009, Product Design Techniques in Reverse Engineering and New Product Development, , Pearson Education (LPE),2001./ISBN 9788177588217
7. Yousef Haik, T. M. M. Shahin, "Engineering Design Process", 2nd Edition Reprint, Cengage Learning, 2010, ISBN 0495668141
8. Clive L.Dym, Patrick Little, "Engineering Design: A Project-based Introduction", 3rd Edition, John Wiley & Sons, 2009, ISBN 978-0-470-22596-7

ET5005

AUTOMOTIVE EMBEDDED SYSTEM

LTPC
3003

COURSE OBJECTIVES

- To expose the students to the fundamentals and building of Electronic Engine Control systems .
- To teach on functional components and circuits for vehicles
- To discuss on programmable controllers for vehicles
- To teach logics of automation & commercial techniques for vehicle communication
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

UNIT I BASICS OF ELECTRONIC ENGINE CONTROL SYSTEMS

9

Motivation ,concept for electronic engine controls and management-Standards; introduction to fuel economy- automobile sensors-volumetric, thermal, air-fuel ratio, solenoid ,hall effect- exhaust gas oxygen sensors, Oxidizing catalytic efficiency, emission limits and vehicle performance; advantages of using Electronic engine controls – open and closed loop fuel control; Block diagram of Electronic ignition system and Architecture of a EMS with multi point fuel injection system, Direct injection; programmed ignition- actuators interface to the ECU; starter motors and circuits - sensors interface to the ECU; Actuators and their characteristics – exhaust gas recirculation.

UNIT II FUEL CELL FOR AUTOMOTIVE POWER

9

Fuel cell-Introduction-Proton exchange membrane FC (PEM), Solid oxide fuel cell (SOFC)-properties of fuel cells for vehicles-power system of an automobile with fuel cell based drive, and their characteristics

UNIT III VEHICLE MANAGEMENT SYSTEMS

9

Electronic Engine Control-engine mapping,air/fuel ratio spark timing control strategy, fuel control, electronic ignition-Vehicle cruise control- speed control-anti-locking braking system-electronic suspension - electronic steering , wiper control ; Vehicle system schematic for interfacing with EMS, ECU. Energy Management system for electric vehicles- for sensors, accelerators, brake-Battery management, Electric Vehicles-Electrical loads, power management system-electrically assisted power steering system.

UNIT IV AUTOMOTIVE TELEMATICS

9

Role of Bluetooth, CAN, LIN and flex ray communication protocols in automotive applications; Multiplexed vehicle system architecture for signal and data / parameter exchange between EMS, ECUs with other vehicle system components and other control systems; Realizing bus interfaces for diagnostics, dashboard display ,multimedia electronics- Introduction to Society of Automotive Engineers(SAE). J1850 message with(IFR) in frame response in protocol-Local Interconnect n/w [LI N], Bluetooth.

UNIT V ELECTRONIC DIAGNOSTICS FOR VEHICLES

9

System diagnostic standards and regulation requirements –On board diagnosis of vehicles electronic units &electric units-Speedometer, oil and temperature gauges, and audio system .

Note: Class room discussions and tutorials can include the following guidelines for improved teaching /learning process : Discussions//Practice on Workbench/Exercise/ AUTOSAR/ Vehicle simulators :on the basics of interfacing sensors, actuators to special automobile-microcontrollers, role of Instrumentation software packages / special automobile-microcontrollers for i/o port communication applicable to vehicles

TOTAL:45 PERIODS

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

- Design and develop automotive embedded systems.
- Analyze various embedded products used in automotive industry.
- Evaluate the opportunities involving technology, a product or a service required for developing a startup idea used for automotive applications
- Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design.

REFERENCES

1. William B. Ribbens ,”Understanding Automotive Electronics”, Elseiver,2012
2. Ali Emedi, Mehrded ehsani, John M Miller , “Vehicular Electric power system- land, Sea, Air and Space Vehicles” Marcel Decker, 2004.
3. L.Vlacic,M.Parent,F.Harahima,”Intelligent Vehicl Technologies”,SAE International,2001.
4. Jack Erjavec,Jeff Arias,”Alternate Fuel Technology-Electric ,Hybrid& Fuel Cell Vehicles”,Cengage ,2012
5. Electronic Engine Control technology – Ronald K Jurgen Chilton’s guide to Fuel Injection – Ford
6. Automotive Electricals / Electronics System and Components, Tom Denton, 3rd Edition, 2004.
7. Uwe Kiencke, Lars Nielsen, “Automotive Control Systems: For Engine, Driveline, and Vehicle”, Springer; 1 edition, March 30, 2000 .
8. Automotive Electricals Electronics System and Components, Robert Bosch Gmbh, 4th Edition, 2004.
9. Automotive Hand Book, Robert Bosch, Bently Publishers, 1997.
10. Jurgen, R., Automotive Electronics Hand Book.

COURSE OBJECTIVES

- To introduce the Reconfigurable Processor technologies
- To familiarize the need and role of Reconfigurable Processor for embedded system applications.
- To impart the knowledge of Reconfigurable embedded Processor for real time applications.

UNIT I INTRODUCTION**9**

Introduction to reconfigurable processor- Reconfigurable Computing-Programming elements and Programming Tools for Reconfigurable Processors, ASIC design flow- Hardware/Software Codesign-FPAA Architecture overview- recent trends in Reconfigurable Processor & SoC.

UNIT II PROGRAMMABLE LOGIC DEVICES CPLD**9**

Introduction to Programmable logic devices, SPLDs, CPLD building blocks- Architectures and features of Altera:MAX 7000, MAX V- Xilinx XC 9500, CoolRunner-II.

UNIT III PROGRAMMABLE LOGIC DEVICES FPGA**9**

FPGA architecture overview- Challenges of FPGA processor design-Opportunities of FPGA processor design- Designing SoftCore Processors – Designing Hardcore Processors –hardware/software co simulation- FPGA to multi core embedded computing- FPGA based on-board computer system.

UNIT IV RECONFIGURABLE SOC PROCESSORS**9**

SoC Overview –Architecture and applications of Xilinx Virtex II pro ,Zynq-7000, Altera Excalibur, Cyclone V -Triscend A7, E5- Atmel FPSLIC- Multicore SoCs.

UNIT V RECONFIGURABLE PROCESSOR AND SOC APPLICATIONS**9**

Reconfigurable processor based DC motor control- digital filter design- mobile phone development-High Speed Data Acquisition -Image Processing application-controller implementation for mobile robot.

Note: Class Room Discussions and Tutorials can include the following Guidelines for improved Teaching /Learning Process: Practice through any of Case studies through Exercise/Discussions on Design , Development of embedded solutions using reconfigurable processor support

TOTAL:45 PERIODS

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

- Adaptability, in its complete strength, is present in reconfigurable processors, which makes it an important IP in modern System-on-Chips (SoCs).
- Reconfigurable processors have risen to prominence as a dominant computing platform across embedded, general-purpose, and high-performance application domains during the last decade
- Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design.

REFERENCES

1. Nurmi, Jari (Ed.) "Processor Design System-On-Chip Computing for ASICs and FPGAs" Springer, 2007.
2. Ian Grout , "Digital system design with FPGAs and CPLDs" Elsevier, 2008.

3. Joao Cardoso, Michael Hübner, "Reconfigurable Computing: From FPGAs to Hardware/Software Codesign" Springer, 2011.
4. Ron Sass and Andrew G.Schmidt, " Embedded System design with platform FPGAs: Principles and Practices", Elsevier, 2010.
5. Steve Kilts, "Advanced FPGA Design: Architecture, Implementation, and Optimization" Willey, 2007

ET5092

DIGITAL IMAGE PROCESSING

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

COURSE OBJECTIVES:

The objectives of this course to impart knowledge in

- the fundamentals of image processing
- the techniques involved in image enhancement
- the low and high-level features for image analysis
- the fundamentals and significance of image compression
- the hardware for image processing applications

UNIT I FUNDAMENTALS OF IMAGE PROCESSING 9

Introduction to image processing systems, sampling and quantization, color fundamentals and models, image operations – arithmetic, geometric and morphological. Multi-resolution analysis – image pyramids

UNIT II IMAGE ENHANCEMENT 9

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. Image enhancement for remote sensing images and medical images.

UNIT III IMAGE SEGMENTATION AND FEATURE ANALYSIS 9

Detection of discontinuities – edge operators – edge linking and boundary detection, thresholding – feature analysis and extraction – region based segmentation – morphological watersheds – shape skeletonization, phase congruency. Number plate detection using segmentation algorithm.

UNIT IV IMAGE COMPRESSION 9

Image compression: fundamentals – models – elements of information theory – error free compression – lossy compression – compression standards. Applications of image compression techniques in video and image transmission.

UNIT V EMBEDDED IMAGE PROCESSING 9

Introduction to embedded image processing. ASIC vs FPGA - memory requirement, power consumption, parallelism. Design issues in VLSI implementation of Image processing algorithms - interfacing. Hardware implementation of image processing algorithms: Segmentation and compression

TOTAL:45 PERIODS

*NOTE:*Discussions / Exercise / practice on Image enhancement, segmentation and compression with simulation tools such as Matlab/ Raspberry pi (python programming) will help the student understand image processing concepts and hardware implementation using relevant processors

COURSE OUTCOMES:

At the end of the course students will comprehend

- Fundamentals of image processing and techniques involved in image enhancement, segmentation and compression and their real-time applications
- The implementation of image processing applications using software and hardware.

REFERENCES:

1. Rafael C. Gonzalez and Richard E. Woods, "Digital Image processing", 2nd edition, Pearson education, 2003
2. Anil K. Jain, "Fundamentals of digital image processing", Pearson education, 2003
3. Milan Sonka, ValclavHalavac and Roger Boyle, "Image processing, analysis and machine vision", 2nd Edition, Thomson learning, 2001
4. Mark Nixon and Alberto Aguado, "Feature extraction & Image processing for computer vision", 3rd Edition, Academic press, 2012
5. Donald G. Bailey, "Design for Embedded Image processing on FPGAs" John Wiley and Sons, 2011.

ET5007

EMBEDDED NETWORKING AND AUTOMATION OF ELECTRICAL SYSTEM

**LT P C
3 0 0 3**

COURSE OBJECTIVES

- To expose the students to the fundamentals of wired embedded networking techniques.
- To expose the students to the fundamentals of wireless embedded networking
- To study on design of automation in instrumentation
- To introduce design of Programmable measurement & control of electrical Devices & grid
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

UNIT I EMBEDDED PROCESS COMMUNICATION WITH INSTRUMENT BUS 9

Embedded Networking: Introduction – Cluster of Instruments in System: introduction to bus protocols, connectors, Bus Architecture & Interfacing of external instruments to – RS 232C, RS – 422, RS 485 and USB standards – embedded ethernet – MOD bus and CAN bus.

UNIT II WIRELESS EMBEDDED NETWORKING 9

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

UNIT III BUILDING SYSTEM AUTOMATION 9

Concept of Uc Based & PC based data acquisition – Concept of Virtual Instrumentation - Programming Environment to build a Virtual Instrumentation, Building system automation with graphical user interface programming-Programmable Logic Controllers-introduction-Ladder& Functional Block programming-Case study on Temperature control, Valve sequencing control

UNIT IV MEASUREMENT AND EMBEDDED CONTROL OF ELECTRICAL APPARATUS 9

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

UNIT V COMMUNICATION FOR LARGE ELECTRICAL SYSTEM AUTOMATION 9

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

NOTE

Discussions/Exercise/Practice on Workbench /simulators: on the basics interface of sensors, actuators to microcontrollers, role of virtual Instrumentation software packages/ simulators/ special microcontrollers for i/o port communication with electrical loads.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

- The learning process delivers insight into categorizing various i/p-o/p configurations of computational processors with improved communication strategies
- Improved Employability and enterprisership capacity due to knowledge upgradation on recent trends in embedded systems design .

REFERENCES:

1. Control and automation of electrical power distribution systems, James Northcote-Green, Robert Wilson, CRC, Taylor and Francis, 2006
2. Krzysztof Iniewski, "Smart Grid ,Infrastructure & Networking", TMcGH, 2012
3. Robert Faludi, "Building Wireless Sensor Networks, O'Reilly, 2011
4. W. Bolton, Programmable Logic Controllers, 5th Ed, Elsevier, 2010.
5. Shih-Lin Wu, Yu-Chee Tseng, {"Wireless Ad Hoc Networking, PAN, LAN, SAN, Aurebach Pub, 2012
6. Jan Axelson 'Embedded Ethernet and Internet Complete', Penram publications
7. Bhaskar Krishnamachari, 'Networking wireless sensors', Cambridge press 2005
8. Robert H. Bishop, "Learning with Lab-View" Prentice Hall, 2009
9. Sanjay Gupta, "Virtual Instrumentation, LABVIEW", TMH, New Delhi, 2003
- 10 Ernest O. Doebelin and Dhanesh N Manik, " Measurement Systems – Application and Design", 5th Edn, TMH, 2007.

ET5008

SMART SYSTEM DESIGN

**LT P C
3 0 0 3**

COURSE OBJECTIVES

- To understand about the smart system technologies and its role in real time applications
- To expose students to different open source platforms and Attributes.
- To familiarize the design and development of embedded system based system design.

UNIT I INTRODUCTION

9

Overview of smart system design and requirements- Hardware and software selection & co-design- Communications-smart sensors and actuators-Open-source resources for embedded system- android

for embedded system - Embedded system for Ecommerce- Embedded system for Smart card design and development –Recent trends.

UNIT II MOBILE EMBEDDED SYSTEM 9

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

UNIT III HOME AUTOMATION: 9

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

UNIT IV SMART APPLIANCES AND ENERGY MANAGEMENT 9

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

UNIT V EMBEDDED SYSTEMS AND ROBOTICS 9

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

TOTAL : 45 PERIODS

Note: Class room discussions and tutorials can include the following guidelines for improved teaching /learning process :Discussions on integration of H/W & S/W technology in automation of system/process.

OUTCOMES

- Students will develop more understanding on the concepts of smart system design and its present developments.
- Students will study about different embedded open source and cost effective techniques for developing solution for real time applications.
- Students will acquire knowledge on different platforms and Infrastructure for Smart system design.
- Students will learn the art of implementing embedded system for smart applications and control.

REFERENCES:

1. Thomas Bräunl, Embedded Robotics ,Springer, 2003.
2. Grimm, Christoph, Neumann, Peter, Mahlknech and Stefan, Embedded Systems for Smart Appliances and Energy Management , Springer 2013.
3. Raj Kamal, *Embedded Systems - Architecture, Programming and Design* , McGraw- Hill, 2008
4. Nilanjan Dey, Amartya Mukherjee, Embedded Systems and Robotics with Open Source Tools, CRC press, 2016.
5. Karim Yagmour, Embedded Android , O'Reilly, 2013.
6. Steven Goodwin ,Smart Home Automation with Linux and Raspberry Pi, Apress, 2013
7. C.K.Toh, " AdHoc mobile wireless networks", Prentice Hall, Inc, 2002.
8. Kazem Sohraby, Daniel Minoli and Taieb Znati, " Wireless Sensor Networks Technology, Protocols, and Applications", John Wiley & Sons, 2007.
9. Anna Ha'c, "Wireless Sensor Network Designs", John Wiley & Sons Ltd, 2003.
10. Robert Faludi,"Wireless Sensor Networks",O'Reilly,2011.

COURSE OBJECTIVES

- To develop an understanding on business promotion process.
- To expose students on the skills required for success in business.
- To impart embedded system technology based entrepreneurship.

UNIT I BASICS FOR ENTREPRENEURSHIP 9

The entrepreneurial culture and structure -theories of entrepreneurship -entrepreneurial traits - types -behavioural patterns of entrepreneurs -entrepreneurial motivation -establishing entrepreneurial systems -idea processing, personnel, financial information and intelligence, rewards and motivation - concept bank -Role of industrial Fairs.

UNIT II CHALLENGES FOR ENTREPRENEURSHIP 9

Setting quality standards- recruitment strategies- time schedules- Financial analysis - credit facilities- Marketing channel – advertisement- institutions providing technical, financial and marketing assistance- factory design -design requirements -applicability of the Factories Act.

UNIT III RESPONSIBILITIES IN ENTREPRENEURSHIP 9

Steps for starting a small industry -selection of type of organization -Incentives and subsidies - Central Govt. schemes and State Govt. Schemes -incentives to SSI -registration, Registration and Licensing requirements for sales tax, CST, Excise Duty -Power -Exploring export possibilities- incentives for exports -import of capital goods and raw materials- Entrepreneurship development programmes in India- Role and Improvement in Indian Economy.

UNIT IV SCOPE IN EMBEDDED SYSTEM FIELD 9

Entrepreneurship opportunities in Embedded system technologies - embedded systems design, modeling, Feasibility study on embedded system products- Entrepreneurial skills for embedded system hardware and software architecture, software and hardware co-design and challenges; problems of entrepreneurship in Embedded system field.

UNIT V SCOPE THROUGH EMBEDDED PRODUCTS 9

Embedded system Product development- feature driven development- release management-market pull product search ,Entrepreneurial case studies: Mobile phone development- automation components-Washing machine- Food Processing system and devices- High Performance embedded computers- Industrial Controllers.

Note: Class room discussions and tutorials can include the following guidelines for improved teaching /learning process :Discussions with Case studies on establishing entrepreneurial development through Government supported schemes for utilizing technology.

TOTAL : 45 PERIODS

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

- Manage people, processes, and resources within a diverse organization.
- Apply knowledge of leadership concepts in an integrated manner.
- Analyze the internal/external factors affecting a business/organization to evaluate business opportunities.
- demonstrate extemporaneous speaking skills developed through in-class discussion of text materials, case study analyses, and current entrepreneurship-related issues.

- demonstrate basic computer proficiency, including the use of word processing, presentation, and spreadsheet software packages, as well as a basic facility with the internet and other research tools.
- Key concepts underpinning entrepreneurship and its application in the recognition and exploitation of product/ service/ process opportunities
- Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design.

REFERENCES

- 1 Kuratko, Entrepreneurship : A Contemporary Approach, Thomson Learning, 2001.
- 2 Thomas Zimmerer et.al., Essentials of Entrepreneurship and small business Management 3rd Ed. Pearson Education, 2002.
- 3 Greene, Entrepreneurship: Ideas in Action, Thomson Learning, Mumbai, 2000
- 4 Jeffry Timmons, New Ventrure creation, McGraw Hill, 1999.
- 5 Gupta and Smivasan, Entrepreneurial Development, New Delhi, Sultan Chand, 1992
- 6 LyLa B. Das "Embedded Systems: An Integrated Approach" Pearson, 2013
7. James K.peckol , " Embedded Systems: A contemporary Design Tool", Wiley,2014

ET5010

NANO ELECTRONICS

**LT P C
3 0 0 3**

COURSE OBJECTIVES

- To introduce the properties of electron and its implication for electronics
- To teach the importance and the issues of Nanoscale CMOS technology.
- To introduce the characteristics and applications of nano electronic devices, nano fabrication methods and techniques.
- To teach the circuits and architectural features of nano memory devices.
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

UNIT I INTRODUCTION

12

Particles, waves, Wave mechanics, schrodinger equation, free and confined electrons, particle statistics and density of states. Electron transport in semiconductors and nanostructures, Quantum dots, Quantum Well, Quantum wire , materials and its properties, Ballistic electron transport, 1D transport , Spin electronics- Electrical and Electronics Applications of Nanotechnology.

UNIT II NANOSCALE CMOS

9

Survey of modern electronics and trends towards nanoelectronics CMOS scaling, challenges and limits, static power, device variability, interconnect - CNT-FET, HEMT , pHEMT FinFET, FerroFET-nanoscale CMOS circuit design and analysis

UNIT III NANO-ELECTRONIC STRUCTURE AND DEVICES.

9

Resonant-tunneling diodes- Resonant Tunneling Transistor-Single-electron transfer devices-Potential effect transistors- Quantum-dot cellular automata, Nano Photonic Devices-Molecular electronic devices -Nano-electromechanical system devices

UNIT IV NANO-ELECTRONIC MEMORIES

6

Nano tube for memories- Nano RAM- Nanoscale DRAM, SRAM, Tunnel magnetoresistance-Giant magnetoresistance- design and applications.

UNIT V FABRICATION TECHNIQUES

9

Clean room standards-Microfabrication –nanofabrication- nanofabrication issues- E-beam lithography- X-ray and ion-beam lithography- nanoimprint lithography- Scanning probe lithography- dip-pen nanolithography- Nano-characterization techniques.

Note: Class room discussions and tutorials can include the following guidelines for improved teaching /learning process :Discussions/Practice on Workbench : on modelling of nano/micro analog &digital devices.

TOTAL : 45 PERIODS

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

- Students will understand the divers electronic device fabrication.
- The students should be able to understand basic and advanced concepts of nanoelectronic devices, sensors and transducers and their applications in nanotechnology
- The concepts of a quantum well, quantum transport and tunnelling effects.
- Understand the impact of nanoelectronics onto information technology, communication and computer science.
- Design integrated circuits (micro chip) using state-of-the-art CMOS technology
- The learning process delivers insight into categorizing various nano configurations of computational processors with improved design strategies.
- Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design.

REFERENCES :

1. Hagelstein, Peter L., Stephen D. Senturia, and Terry P. Orlando, "Introduction to Applied Quantum and Statistical Physics.", New York, NY: Wiley, 2004.
2. Rainer Waser, "Nanoelectronics and Information Technology", Wiley 2005
3. Michael A. Nielsen and Isaac L. Chuang, "Quantum Computation and Quantum Information", Cambridge University Press, 2000.
4. Adrian Ionesu and Kaustav Banerjee eds. " Emerging Nanoelectronics: Life with and after CMOS" , Vol I, II, and III, Kluwer Academic, 2005.
5. Kiyoo Itoh Masashi Horiguchi ,Hitoshi Tanaka, Ultra Low voltage nano scale memories. Spl Indian Edition, Springer.
6. George W. Hanson, Fundamental of nanoelectronics, Pearson education.

ET5011

DISTRIBUTED EMBEDDED COMPUTING

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

COURSE OBJECTIVES

- To expose the students to the fundamentals of Network communication technologies and distributed computing.
- To teach the fundamentals of Internet
- To study on Java based Networking and distributed computing
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

| | | |
|--|----------------------------------|----------|
| UNIT I | DISTRIBUTED SYSTEM | 9 |
| Introduction- Communication in distribution system-Client/Server Model-Synchronization in distributed system | | |
| UNIT II | EMBEDDED JAVA | 9 |
| Overview of JAVA – Programs- Multithreaded programming- APLET programming- I/O streaming- RMI- Introduction to Embedded JAVA | | |
| UNIT III | DISTRIBUTED COMPUTING | 9 |
| Definition- Model of distributed computation- Distributed shared memory- Authentication in distributed system | | |
| UNIT IV | SECURITY IN COMPUTING | 9 |
| Security meaning- Threads in networks- Network security control- Firewall- Authentication- E-mail security- Security in web services- Case studies | | |
| UNIT V | WEB BASED HOME AUTOMATION | 9 |
| Components of Distributed Embedded - Protocols & Standards - Hardware/Software selection for Distributed Embedded – case study : Web based Home Automation | | |

Note: Class room discussions and tutorials can include the following guidelines for improved teaching /learning process: Class room discussions and tutorials can include the following guidelines for improved teaching /learning process :Discussions/Practice on Workbench : Program Development and practice in exercises with XML/HTML/Java Programming Environments.

TOTAL : 45 PERIODS

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

- Able to apply knowledge from undergraduate engineering and other disciplines to identify, formulate, solve novel advanced electronics engineering along with soft computing problems that require advanced knowledge within the field.
- Able to understand and integrate new knowledge within the field and advanced technical knowledge in multiple contexts.
- Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design.

REFERENCES:

1. Andrew S. Tanenbaum, “Distributed operating systems”, Pearson 2013
2. E Balagurusamy,” Programming with JAVA”, Mc Graw Hill 2013
3. Ajay D Kshemkalyani,Mukesh Singhal, “Distributed Computing” – Principles, Algorithm and systems, Cambridge university press 2008
4. Charles P. Pfleeger, “Security in Computing”, Pearson 2009.

PS5091

SMART GRID

**LT P C
3 0 0 3**

OBJECTIVES:

- To Study about Smart Grid technologies, different smart meters and advanced metering infrastructure.
- To familiarize the power quality management issues in Smart Grid.
- To familiarize the high performance computing for Smart Grid applications

UNIT I INTRODUCTION TO SMART GRID 9
Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, functions, opportunities, challenges and benefits, Difference between conventional & Smart Grid, National and International Initiatives in Smart Grid.

UNIT II SMART GRID TECHNOLOGIES 9
Technology Drivers, Smart energy resources, Smart substations, Substation Automation, Feeder Automation, Transmission systems: EMS, FACTS and HVDC, Wide area monitoring, Protection and control, Distribution systems: DMS, Volt/Var control, Fault Detection, Isolation and service restoration, Outage management, High-Efficiency Distribution Transformers, Phase Shifting Transformers, Plug in Hybrid Electric Vehicles (PHEV).

UNIT III SMART METERS AND ADVANCED METERING INFRASTRUCTURE 9
Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Phasor Measurement Unit(PMU), Intelligent Electronic Devices (IED) & their application for monitoring & protection.

UNIT IV POWER QUALITY MANAGEMENT IN SMART GRID 9
Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.

UNIT V HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS 9
Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broadband over Power line (BPL), IP based Protocols, Basics of Web Service and CLOUD Computing to make Smart Grids smarter, Cyber Security for Smart Grid.

TOTAL : 45 PERIODS

OUTCOMES:

- Learners will develop more understanding on the concepts of Smart Grid and its present developments.
- Learners will study about different Smart Grid technologies.
- Learners will acquire knowledge about different smart meters and advanced metering infrastructure.
- Learners will have knowledge on power quality management in Smart Grids
- Learners will develop more understanding on LAN, WAN and Cloud Computing for Smart Grid applications.

REFERENCES

- 1 Stuart Borlase “Smart Grid :Infrastructure, Technology and Solutions”, CRC Press 2012.
- 2 Janaka Ekanayake, Nick Jenkins, KithsiriLiyanaage, Jianzhong Wu, Akihiko Yokoyama, “Smart Grid: Technology and Applications”, Wiley 2012.
- 3 Vehbi C. Güngör, DilanSahin, TaskinKocak, Salih Ergüt, Concettina Buccella, Carlo Cecati, and Gerhard P. Hancke, “Smart Grid Technologies: Communication Technologies and Standards” IEEE Transactions On Industrial Informatics, Vol. 7, No. 4, November 2011.
- 4 Xi Fang, Satyajayant Misra, Guoliang Xue, and Dejun Yang “Smart Grid – The New and Improved Power Grid: A Survey” , IEEE Transaction on Smart Grids, vol. 14, 2012.

OBJECTIVES:

- To understand the concept of electrical vehicles and its operations
- To understand the need for energy storage in hybrid vehicles
- To provide knowledge about various possible energy storage technologies that can be used in electric vehicles

UNIT I ELECTRIC VEHICLES AND VEHICLE MECHANICS 9

Electric Vehicles (EV), Hybrid Electric Vehicles (HEV), Engine ratings, Comparisons of EV with internal combustion Engine vehicles, Fundamentals of vehicle mechanics

UNIT II ARCHITECTURE OF EV's AND POWER TRAIN COMPONENTS 9

Architecture of EV's and HEV's – Plug-n Hybrid Electric Vehicles (PHEV)- Power train components and sizing, Gears, Clutches, Transmission and Brakes

UNIT III CONTROL OF DC AND AC DRIVES 9

DC/DC chopper based four quadrant operations of DC drives – Inverter based V/f Operation (motoring and braking) of induction motor drive system – Induction motor and permanent motor based vector control operation – Switched reluctance motor (SRM) drives

UNIT IV BATTERY ENERGY STORAGE SYSTEM 9

Battery Basics, Different types, Battery Parameters, Battery modeling, Traction Batteries.

UNIT V ALTERNATIVE ENERGY STORAGE SYSTEMS 9

Fuel cell – Characteristics- Types – hydrogen Storage Systems and Fuel cell EV – Ultra capacitors

TOTAL : 45 PERIODS**OUTCOMES:**

Learners will understand the operation of Electric vehicles and various energy storage technologies for electrical vehicles

REFERENCES

- 1 Iqbal Hussain, “**Electric and Hybrid Vehicles: Design Fundamentals, Second Edition**” CRC Press, Taylor & Francis Group, Second Edition (2011).
- 2 Ali Emadi, Mehrdad Ehsani, John M.Miller, “Vehicular Electric Power Systems”, Special Indian Edition, Marcel dekker, Inc 2010.

COURSE OBJECTIVES:

The main objectives of this course is to make the students

- Understand the fundamental concepts of soft computing, artificial neural networks and optimization techniques
- Familiarize with recent advancements in Artificial neural networks and optimization techniques

UNIT I INTRODUCTION TO SOFT COMPUTING AND NEURAL NETWORKS 9

Introduction to soft computing: soft computing vs. hard computing – various types of soft computing techniques, from conventional AI to computational intelligence, applications of soft computing. Fundamentals of neural network: biological neuron, artificial neuron, activation function, single layer perceptron – limitations. Multi-layer perceptron – back propagation algorithm.

UNIT II ARTIFICIAL NEURAL NETWORKS 9

Radial basis function networks – reinforcement learning. Hopfield / recurrent network – configuration – stability constraints, associative memory and characteristics, limitations and applications. Hopfield vs. Boltzmann machine. Advances in neural networks – convolution neural networks. Familiarization of Neural network toolbox.

UNIT III FUZZY LOGIC AND NEURO FUZZY SYSTEMS 9

Fundamentals of fuzzy set theory: fuzzy sets, operations on fuzzy sets, scalar cardinality, union and intersection, complement, equilibrium points, aggregation, projection, composition. Fuzzy membership functions. Fundamentals of neuro-fuzzy systems – ANFIS. Familiarization of ANFIS Toolbox.

UNIT IV INTRODUCTION TO OPTIMIZATION TECHNIQUES 9

Classification of optimization problems – classical optimization techniques. Linear programming – simplex algorithm. Non-linear programming – steepest descent method, augmented Lagrange multiplier method – equality constrained problems.

UNIT V ADVANCED OPTIMIZATION TECHNIQUES 9

Simple hill climbing algorithm, Steepest ascent hill climbing – algorithm and features. Simulated annealing – algorithm and features. Genetic algorithm: working principle, fitness function. Familiarization with Optimization Toolbox.

Note: Class room discussions and tutorials can include the following guidelines for improved teaching /learning process :Discussions/Practice on Workbench : on role of Fuzzy,Neural ,Genetic algorithms and Concepts in design of intelligent systems.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course students will

- Comprehend the fundamentals of artificial neural network, fuzzy systems and optimization techniques
- Understand the significance of various optimization algorithms applied to engineering problems.
- Be capable of developing ANN-based models
- Be capable of choosing appropriate optimization techniques for engineering applications. .

REFERENCES:

1. Laurene V. Fausett, “Fundamentals of neural networks, architecture, algorithms and applications, Pearson Education, 2008.
2. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, “Neuro-Fuzzy and soft computing”, Prentice Hall of India, 2003.
3. Simon Haykin, “Neural Networks – A comprehensive foundation”, Pearson Education, 2005.
4. David E. Goldberg, “Genetic algorithms in search, optimization and machine learning”, Pearson Education, 2009.
5. Singiresu S. Rao, “Engineering Optimization – Theory and Practice”, 4th edition, John Wiley & Sons, 2009.
6. Thomas Weise, “Global Optimization algorithms – Theory and applications”, self-published, 2009

COURSE 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
- To study the basis for classification of commercial family of wireless communication technologies

UNIT I INTRODUCTION**9**

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

UNIT II MOBILE NETWORKS**9**

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

UNIT III WIRELESS NETWORKS**9**

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

UNIT IV ROUTING**9**

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

UNIT V TRANSPORT AND APPLICATION LAYERS**9**

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

TOTAL : 45 PERIODS

Note: Class room discussions and tutorials can include the following guidelines for improved teaching /learning process :Discussions on wireless technology ,its integration for multi system by networked communication.

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

- Knowledge of basic and advanced theories on wireless communications systems in physical, link and network layer.
- Ability to understand, model, and design mobile networks.
- Ability to understand and apply mathematically model in wireless communications.
- Wireless communication transceiver algorithm design
- Mobile system design methodology, link level simulation for wireless communications.
- Fundamentals of mobile communication including various propagation path loss models under different operating conditions and their impact on received signal strength
- The learning process delivers insight into categorizing various embedded & communication protocols for networking of distributed static & mobile systems.

REFERENCES

1. Kaveh Pahlavan, Prasanth Krishnamoorthy, " Principles of Wireless Networks' PHI/Pearson Education, 2003
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.
4. C.K.Toth, " 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.
7. William Stallings, " Wireless communications and Networks", PHI/Pearson Education, 2002.

ET5014

CRYPTOGRAPHY AND NETWORK SECURITY

LT P C
3 0 0 3

COURSE OBJECTIVES

- To expose the students to the fundamentals of data security.
- To teach the fundamentals of mathematical aspects in creating Encryption keys
- To teach the fundamentals of Security in data& wireless communication.
- To teach the fundamentals of Secured system operation.
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

UNIT I SYMMETRIC CIPHERS 9

Overview – classical Encryption Techniques – Block Ciphers and the Data Encryption standard – Introduction to Finite Fields – Advanced Encryption standard – Contemporary, Symmetric Ciphers – Confidentiality using Symmetric Encryption.

UNIT II PUBLIC-KEY ENCRYPTION AND HASH FUNCTIONS 9

Introduction to Number Theory – Public-Key Cryptography and RSA – Key Management – Diffie-Hellman Key Exchange – Elliptic Curve Cryptography – Message Authentication and Hash Functions – Hash Algorithms – Digital Signatures and Authentication Protocols.

UNIT III NETWORK SECURITY PRACTICE 9

Authentication Applications – Kerberos – X.509 Authentication Service – Electronic mail Security – Pretty Good Privacy – S/MIME – IP Security architecture – Authentication Header – Encapsulating Security Payload – Key Management.

UNIT IV SYSTEM SECURITY 9

Intruders – Intrusion Detection – Password Management – Malicious Software – Firewalls – Firewall Design Principles – Trusted Systems.

UNIT V WIRELESS SECURITY 9

Introduction to Wireless LAN Security Standards – Wireless LAN Security Factors and Issues.

Note: Class room discussions and tutorials can include the following guidelines for improved teaching /learning process :Discussions/Exercise/Practice on Workbench : on the basics /numerical design aspects of encryption, decryption keys/password creation etc

TOTAL : 45 PERIODS

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

- Identify the major types of threats to information security and the associated attacks, understand how security policies, standards and practices are developed.
- Describe the major types of cryptographic algorithms and typical applications, write code to encrypt and decrypt information using some of the standard algorithms
- To be exposed to original research in network security and master information security governance, and related legal and regulatory issues
- The learning process delivers insight onto role of security aspects during data transfer and communication in systems like grid.
- Improved Employability and entrepreneurship capacity due to knowledge upgradation on recent trends in embedded systems design.

REFERENCES:

1. William Stallings, "Cryptography And Network Security – Principles And Practices", Pearson Education, 3rd Edition, 2003.
2. Atul Kahate, "Cryptography and Network Security", Tata McGraw Hill, 2003.
3. Natalia Olifer and Victor Olifer, "Computer Networks principles. technologies and protocols for network design", Wiley, 2015
4. Bruce Schneier, "Applied Cryptography", John Wiley and Sons Inc, 2001.
5. Stewart S. Miller, "Wi-Fi Security", McGraw Hill, 2003.
6. Charles B. Pfleeger, Shari Lawrence Pfleeger, "Security In Computing", 3rd Edition, Pearson Education, 2003.
7. Mai, "Modern Cryptography: Theory and Practice", First Edition, Pearson Education, 2003.

IN5079

ROBOTICS AND CONTROL

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

COURSE OBJECTIVES

- To introduce robot terminologies and robotic sensors To educate direct and inverse kinematic relations
- To educate on formulation of manipulator Jacobians and introduce path planning techniques
- To educate on robot dynamics
- To introduce robot control techniques

UNIT I INTRODUCTION AND TERMINOLOGIES

9

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- vision system-social issues.

UNIT II KINEMATICS

9

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

UNIT III DIFFERENTIAL MOTION AND PATH PLANNING

9

Jacobian-differential motion of frames-Interpretation-calculation of Jacobian-Inverse Jacobian- Robot Path planning

UNIT IV DYNAMIC MODELLING**9**

Lagrangian mechanics- Two-DOF manipulator- Lagrange-Euler formulation – Newton- Euler formulation – Inverse dynamics

UNIT V ROBOT CONTROL SYSTEM**9**

- Linear control schemes- joint actuators- decentralized PID control- computed torque control – force control- hybrid position force control- Impedance/ Torque control

TOTAL : 45 PERIODS**OUTCOMES:**

- Ability to understand the components and basic terminology of Robotics
- Ability to model the motion of Robots and analyze the workspace and trajectory planning of robots
- Ability to develop application based Robots
- Ability to formulate models for the control of mobile robots in various industrial applications

REFERENCES

1. R.K. Mittal and I J Nagrath, “ Robotics and Control”, Tata MacGraw Hill, Fourth edition.
2. Saeed B. Niku , "Introduction to Robotics ", Pearson Education, 2002.
3. Fu, Gonzalez and Lee Mcgrahill , "Robotics ", international edition.
4. R.D. Klafter, TA Chmielewski and Michael Negin, "Robotic Engineering, An Integrated approach", Prentice Hall of India, 2003.

ANNA UNIVERSITY, CHENNAI

REGULATIONS 2013

CREDIT SYSTEM

AFFILIATED COLLEGES

POST-GRADUATE PROGRAMMES

The following Regulations is applicable to the students admitted to M.E / M.Tech., M.C.A and M.B.A. Programmes at all Engineering Colleges affiliated to Anna University, Chennai (other than Autonomous Colleges) and to all the University Colleges of Engineering of Anna University, Chennai from the academic year 2013-2014.

1 PRELIMINARY DEFINITIONS AND NOMENCLATURE

In these Regulations, unless the context otherwise requires:

- i. **“Programme”** means Post graduate Degree Programme e.g. M.E., M.Tech. Degree Programme.
- ii. **“Branch”** means specialization or discipline of M.E. / M.Tech. Degree Programme like “Structural Engineering”, “Engineering Design”, etc.
- iii. **“Course”** means Theory or Practical subject that is normally studied in a semester, like Applied Mathematics, Advanced Thermodynamics, etc.
- iv. **“Director, Academic Courses”** means the authority of the University who is responsible for all academic activities of the University for implementation of relevant Rules and Regulations.
- v. **“Chairman”** means the Head of the Faculty.
- vi. **“Head of the Department”** means Head of the Department concerned.
- vii. **“Head of the Institution”** means the Principal of a College / Institution who is responsible for all academic activities of that College / Institution and for implementation of relevant Rules and Regulations.
- viii. **“Controller of Examinations”** means the Authority of the University who is responsible for all activities of the University Examinations.
- ix. **“University”** means ANNA UNIVERSITY, CHENNAI.

2 PROGRAMMES OFFERED, MODES OF STUDY AND ADMISSION REQUIREMENTS

2.1 P.G. PROGRAMMES OFFERED:

1. M.E
2. M.Tech.
3. M.B.A.
4. M.C.A.

2.2 MODES OF STUDY:

2.2.1 Full-Time:

Candidates admitted under 'Full-Time' should be available in the College / Institution during the entire duration of working hours (From Morning to Evening on Full-Time basis) for the curricular, co-curricular and extra-curricular activities assigned to them.

The Full-Time candidates should not attend any other Full-Time programme(s) / course(s) or take up any Full-Time job / Part-Time job in any Institution or Company during the period of the Full-Time programme. Violation of the above rules will result in cancellation of admission to the PG programme.

2.2.2 Part-Time – Day Time Mode:

This mode of study is applicable to those candidates admitted under sponsored category (Teacher candidates only). In this mode of study, the candidates are required to attend classes along with Full-Time students for the required number of courses and complete the programme in three years.

2.2.3 Conversion from one mode of study to the other is not permitted.

2.3 ADMISSION REQUIREMENTS:

2.3.1 Candidates for admission to the first semester of the Post-Graduate Degree Programme shall be required to have passed an appropriate Under-Graduate Degree **Examination of Anna University** or equivalent as specified under qualification for admission as per the Tamil Nadu Common Admission (TANCA) criteria.

Note: TANCA releases the updated criteria during the admissions every academic year. Admission shall be offered only to the candidates who possess the qualification prescribed against each programme. Any other relevant qualification which is not prescribed against each programme shall be considered for equivalence by the committee constituted for the purpose. Admission to such degrees shall be offered only after obtaining equivalence to such degrees.

2.3.2 However, the Syndicate of the University may decide to restrict admission in any particular year to candidates having a subset of qualifications prescribed at the time of admission.

- 2.3.3** Notwithstanding the qualifying examination the candidate might have passed, he/she shall have a minimum level of proficiency in the appropriate programme / courses as prescribed by the Syndicate of the University from time to time.
- 2.3.4** Eligibility conditions for admission such as the class obtained, the number of attempts in qualifying examination and physical fitness will be as prescribed by the Syndicate of the University from time to time.
- 2.3.5** All Part-Time (Day-Time mode) candidates should satisfy other conditions regarding Experience, Sponsorship etc. that may be prescribed by the Syndicate from time to time.

3 DURATION AND STRUCTURE OF THE PROGRAMMES:

- 3.1** The minimum and maximum period for completion of the P.G. Programmes are given below:

| Programme | Min. No. of Semesters | Max. No. of Semesters |
|----------------------------|------------------------------|------------------------------|
| M.E. / M.Tech. (Full-Time) | 4 | 8 |
| M.E. / M.Tech. (Part Time) | 6 | 12 |
| M.C.A. (Full Time) | 6 | 12 |
| M.B.A. (Full Time) | 4 | 8 |
| M.B.A. (Part Time) | 6 | 12 |

- 3.2** Every **Programme** will have a curriculum and syllabus consisting of core courses, elective courses and project work.
The Programme may also include seminar, practical, practical / Industrial training, Summer project if they are specified in the curriculum.
- 3.3** The Curriculum and Syllabi of all the P.G. Programmes shall be approved by the Academic Council of Anna University. The number of Credits to be earned for the successful completion of the programme shall be as specified in the Curriculum of the respective specialization of the P.G. Programme
- 3.4** Each semester shall normally consist of 90 working days or 350 periods of each 50 minutes duration, for full-time mode of study (400 Periods for M.B.A.) or 200 periods for part-time mode of study. The Head of the Institution shall ensure that every teacher imparts instruction as per the number of periods specified in the syllabus and that the teacher teaches the full content of the specified syllabus for the course being taught. For the purpose of calculation of attendance requirement for writing the end semester examinations (as per clause 9) by students, following method shall be used.

$$\text{Percentage of Attendance} = \frac{\text{Total no. of periods attended in all the courses per semester}}{(\text{No.of periods / week as prescribed in the curriculum}) \times 15 \text{ taken together for all courses of the semester}} \times 100$$

End Semester Examinations conducted by the University will be scheduled after the last working day of the semester.

- 3.5** The minimum prescribed credits required for the award of the degree shall be within the limits specified below:

| PROGRAMME | PRESCRIBED CREDIT RANGE |
|------------------|--------------------------------|
| M.E. / M.Tech. | 65 to 75 |

| Programme | Prescribed Credits |
|------------------|---------------------------|
| M.C.A. | 119 |
| M.B.A. | 96 |

- 3.6** Credits will be assigned to the courses for different modes of study as given below:

- 3.6.1** The following will apply to all modes of P.G. Programmes.

- One credit for each lecture period allotted per week
- One credit for each tutorial period allotted per week
- One credit for each seminar/practical session/project work of two periods designed per week (2 credits for 3 or 4 periods of practical).

- 3.6.2** Two weeks of practical training in any industrial / research laboratory correspond to one credit, and is applicable to all modes of study.

- 3.6.3** Practical training or Industrial Training if specified in the Curriculum should be organized by the Head of the Department / Institution for a duration not exceeding 4 weeks.

- 3.6.4** Summer project if specified in the Curriculum, should be organized by the Head of the Department / Institution for a duration not exceeding 6 weeks.

- 3.7** The electives from the curriculum are to be chosen with the approval of the Head of the Department. A candidate may be permitted by the Head of the Department to choose a maximum of two electives from other P.G. Programmes offered in the Department /any other Department of the Institutions during the period of his/her study, provided the Head of the Department offering such course also approves such requests subject to no clash in the time-table for the lecture classes of both departments.

- 3.8** The medium of instruction shall be English for all courses, examinations, seminar presentations and project thesis/dissertation reports.

4. PROJECT WORK

- 4.1** The project work for M.E. / M.Tech. Programmes consist of Phase-I and Phase-II. The Phase-I is to be undertaken during III semester and Phase-II, which is a continuation of Phase-I is to be undertaken during IV semester.

- 4.2** In case of candidates of M.E. / M.Tech. Programmes not completing Phase-I of project work successfully, the candidates can undertake Phase-I again in the subsequent semester. In such cases the candidates can enroll for Phase-II, only after successful completion of Phase-I.

- 4.3** Project work shall be carried out under the supervision of a “qualified teacher” in the Department concerned. In this context “qualified teacher” means the faculty member possessing (i) PG degree with a minimum of 3 years experience in teaching or (ii) Ph.D. degree.
- 4.4** A candidate may, however, in certain cases, be permitted to work on projects in an Industrial/Research Organization, on the recommendations of the Head of the Department Concerned. In such cases, the Project work shall be jointly supervised by a supervisor of the department and an expert, as a joint supervisor from the organization and the student shall be instructed to meet the supervisor periodically and to attend the review committee meetings for evaluating the progress.
- 4.5** The Project work (Phase II in the case of M.E/M.Tech.) shall be pursued for a minimum of 16 weeks during the final semester.
- 4.6** The deadline for submission of final Project Report is 60 calendar days from the last working day of the semester in which project / thesis / dissertation is done. However, the Phase-I of the Project work in the case M.E. / M.Tech. Programmes shall be submitted within a maximum period of 30 calendar days from the last working day of the semester as per the academic calendar published by the University.

5 EVALUATION OF PROJECT WORK

The evaluation of Project Work for Phase-I & Phase-II in the case of M.E. / M.Tech. and project work of M.B.A and M.C.A shall be done independently in the respective semesters and marks shall be allotted as per the weightages given in Clause 5.1.

- 5.1** There shall be three assessments (each 100 marks) during the Semester by a review committee. The Student shall make presentation on the progress made before the Committee. The Head of the Institution shall constitute the review committee for each branch of study. The total marks obtained in the three assessments shall be reduced to 20 marks and rounded to the nearest integer (as per the Table given below). There will be a vice-voce Examination during End Semester Examinations conducted by a Committee consisting of the supervisor, one internal examiner and one external examiner. The internal examiner and the external examiner shall be appointed by the Controller of Examination. The distribution of marks for the internal assessment and End semester examination is given below:

| Internal Assessment (20 Marks) | | | End Semester Examination (80 Marks) | | | |
|---------------------------------------|--------------------|---------------------|--|--|-------------------|---------------------|
| Review - I | Review - II | Review - III | Thesis Submission (30 Marks) | Viva – Voce (Rounded to 50 Marks) | | |
| | | | External Examiner | Internal Examiner | External Examiner | Supervisor Examiner |
| 5 | 7.5 | 7.5 | 30 | 15 | 20 | 15 |

- 5.2** The Project Report prepared according to approved guidelines as given by Director, Academic Courses and duly signed by the supervisor(s) and the Head of the Department concerned shall be submitted to the Head of the Institution.
- 5.3** If the candidate fails to obtain 50% of the internal assessment marks in the Phase–I and Phase–II / final project, he/she will not be permitted to submit the report for that particular semester and has to re-enroll for the same in the subsequent semester.

If a candidate fails to submit the project report on or before the specified deadline, he/she is deemed to have failed in the Project Work and shall re-enroll for the same in a subsequent semester. This applies to both Phase–I and Phase–II in the case of M.E. / M.Tech. Project Work and the Final Project work of M.B.A. / M.C.A.

If a candidate fails in the end semester examinations of Phase–I, he/she has to resubmit the Project Report within 30 days from the date of declaration of the results. If he / she fails in the End semester examination of Phase–II of Project work of M.E. / M.Tech. or the Final Project work of M.B.A. / M.C.A, he/she shall resubmit the Project Report within 60 days from the date of declaration of the results. The resubmission of a project report and subsequent viva-voce examination will be considered as reappearance with payment of exam fee. For this purpose the same Internal and External examiners shall evaluate the resubmitted report.

- 5.3.1** A copy of the approved Project Report after the successful completion of viva-voce examinations shall be kept in the library of the college / institution.
- 5.3.2** Practical / Industrial Training, Summer Project if specified in the Curriculum shall not exceed the maximum duration of 4 weeks and should be organized by the Head of the Department for every student.
- 5.3.3** At the end of Practical / Industrial Training, Summer Project the candidate shall submit a certificate from the organization where he/she has undergone training and also a brief report. The evaluation for 100 marks will be carried out internally based on this report and a Viva-Voce Examination will be conducted by a Departmental Committee constituted by the Head of the Institution. Certificates submitted by the students shall be attached to the mark list sent by the Head of the Institution to the Controller of Examination.

6 CLASS ADVISER

There shall be a class advisor for each class. The class advisor will be one among the (course-instructors) of the class. He / She will be appointed by the Head of the department concerned. The class advisor is the ex-officio member and the Convener of the class committee. The responsibilities for the class advisor shall be:

- To act as the channel of communication between the HoD and the students of the respective class.
- To collect and maintain various statistical details of students.
- To help the chairperson of the class committee in planning and conduct of the class committee meetings.

- To monitor the academic performance of the students including attendance and to inform the class committee.
- To attend to the students' welfare activities like awards, medals, scholarships and industrial visits.

7 CLASS COMMITTEE

7.1 A Class Committee consists of teachers of the concerned class, student representatives and a chairperson who is not teaching the class. It is like the 'Quality Circle' (more commonly used in industries) with the overall goal of improving the teaching-learning process. The functions of the class committee include:

- Solving problems experienced by students in the class room and in the laboratories.
- Clarifying the regulations of the programme and the details of rules therein.
- Informing the student representatives, the "academic schedule" including the dates of assessments and the syllabus coverage for each assessment period.
- Informing the student representatives, the details of regulations regarding the weightage used for each assessment. In the case of practical courses (laboratory / project work / seminar etc.) the breakup of marks for each experiment/ exercise/ module of work, should be clearly discussed in the class committee meeting and informed to the students.
- Analyzing the performance of the students of the class after each test and finding the ways and means of improving the Students Performance
- Identifying the weak students, if any, in any specific subject and requesting the teachers concerned to provide some additional help or guidance or coaching to such weak students as frequently as possible.

7.2 The class committee for a class under a particular programme is normally constituted by the Head of the Department. However, if the students of different programmes are mixed in a class, the class committee is to be constituted by the Head of the Institution.

7.3 The class committee shall be constituted on the first working day of any semester or earlier.

7.4 At least 2 student representatives (usually 1 boy and 1 girl) shall be included in the class committee.

7.5 The chairperson of the class committee shall invite the Class adviser(s) and the Head of the Department to the meeting of the class committee.

7.6 The Head of the Institution may participate in any class committee of the institution.

7.7 The Chairperson of the Class Committee is required to prepare the minutes of every meeting, submit the same to the Head of the Institution within two days of the meeting and arrange to circulate among the concerned students and teachers. If there are some points in the minutes requiring action by the management, the same shall be brought to the notice of the management by the Head of the Institution.

- 7.8 The first meeting of the class committee shall be held within one week from the date of commencement of the semester in order to inform the students about the nature and weightage of assessments within the framework of the Regulations. Two or three subsequent meetings may be held at suitable intervals. During these meetings the student members, representing the entire class, shall meaningfully interact and express the opinions and suggestions of the class students to improve the effectiveness of the teaching-learning process.

8 COURSE COMMITTEE FOR COMMON COURSES

Each common course offered to more than one group of students shall have a "Course Committee" comprising all the teachers teaching the common course with one of them nominated as Course Coordinator. The nomination of the course Coordinator shall be made by the Head of the Department / Head of the Institution depending upon whether all the teachers teaching the common course belong to a single department or to several departments. The 'Course committee' shall meet as often as possible and ensure uniform evaluation of the tests and arrive at a common scheme of evaluation for the tests. Wherever it is feasible, the course committee may also prepare a common question paper for the Assessment Test(s).

9 ATTENDANCE REQUIREMENTS FOR COMPLETION OF A SEMESTER

- 9.1 A candidate who has fulfilled the following conditions shall be deemed to have satisfied the attendance requirements for completion of a semester.

Ideally every student is expected to attend all classes and earn 100% attendance. However in order to allow provision for certain unavoidable reasons such as prolonged hospitalization / accident / specific illness the student is expected to earn a minimum of 75% attendance to become eligible to write the End-Semester Examinations.

Therefore, every student shall secure not less than 75% of overall attendance in that semester as per clause 3.4.

- 9.2 However, a candidate who secures overall attendance between 65% and 74% in that current semester due to medical reasons (prolonged hospitalization / accident / specific illness / participation in sports events) may be permitted to appear for the current semester examinations subject to the condition that the candidate shall submit the medical certificate / sports participation certificate to the Head of the Institution. The same shall be forwarded to the Controller of Examinations for record purposes.

- 9.3 Candidates who could secure less than 65% overall attendance and **Candidates who do not satisfy the clauses 9.1 & 9.2** will not be permitted to write the end-semester examination of that current semester and are not permitted to go to next semester. They are required to repeat the incomplete semester in the next academic year.

10 PROCEDURES FOR AWARDING MARKS FOR INTERNAL ASSESSMENT(IA)

The maximum marks assigned to different courses shall be as given below:
Each of the theory and practical courses (including project work) shall carry a maximum of 100 marks of which 20 marks will be through internal assessment and the End Semester Examination (ESE) will carry 80 marks.

10.1 The marks for the continuous assessment shall be awarded as per the procedure given below:

(i) Theory Courses:

Three tests each carrying 100 marks shall be conducted during the semester by the Department / College concerned. The total marks obtained in all tests put together out of 300, shall be proportionately reduced for 20 marks and rounded to the nearest integer (This also implies equal weightage to all the three tests).

(ii) Practical Courses:

The maximum marks for Internal Assessment shall be 20 in case of practical courses. Every practical exercise / experiment shall be evaluated based on conduct of experiment / exercise and records maintained. There shall be at least one test. The criteria for arriving at the Internal Assessment marks of 20 is as follows: 75 marks shall be awarded for successful completion of all the prescribed experiments done in the Laboratory and 25 marks for the test. The total mark shall be reduced to 20 and rounded to the nearest integer.

(iii) Theory Courses with Laboratory component:

The maximum marks for Internal Assessment shall be 20 in case of theory courses with Laboratory component. For a theory course with Laboratory component, there shall be three assessments: the first two assessments (each with a maximum of 100 marks) will be from theory portions and the third assessment (maximum marks 100) will be for laboratory component. The sum of marks of all three assessments shall be reduced to 20 marks and rounded to the nearest integer.

(iv) Seminar / Professional Practices / Case Study:

The seminar / Case study is to be considered as purely INTERNAL (with 100% internal marks only). Every student is expected to present a minimum of 2 seminars per semester before the evaluation committee and for each seminar marks can be equally apportioned. The three member committee appointed by Head of the Institution will evaluate the seminar and at the end of the semester the marks can be consolidated and taken as the final mark. The evaluation shall be based on the seminar paper (40%), presentation (40%) and response to the questions asked during presentation (20%).

(v)The Industrial / Practical Training shall carry 100 marks and shall be evaluated through internal assessment only. At the end of Industrial / Practical training / internship / Summer Project, the candidate shall submit a certificate from the organization where he / she has undergone training and a brief report. The evaluation will be made based on this report and a Viva-Voce Examination, conducted internally by a three member Departmental Committee constituted by the Head of the Institution. Certificates submitted by the candidate shall be attached to the mark list sent by the Head of the Department.

- 10.2** Internal marks approved by the Head of the Institution shall be displayed by the respective HODs within 5 days from the last working day.
- 10.3** Every teacher is required to maintain an 'ATTENDANCE AND ASSESSMENT RECORD' which consists of attendance marked in each lecture or practical or project work class, the test marks and the record of class work (topics covered), separately for each course. This should be submitted to the Head of the Department periodically (at least three times in a semester) for checking the syllabus coverage and the records of test marks and attendance. The Head of the department will put his signature and date after due verification. At the end the semester, the record should be verified by the Head of the institution who will keep this document in safe custody (for five years). The university or any inspection team appointed by the University may inspect the records of attendance and assessments of both current and previous semesters.

11 REQUIREMENTS FOR APPEARING FOR SEMESTER EXAMINATION

- 11.1** A candidate shall normally be permitted to appear for the University examinations of the current semester if he/she has satisfied the semester completion requirements as per clause 9.1 & 9.2 and has registered for examination in all courses of the current semester.
- 11.2** Further, registration is mandatory for all the courses in the current semester as well as for arrear(s) course(s) for the university examinations failing which, the candidate will not be permitted to move to the higher semester.
- 11.3** A student who has passed all the courses prescribed in the curriculum for the award of the degree shall not be permitted to re-enroll to improve his/her marks in a course or the aggregate marks / CGPA.

12 UNIVERSITY EXAMINATIONS

- 12.1** There shall be an End- Semester Examination of 3 hours duration in each lecture based course.

The examinations shall ordinarily be conducted between October and December during the odd semesters and between April and June in the even semesters.

For the practical examinations (including project work), both internal and external examiners shall be appointed by the University.

12.2 WEIGHTAGE

The following will be the weightage for different courses.

- i) Lecture or Lecture cum Tutorial based course:
- | | | |
|--------------------------|---|-----|
| Internal Assessment | - | 20% |
| End Semester Examination | - | 80% |
- ii) Laboratory based courses
- | | | |
|--------------------------|---|-----|
| Internal Assessment | - | 20% |
| End Semester Examination | - | 80% |

| | | |
|--|---|------|
| iii) Project work | | |
| Internal Assessment | - | 20% |
| Evaluation of Project Report by external examiner | - | 30% |
| Viva-Voce Examination | - | 50% |
| iv) Practical training / summer project / seminar | | |
| Internal Assessment | - | 100% |

13 PASSING REQUIREMENTS

- 13.1** A candidate who secures not less than 50% of total marks prescribed for the course with a minimum of 50% of the marks prescribed for each of the course of the End-Semester University Examination in both theory and practical courses shall be declared to have passed in the course and acquired the relevant number of credits.
- 13.2** If the candidate fails to secure a pass in a particular course as per clause 13.1, it is mandatory that the candidate shall register and re-appear for the examination in that course during the subsequent semester when examination is conducted for that course. Further, the candidate should continue to enroll and reappear for the examination till a **pass** is secured in such arrear course.
- 13.3** The internal assessment marks obtained by the candidate in the first appearance shall be retained and considered valid for all subsequent attempts till the candidate secure a pass. However, from the third attempt onwards if a candidate fails to obtain pass marks (IA + End Semester Examination) as per clause 13.1, then the candidate shall be declared to have passed the examination if he/she secure a minimum of 50% marks prescribed for the university end semester examinations alone.

14 ELIGIBILITY FOR THE AWARD OF THE DEGREE

- 14.1** A student shall be declared eligible for the award of the degree if he/she has:
- (i) Successfully passed all the courses as specified in the curriculum corresponding to his/her programme within the stipulated period. (as per clause 3.1)
 - (ii) No disciplinary action is pending against him/her.
 - (iii) The award of the degree must have been approved by the syndicate.
 - (iv) Successfully completed any additional courses prescribed by the Director, Academic Courses

15 AWARD OF LETTER GRADES

- 15.1** All assessments of a course will be done on absolute marks basis. However, for the purpose of reporting the performance of a candidate, letter grades, each carrying certain points specified, will be awarded as per the range of total marks (out of 100) obtained by the candidate (Regular or Arrear), as detailed below:

| Letter grade | Grade Points | Marks Range |
|--------------|---|-------------|
| S | 10 | 91 – 100 |
| A | 9 | 81 – 90 |
| B | 8 | 71 – 80 |
| C | 7 | 61 – 70 |
| D | 6 | 57 – 60 |
| E | 5 | 50 – 56 |
| U | 0 | < 50 |
| | (or 50, but not satisfying clause 13.1) | |
| W | 0 | |

A student is deemed to have passed and acquired the corresponding credits in a particular course if he / she **obtained** any one of the following grades: “S”, “A”, “B”, “C”, “D”, “E”.

‘SA’ denotes shortage of attendance (as per Clause 6) and hence prevented from writing end semester examination. ‘SA’ will appear only in the result sheet.

‘U’ denotes Reappearance (RA) is required for the examination in that particular course. ‘W’ denotes withdrawal from exam for the particular course.
(The grades U and W will figure both in Mark Sheet as well as in Result Sheet)

15.2 GRADE SHEET

After results are declared, Grade Sheets will be issued to each student which will contain the following details:

- The college in which the candidate has studied.
- The list of courses enrolled during the semester and the grades scored.
- The Grade Point Average (GPA) for the semester and
- The Cumulative Grade Point Average (CGPA) of all courses enrolled from first semester onwards.

GPA for a semester is the ratio of the sum of the products of the number of credits for courses acquired and the corresponding points to the sum of the number of credits for the courses acquired in the semester. CGPA will be calculated in a similar manner, considering all the courses registered from first semester.

$$\text{GPA / CGPA} = \frac{\sum_{i=1}^n C_i GP_i}{\sum_{i=1}^n C_i}$$

where

C_i is the number of credits assigned to the course

GP_i is the Grade point corresponding to the grade obtained for each Course

n is number of all Courses successfully cleared during the particular semester in the case of GPA and during all the semesters in the case of **CGPA**.

“U”, “I” and “W” grades will be excluded for calculating GPA and CGPA.

16 CLASSIFICATION OF THE DEGREE AWARDED

16.1 FIRST CLASS WITH DISTINCTION:

A candidate who satisfies the following conditions shall be declared to have passed the examination in **First class with Distinction**:

M.E. / M.Tech. M.B.A.(Full Time)

- Should have passed the End semester examination in all the courses of all the four semesters in his/her **First Appearance** within two years. Withdrawal from examination (vide Clause 17) will not be considered as an appearance. One year authorized break of study (if availed of) is permitted in addition to two years for award of First class with Distinction.
- Should have secured a CGPA of not less than 8.50

M.E. / M.Tech. M.B.A.(Part Time) and M.C.A (Full Time)

- Should have passed the End semester examination in all the courses of all the six semesters in his/her **First Appearance** within three years. Withdrawal from examination (vide Clause 17) will not be considered as an appearance. One year authorized break of study (if availed of) is permitted in addition to three years for award of First class with Distinction.
- Should have secured a CGPA of not less than 8.50.

16.2 FIRST CLASS:

A candidate who satisfies the following conditions shall be declared to have passed the examination in **First class**:

M.E. / M.Tech. M.B.A.(Full Time)

- Should have passed the End semester examination in all the courses of all the four semesters within three years. One year authorized break of study (if availed of) or prevention from writing the End Semester examination due to lack of attendance (if applicable) is included in the three years.
- Should have secured a CGPA of not less than 6.50.

M.E. / M.Tech. M.B.A. (Part Time) and M.C.A (Full Time)

- Should have passed the End semester examination in all the courses of all the six semesters within four years. One year authorized break of study (if availed of) or prevention from writing the End Semester examination due to lack of attendance (if applicable) is included in the four years.
- Should have secured a CGPA of not less than 6.50.

16.3 SECOND CLASS:

All other candidates (not covered in clauses 16.1 and 16.2) who qualify for the award of the degree (vide Clause 14) shall be declared to have passed the examination in **Second Class**.

- 16.4.** A candidate who is absent in semester examination in a course / project work after having registered for the same shall be considered to have appeared in that examination for the purpose of classification.

16.5 Photocopy / Revaluation

A candidate can apply for photocopy of his/her semester examination answer paper in a theory course, within 2 weeks from the declaration of results, on payment of a prescribed fee through proper application to the Controller of Examinations through the Head of Institutions. The answer script is to be valued and justified by a faculty member, who handled the subject and recommend for revaluation with breakup of marks for each question. Based on the recommendation, the candidate can register for the revaluation through proper application to the Controller of Examinations. The Controller of Examinations will arrange for the revaluation and the results will be intimated to the candidate concerned through the Head of the Institutions. Revaluation is not permitted for practical courses and for project work.

A candidate can apply for revaluation of answer scripts for not exceeding 5 subjects at a time.

16.6 Review

Candidates not satisfied with Revaluation can apply for Review of his/ her examination answer paper in a theory course, within the prescribed date on payment of a prescribed fee through proper application to Controller of Examination through the Head of the Institution.

Candidates applying for Revaluation only are eligible to apply for Review.

17 PROVISION FOR WITHDRAWAL FROM EXAMINATION:

A candidate may for valid reasons and on prior application, be granted permission to withdraw from appearing for the examination of any one course or consecutive examinations of more than one course in a semester examination.

- 17.1** Such withdrawal shall be permitted only once during the entire period of study of the degree programme.
- 17.2** Withdrawal application is valid only if it is made within 10 days prior to the commencement of the examination in that course or courses and recommended by the Head of the Institution and approved by the Controller of Examinations.
- 17.3** Notwithstanding the requirement of mandatory TEN days notice, applications for withdrawal for special cases under extraordinary conditions will be considered on the merit of the case.
- 17.4** Withdrawal shall not be construed as an appearance for the eligibility of a candidate for First Class with Distinction. Withdrawal is not permitted in the final semester.

- 17.5 Withdrawal from the End semester examination is **NOT** applicable to arrears subjects of previous semesters
- 17.6 The candidate shall reappear for the withdrawn courses during the examination conducted in the subsequent semester.

18 AUTHORIZED BREAK OF STUDY FROM A PROGRAMME

- 18.1 Break of Study shall be granted only once for valid reasons for a maximum of one year during the entire period of study of the degree programme. However, in extraordinary situation the candidate may apply for additional break of study not exceeding another one year by paying prescribed fee for break of study. If a candidate intends to temporarily discontinue the programme in the middle of the semester for valid reasons, and rejoin the programme in a subsequent year, permission may be granted based on the merits of the case provided he / she applies to the **Director, Student Affairs** in advance, but not later than the last date for registering for the end semester examination of the semester in question, through the Head of the Institution stating the reasons therefor and the probable date of rejoining the programme.
- 18.2 The candidates permitted to rejoin the programme after break of study / prevention due to lack of attendance, shall be governed by the Curriculum and Regulations in force at the time of rejoining. The students rejoining in new Regulations shall apply to the Director, Academic Courses in the prescribed format through Head of the Institution at the beginning of the readmitted semester itself for prescribing additional courses, if any, from any semester of the regulations in-force, so as to bridge the curriculum in-force and the old curriculum.
- 18.3 The authorized break of study (for a maximum of one year) will not be counted for the duration specified for passing all the courses for the purpose of classification. (vide Clause 16.1). However, additional break of study granted will be counted for the purpose of classification.
- 18.4 The total period for completion of the Programme reckoned from, the commencement of the first semester to which the candidate was admitted shall not exceed the maximum period specified in clause 3.1 irrespective of the period of break of study (vide clause 18.1) in order that he/she may be eligible for the award of the degree.
- 18.5 If any student is detained for want of required attendance, the period spent in that semester shall not be considered as authorized 'Break of Study' is not applicable for this case.

19 DISCIPLINE

- 19.1 Every student is required to observe disciplined and decorous behavior both inside and outside the college and not to indulge in any activity which will tend to bring down the prestige of the University / College. The Head of Institution shall constitute a disciplinary committee consisting of Head of Institution, Two Heads of Department of which one should be from the faculty of the student, to enquire into acts of indiscipline and notify the University about the disciplinary action recommended for approval. In case of any serious disciplinary action which leads to suspension or dismissal, then a committee shall be constituted including one representative from Anna University, Chennai. In this regard, the member will be nominated by the University on getting information from the Head of the Institution.

19.2 If a student indulges in malpractice in any of the University / internal examination he / she shall be liable for punitive action as prescribed by the University from time to time.

20 REVISION OF REGULATIONS, CURRICULUM AND SYLLABI

The University may from time to time revise, amend or change the Regulations, Curriculum, Syllabus and scheme of examinations through the Academic Council with the approval of Syndicate.

**ANNA UNIVERSITY, CHENNAI
AFFILIATED INSTITUTIONS
REGULATIONS - 2013**

M.E. EMBEDDED SYSTEM TECHNOLOGIES

I - IV SEMESTERS (FULL TIME) CURRICULUM AND SYLLABUS

SEMESTER I

| THEORY | | | | | |
|--------------------|--|----------|----------|----------|----------|
| Course Code | Course Title | L | T | P | C |
| MA7163 | Applied Mathematics for Electrical Engineers | 3 | 1 | 0 | 4 |
| ET7101 | Advanced Digital System Design | 3 | 0 | 0 | 3 |
| ET7102 | Microcontroller Based System Design | 3 | 0 | 0 | 3 |
| ET7103 | Real Time Systems | 3 | 0 | 0 | 3 |
| ET7104 | Design of Embedded Systems | 3 | 0 | 0 | 3 |
| | Elective I | 3 | 0 | 0 | 3 |

| PRACTICAL | | | | | |
|--------------------|------------------------------|-----------|----------|----------|-----------|
| Course Code | Course Title | L | T | P | C |
| ET7111 | Embedded System Laboratory I | 0 | 0 | 3 | 2 |
| Total | | 18 | 1 | 3 | 21 |

SEMESTER II

| THEORY | | | | | |
|--------------------|--|----------|----------|----------|----------|
| Course Code | Course Title | L | T | P | C |
| ET7201 | VLSI Architecture and Design Methodologies | 3 | 0 | 0 | 3 |
| ET7202 | Embedded Networking | 3 | 1 | 0 | 4 |
| ET7203 | Wireless and Mobile Communication | 3 | 0 | 0 | 3 |
| ET7204 | Software for Embedded Systems | 3 | 0 | 0 | 3 |
| | Elective II | 3 | 0 | 0 | 3 |
| | Elective III | 3 | 0 | 0 | 3 |

| PRACTICAL | | | | | |
|--------------------|-------------------------------|-----------|----------|----------|-----------|
| Course Code | Course Title | L | T | P | C |
| ET7211 | Embedded System Laboratory II | 0 | 0 | 3 | 2 |
| Total | | 18 | 1 | 3 | 21 |

SEMESTER III

| THEORY | | | | | |
|--------------------|---------------------|----------|----------|----------|----------|
| Course Code | Course Title | L | T | P | C |
| | Elective IV | 3 | 0 | 0 | 3 |
| | Elective V | 3 | 0 | 0 | 3 |
| | Elective VI | 3 | 0 | 0 | 3 |

| PRACTICAL | | | | | |
|--------------------|------------------------|----------|----------|-----------|-----------|
| Course Code | Course Title | L | T | P | C |
| ET7311 | Project Work (Phase I) | 0 | 0 | 12 | 6 |
| Total | | 9 | 0 | 12 | 15 |

SEMESTER IV

| PRACTICAL | | | | | |
|--------------------|-------------------------|----------|----------|-----------|-----------|
| Course Code | Course Title | L | T | P | C |
| ET7411 | Project Work (Phase II) | 0 | 0 | 24 | 12 |
| Total | | 0 | 0 | 24 | 12 |

TOTAL NO OF CREDITS 69

ELECTIVES

SEMESTER I

| Course Code | Course Title | L | T | P | C |
|-------------|---|---|---|---|---|
| ET7001 | Digital Instrumentation | 3 | 0 | 0 | 3 |
| ET7002 | Real Time Operating Systems | 3 | 0 | 0 | 3 |
| AP7001 | Computer Architecture and Parallel Processing | 3 | 0 | 0 | 3 |

SEMESTER II

| Course Code | Course Title | L | T | P | C |
|-------------|---|---|---|---|---|
| ET7003 | Design of Embedded Control Systems | 3 | 0 | 0 | 3 |
| ET7004 | Programming with VHDL | 3 | 0 | 0 | 3 |
| ET7005 | Adhoc Networks | 3 | 0 | 0 | 3 |
| ET7006 | Advanced Digital Signal Processing | 3 | 0 | 0 | 3 |
| CL7204 | Soft Computing Techniques | 3 | 0 | 0 | 3 |
| ET7007 | RISC Processor Architecture and Programming | 3 | 0 | 0 | 3 |

SEMESTER III

| Course Code | Course Title | L | T | P | C |
|-------------|--|---|---|---|---|
| ET7008 | Advanced Embedded Systems | 3 | 0 | 0 | 3 |
| ET7009 | Pervasive Devices and Technology | 3 | 0 | 0 | 3 |
| ET7010 | Cryptography and Network Security | 3 | 0 | 0 | 3 |
| ET7011 | Smart Meter and Smart Grid Communication | 3 | 0 | 0 | 3 |
| ET7012 | Computer in Networking and Digital Control | 3 | 0 | 0 | 3 |
| ET7013 | Distributed Embedded Computing | 3 | 0 | 0 | 3 |
| CL7004 | Robotics and Control | 3 | 0 | 0 | 3 |
| ET7014 | Application of MEMS Technology | 3 | 0 | 0 | 3 |
| ET7015 | Digital Image Processing and Applications | 3 | 0 | 0 | 3 |

OBJECTIVES:

- To develop the ability to apply the concepts of Matrix theory and Linear programming in Electrical Engineering problems.
- To achieve an understanding of the basic concepts of one dimensional random variables and apply in electrical engineering problems.
- To familiarize the students in calculus of variations and solve problems using Fourier transforms associated with engineering applications.

UNIT I MATRIX THEORY**(9+3)**

The Cholesky decomposition - Generalized Eigen vectors, Canonical basis - QR factorization - Least squares method - Singular value decomposition.

UNIT II CALCULUS OF VARIATIONS**(9+3)**

Concept of variation and its properties – Euler’s equation – Functional dependant on first and higher order derivatives – Functionals dependant on functions of several independent variables – Variational problems with moving boundaries – problems with constraints - Direct methods: Ritz and Kantorovich methods.

UNIT III ONE DIMENSIONAL RANDOM VARIABLES**(9+3)**

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 IV LINEAR PROGRAMMING**(9+3)**

Formulation – Graphical solution – Simplex method – Two phase method - Transportation and Assignment Models

UNIT V FOURIER SERIES**(9+3)**

Fourier Trigonometric series: Periodic function as power signals – Convergence of series – Even and odd function: cosine and sine series – Non-periodic function: Extension to other intervals - Power signals: Exponential Fourier series – Parseval’s theorem and power spectrum – Eigen value problems and orthogonal functions – Regular Sturm-Liouville systems – Generalized Fourier series.

L:45 +T: 15 TOTAL: 60 PERIODS**REFERENCES:**

1. Richard Bronson, “Matrix Operation”, Schaum’s outline series, 2nd Edition, McGraw Hill, 2011.
2. Gupta, A.S., Calculus of Variations with Applications, Prentice Hall of India Pvt. Ltd., New Delhi, 1997.
3. Oliver C. Ibe, “Fundamentals of Applied Probability and Random Processes, Academic Press, (An imprint of Elsevier), 2010.
4. Taha, H.A., “Operations Research, An introduction”, 10th edition, Pearson education, New Delhi, 2010.
5. Andrews L.C. and Phillips R.L., Mathematical Techniques for Engineers and Scientists, Prentice Hall of India Pvt.Ltd., New Delhi, 2005.
6. Elsgolts, L., Differential Equations and the Calculus of Variations, MIR Publishers, Moscow, 1973.

7. Grewal, B.S., Higher Engineering Mathematics, 42nd edition, Khanna Publishers, 2012.
8. O'Neil, P.V., Advanced Engineering Mathematics, Thomson Asia Pvt. Ltd., Singapore, 2003.
9. Johnson R. A. and Gupta C. B., "Miller & Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 7th Edition, 2007.

OBJECTIVES

- To expose the students to the fundamentals of sequential system design, modelling
- To teach the fundamentals of Asynchronous circuits, switching errors
- To study on Fault identification in digital switching circuits
- To introduce logics for design of Programmable Devices
- To comparatively study the classification of commercial family of Programmable Devices

UNIT I SEQUENTIAL CIRCUIT DESIGN**9**

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.

UNIT II ASYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN**9**

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 III FAULT DIAGNOSIS AND TESTABILITY ALGORITHMS**9**

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 IV SYNCHRONOUS DESIGN USING PROGRAMMABLE DEVICES**9**

Programming Techniques -Re-Programmable Devices Architecture- Function blocks, I/Oblocks, Interconnects, Realize combinational, Arithmetic, Sequential Circuit with Programmable Array Logic; Architecture and application of Field Programmable Logic Sequence.

UNIT V ARCHITECTURES AND PROGRAMMING PROGRAMMABLE LOGIC DEVICES**9**

Architecture with EPLD, PEEL – Realization State machine using PLD – FPGA-Aptix Field Programmable Interconnect – Xilinx FPGA – Xilinx 2000 - Xilinx 4000 family.VHDL based Designing with PLD-ROM,PAL,PLA,Sequential PLDs,Case study –Keypad Scanner.

TOTAL : 45 PERIODS**REFERENCES:**

1. Donald G. Givone, "Digital principles and Design", Tata McGraw Hill 2002.
2. Stephen Brown and Zvonk Vranesic, "Fundamentals of Digital Logic with VHDL Design", Tata McGraw Hill, 2002
3. Charles H. Roth Jr., "Digital Systems design using VHDL", Cengage Learning, 2010.
4. Mark Zwolinski, "Digital System Design with VHDL", Pearson Education, 2004
5. Parag K Lala, "Digital System design using PLD", BS Publications, 2003
6. John M Yarbrough, "Digital Logic applications and Design", Thomson Learning, 2001
7. Nripendra N Biswas, "Logic Design Theory", Prentice Hall of India, 2001
8. Charles H. Roth Jr., "Fundamentals of Logic design", Thomson Learning, 2004.
9. John V.Oldfield, Richard C.Dorf, "Field Programmable Gate Arrays", Wiley India Edition, 2008

OBJECTIVES

- To expose the students to the fundamentals of microcontroller based system design.
- To teach I/O and RTOS role on microcontroller.
- To impart knowledge on PIC Microcontroller based system design.
- To introduce Microchip PIC 8 bit peripheral system Design
- To give case study experiences for microcontroller based applications.

UNIT I 8051 ARCHITECTURE**9**

Architecture – memory organization – addressing modes – instruction set –Timers - Interrupts - I/O ports, Interfacing I/O Devices – Serial Communication.

UNIT II 8051 PROGRAMMING**9**

Assembly language programming – Arithmetic Instructions – Logical Instructions –Single bit Instructions – Timer Counter Programming – Serial Communication Programming Interrupt Programming – RTOS for 8051 – RTOSLite – FullRTOS – Task creation and run – LCD digital clock/thermometer using FullRTOS

UNIT III PIC MICROCONTROLLER**9**

Architecture – memory organization – addressing modes – instruction set – PIC programming in Assembly & C –I/O port, Data Conversion, RAM & ROM Allocation, Timer programming, MP-LAB.

UNIT IV PERIPHERAL OF PIC MICROCONTROLLER**9**

Timers – Interrupts, I/O ports- I2C bus-A/D converter-UART- CCP modules -ADC, DAC and Sensor Interfacing –Flash and EEPROM memories.

UNIT V SYSTEM DESIGN – CASE STUDY**9**

Interfacing LCD Display – Keypad Interfacing - Generation of Gate signals for converters and Inverters - Motor Control – Controlling DC/ AC appliances – Measurement of frequency - Stand alone Data Acquisition System.

TOTAL : 45 PERIODS**REFERENCES:**

1. Muhammad Ali Mazidi, Rolin D. Mckinlay, Danny Causey ‘ PIC Microcontroller and Embedded Systems using Assembly and C for PIC18’, Pearson Education 2008
2. John Iovine, ‘PIC Microcontroller Project Book ’, McGraw Hill 2000
3. Myke Predko, “Programming and customizing the 8051 microcontroller”, Tata McGrawHill 2001.
4. Muhammad Ali Mazidi, Janice G. Mazidi and Rolin D. McKinlay, ‘The 8051 Microcontroller and Embedded Systems’ Prentice Hall, 2005.
5. Rajkamal, ”.Microcontrollers-Architecture,Programming,Interfacing & System Design”, 2ed,Pearson,2012.
6. I Scott Mackenzie and Raphael C.W. Phan, “The Micro controller”, Pearson, Fourth edition 2012

OBJECTIVES

- To expose the students to the fundamentals of Real Time systems
- To teach the fundamentals of Scheduling and features of programming languages
- To study the data management system for real time
- To introduce the fundamentals of real time communication
- To teach the different algorithms and techniques used for real time systems

UNIT I INTRODUCTION**9**

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 PROGRAMMING LANGUAGES AND TOOLS**9**

Programming Languages and Tools – Desired language characteristics – Data typing – Control structures – Facilitating Hierarchical Decomposition, Packages, Run time (Exception) Error handling – Overloading and Generics – Multitasking – Low level programming – Task Scheduling – Timing Specifications – Programming Environments – Run – time support.

UNIT III REAL TIME DATABASES**9**

Real time Databases – Basic Definition, Real time Vs General Purpose Databases, Main Memory Databases, Transaction priorities, Transaction Aborts, Concurrency control issues, Disk Scheduling Algorithms, Two – phase Approach to improve Predictability – Maintaining Serialization Consistency – Databases for Hard Real Time Systems.

UNIT IV COMMUNICATION**9**

Real – Time Communication – Communications media, Network Topologies Protocols, Fault Tolerant Routing. Fault Tolerance Techniques – Fault Types – Fault Detection. Fault Error containment Redundancy – Data Diversity – Reversal Checks – Integrated Failure handling.

UNIT V . EVALUATION TECHNIQUES**9**

Reliability Evaluation Techniques – Obtaining parameter values, Reliability models for Hardware Redundancy – Software error models. Clock Synchronization – Clock, A Nonfault – Tolerant Synchronization Algorithm – Impact of faults – Fault Tolerant Synchronization in Hardware – Fault Tolerant Synchronization in software.

TOTAL : 45 PERIODS**REFERENCES**

1. C.M. Krishna, Kang G. Shin, “Real – Time Systems”, McGraw – Hill International Editions, 1997.
2. Rajib Mall, ”Real-time systems: theory and practice”, Pearson Education, 2007
3. Peter D.Lawrence, “Real Time Micro Computer System Design – An Introduction”, McGraw Hill, 1988.
4. Stuart Bennett, “Real Time Computer Control – An Introduction”, Prentice Hall of

India, 1998.

5. S.T. Allworth and R.N.Zobel, "Introduction to real time software design", Macmillan, 2nd Edition, 1987.
6. R.J.A Buhur, D.L Bailey, "An Introduction to Real – Time Systems", Prentice –Hall International, 1999.
7. Philip.A.Laplante, "Real Time System Design and Analysis", Prentice Hall of India, 3rd Edition, April 2004

ET7104

DESIGN OF EMBEDDED SYSTEMS

L T P C
3 0 0 3

OBJECTIVES

- To provide a clear understanding on the basic concepts, Building Blocks for Embedded System
- To teach the fundamentals of System design with Partitioning
- To introduce on Embedded Process development Environment
- To study on Basic tool features for target configuration
- To introduce different EDLC Phases & Testing of embedded system

UNIT I EMBEDDED DESIGN WITH MICROCONTROLLERS

9

Product specification – Hardware / Software partitioning – Detailed hardware and software design – Integration – Product testing – Microprocessor Vs Micro Controller – Performance tools – Bench marking – RTOS Micro Controller -issues in selection of processors.

UNIT II PARTITIONING DECISION

9

Hardware / Software duality – Hardware-Software portioning- coding for Hardware- software development – ASIC revolution – Managing the Risk – Co-verification – execution environment – memory organization –memory enhancement – Firmware-speed and code density -System startup

UNIT III FUNCTIONALITIES FOR SYSTEM DESIGN

9

Timers, Watch dog timers – RAM, Flash Memory basic toolset – Integration of Hardware & Firmware- InSystem Programming, InApplication Programming,,IDE-Target Configuration- Host based debugging – Remote debugging – ROM emulators – Logic analyser

UNIT IV IN CIRCUIT EMULATORS

9

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

UNIT V EMBEDDED DESIGN LIFE CYCLE & TESTING

9

Objective, Need, different Phases & Modelling of the EDLC.choice of Target Architectures for Embedded Application Development-for Control Dominated-Data Dominated Systems- Software & Hardware Design, PCB Design, Manufacturing & PCB Assembly-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 : 45 PERIODS

REFERENCES

1. James K. Peckol, "Embedded system Design", John Wiley & Sons, 2010
2. Elicia White, "Making Embedded Systems", O'Reilly Series, SPD, 2011
3. Rajkamal, "Embedded Systems", TMH, 2009.
4. Lyla B Das, "Embedded Systems-An Integrated Approach", Pearson 2013
5. Arnold S. Berger – "Embedded System Design", CMP books, USA 2002.
6. ARKIN, R.C., Behaviour-based Robotics, The MIT Press, 1998.

| Sl.No. | Title | Requirement | Quantity |
|--------|---|---|---------------|
| 1 | Programming with 8 bit Microcontrollers Both Assembly and C programming | 8 bit Microcontrollers with peripherals;Board Support Software Tools | 5 set |
| 2 | Programming with 8 bit Microcontrollers I/O Programming/ Timers/ Interrupts/ Serial port programming/PWM Generation/ Motor Control/ADC/DAC/ LCD/ RTC Interfacing/ Sensor Interfacing | 8 bit Microconptrollers with peripherals;Board Support Software Tools, peripherals with interface DSO(2);Multimeters(6); 3 Types of Sensors(3 each);DC & AC Motors 2 each);interface supports(3 each) | 2 set |
| 3 | Programming with 8 bit PIC/AVR Microcontrollers Both Assembly and C programming | 8 bit PIC/AVR Microconptrollers with peripherals;Board Support Software Tools | 5 set |
| 4 | Programming with PIC /AVR Microcontrollers I/O Programming/ Timers/ Interrupts/ Serial port programming/PWM Generation/ Motor Control/ADC/DAC/ LCD/ RTC Interfacing/ Sensor Interfacing | PIC /AVR Microconptrollers with peripherals;Board Support Software Tools, peripherals with interface DSO(2);Multimeters(6); 3 Types of Sensors(3 each);DC & AC Motors 2 each);interface supports(3 each) | 2 set |
| 5 | Programming with 16 bit processors Both Assembly and C programming | 16 bit processors with peripherals;Board Support Software Tools | 2 set |
| 6 | Programming with 16 bit processors I/O Programming/ Timers/ Interrupts/ Serial port programming/PWM Generation/ Motor Control/ADC/DAC/ LCD/ RTC Interfacing/ Sensor Interfacing | 16 bit Microconptrollers with peripherals;Board Support Software Tools with interface DSO(2);Multimeters(6); 3 Types of Sensors(3 each);DC & AC Motors 2 each);interface supports(3 each) | 2 set |
| 7 | Design with CAD tools Design and Implementation of Combinational , Sequential Circuits in CAD simulators | Simulation Tools as SPICE/others | Multiple user |
| 8 | Study on incircuit Emulators, crosscompilers, debuggers | Microconptrollers with peripherals;IDE, Board Support Software Tools /Uc/OS-II/C Compiler/others | Multiple user |
| 9 | Simulation & Programming of sensor interface & measurement with using programming environments (MATLAB/LabVIEW/Simulation Tools) | Simulation Tools as MATLAB/ LABVIEW /others | Multiple user |

| | | | |
|----|--------------------------------------|--|-------|
| 10 | Programming of TCP/IP protocol stack | Simulation & Experimenting set with IAR C/C++ Compiler,Assembler, peripherals;Board Support Software Tools | 1 set |
|----|--------------------------------------|--|-------|

0 0 3 2

TOTAL: 45 PERIODS

ET7201

VLSI ARCHITECTURE AND DESIGN METHODOLOGIES

LT P C

3 0 0 3

OBJECTIVES

- To give an insight to the students about the significance of CMOS technology and fabrication process.
- To teach the importance and architectural features of programmable logic devices.
- To introduce the ASIC construction and design algorithms
- To teach the basic analog VLSI design techniques.
- To study the Logic synthesis and simulation of digital system with Verilog HDL.

UNIT I CMOS DESIGN

9

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

Programming Techniques-Anti fuse-SRAM-EEPROM 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 10K-Stratix.

UNIT III BASIC CONSTRUCTION, FLOOR PLANNING, PLACEMENT AND ROUTING

6

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

6

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

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.

REFERENCES:

1. M.J.S Smith, "Application Specific integrated circuits", Addison 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.
4. Mohamed Ismail, Terri Fiez, "Analog VLSI Signal and information Processing", McGraw Hill International Editions, 1994.
5. Samir Palnitkar, "Veri Log HDL, A Design guide to Digital and Synthesis" 2nd Ed, Pearson, 2005.
6. John P. Uyemera "Chip design for submicron VLSI CMOS layout and simulation", Cengage Learning India Edition, 2011.

ET7202**EMBEDDED NETWORKING****L T P C
3 1 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**8**

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**10**

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

UNIT III ETHERNET BASICS**9**

Elements of a network – Inside Ethernet – Building a Network: Hardware options – Cables, Connections and network speed – Design choices: Selecting components –Ethernet Controllers – Using the internet in local and internet communications – Inside the Internet protocol

UNIT IV EMBEDDED ETHERNET**9**

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**9**

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

L = 45 T = 15 TOTAL = 60 PERIODS**REFERENCES**

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

ET7203**WIRELESS AND MOBILE COMMUNICATION****L T P C
3 0 0 3****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
- To study the basis for classification of commercial family of wireless communication technologies

UNIT I INTRODUCTION**9**

Wireless Transmission – signal propagation – spread spectrum – Satellite Networks – Capacity Allocation – FAMA – DAMA – MAC

UNIT II MOBILE NETWORKS**9**

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

UNIT III WIRELESS NETWORKS**9**

Wireless LAN – IEEE 802.11 Standard-Architecture – Services – AdHoc Network - Hiper Lan – Blue Tooth.

UNIT IV ROUTING**9**

Mobile IP – DHCP – AdHoc Networks – Proactive and Reactive Routing Protocols – Multicast Routing

UNIT V TRANSPORT AND APPLICATION LAYERS**9**

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

TOTAL : 45 PERIODS

REFERENCES

1. Kaveh Pahlavan, Prasanth Krishnamoorthy, " Principles of Wireless Networks' PHI/Pearson Education, 2003
2. Uwe Hansmann, Lothar Merk, Martin S. Nicklons and Thomas Stober, " Principles of Mobile computing", Springer, New york, 2003.
3. C.K.Toh, " AdHoc mobile wireless networks", Prentice Hall, Inc, 2002.
4. Charles E. Perkins, " Adhoc Networking", Addison-Wesley, 2001.
5. Jochen Schiller, " Mobile communications", PHI/Pearson Education, Second Edition, 2003.
6. William Stallings, " Wireless communications and Networks", PHI/Pearson Education, 2002.

ET7204

SOFTWARE FOR EMBEDDED SYSTEMS

L T P C
3 0 0 3

OBJECTIVES

- To expose the students to the fundamentals of embedded Programming.
- To Introduce the GNU C Programming Tool Chain in Linux.
- To study the basic concepts of embedded C and Embedded OS
- To introduce time driven architecture, Serial Interface with a case study.
- To introduce the concept of embedded Java for Web Enabling of systems.

UNIT I EMBEDDED PROGRAMMING

9

C and Assembly - Programming Style - Declarations and Expressions - Arrays, Qualifiers and Reading Numbers - Decision and Control Statements - Programming Process - More Control Statements - Variable Scope and Functions - C Preprocessor - Advanced Types - Simple Pointers - Debugging and Optimization – In-line Assembly.

UNIT II C PROGRAMMING TOOLCHAIN IN LINUX

9

C preprocessor - Stages of Compilation - Introduction to GCC - Debugging with GDB - The Make utility - GNU Configure and Build System - GNU Binary utilities - Profiling - using *gprof* - Memory Leak Detection with *valgrind* - Introduction to GNU C Library

UNIT III EMBEDDED C AND EMBEDDED OS

9

Adding Structure to 'C' Code: Object oriented programming with C, Header files for Project and Port, Examples. Meeting Real-time constraints: Creating hardware delays - Need for timeout mechanism - Creating loop timeouts - Creating hardware timeouts. Creating embedded operating system: Basis of a simple embedded OS, Introduction to sEOS, Using Timer 0 and Timer 1, Portability issue, Alternative system architecture, Important design considerations when using sEOS.

UNIT IV TIME-DRIVEN MULTI-STATE ARCHITECTURE AND HARDWARE**9**

Multi-State systems and function sequences: Implementing multi-state (Timed) system - Implementing a Multi-state (Input/Timed) system. Using the Serial Interface: RS232 - The Basic RS-232 Protocol - Asynchronous data transmission and baud rates - Flow control - Software architecture - Using on-chip UART for RS-232 communication - Memory requirements - The serial menu architecture - Examples. Case study: Intruder alarm system.

UNIT V EMBEDDED JAVA**9**

Introduction to Embedded Java and J2ME – Smart Card basics – Java card technology overview – Java card objects – Java card applets – working with APDUs – Web Technology for Embedded Systems.

TOTAL : 45 PERIODS**REFERENCES**

1. Steve Oualline, 'Practical C Programming 3rd Edition', O'Reilly Media, Inc, 2006.
2. Stephen Kochan, "Programming in C", 3rd Edition, Sams Publishing, 2009.
3. Michael J Pont, "Embedded C", Pearson Education, 2007.
4. Zhiquan Chen, 'Java Card Technology for Smart Cards: Architecture and Programmer's Guide', Addison-Wesley Professional, 2000.

ET7211**EMBEDDED SYSTEM LABORATORY II****L T P C
0 0 3 2**

| Sl.No. | Title | Requirement | Quantity |
|---------------|--|--|-----------------|
| 1 | Programming with ARM Processors Both Assembly and C programming, I/O Programming/Timers/Interrupts, /ADC/DAC/ LCD /RTC Interfacing/ Sensor Interfacing/i/o device control | ARM family Processors With IDE, Board Support Packages & Peripherals DSO(2);Multimeters(6); 3 Types of Sensors(3 each);DC & AC Motors 2 each);interface supports(3 each) | Multiple user |
| 2 | Programming with Fixed Point & Floating Point DSP Processors Both Assembly /C programming/CCS Compilers- Programming with DSP processors for Correlation, Convolution, Arithmetic adder, Multiplier, Design of Filters - FIR based , IIR | Fixed Point & Floating Point DSP Processors With IDE, Board Support | 2 set each |

| | | | |
|----|--|--|---------------|
| | based | Packages & Peripherals | |
| 3 | Design using Xilinx/Altera CPLD Design and Implementation of simple Combinational/Sequential Circuits | Xilinx/Altera CPLD Processor | Multiple set |
| 4 | Design using Xilinx/Altera FPGA Design and Implementation of simple Combinational/Sequential Circuits | Xilinx/Altera FPGA Processor | Multiple user |
| 3 | Interfacing: Motor Control/ADC/DAC/LCD / RTC Interfacing/ Sensor Interfacing | DSP/ARM/FPGA Processors With IDE, Board Support Packages & P DSO(2);Multimeters(6); 3 Types of Sensors(3 each);DC & AC Motors 2 each);interface supports(3 each) eripherals for interface | 2 set |
| 6 | Study of one type of Real Time Operating Systems (RTOS) with ARM Processor/Microcontroller | ARMProcessor/Microcontroller | Multiple user |
| 7 | Network Simulators Communication Topology of network using NS2/simulators | NS2/simulators | Multiple user |
| 8 | Study on Embedded wireless network Topology | NS2/simulators | Multiple user |
| 9 | Simulation of digital controllers using programming environments | (MATLAB/LabVIEW/Simulators) | Multiple user |
| 10 | Simulation & Programming on DSP /Image Processing using programming environments | (MATLAB/LabVIEW/Simulators) | Multiple user |

TOTAL= 45 PERIODS

REFERENCES :

1. Mohamammad Ali Mazidi & Mazidi ' 8051 Microcontroller and Embedded Systems', Pearson Education
2. Mohammad Ali Mazidi, Rolind Mckinley and Danny Causey, 'PIC Microcontroller and Embedded Systems' Pearson Education
3. UdayaShankara, "Modern Digital Signal Processing Includes Signals and Systems-MATLAB Programs, DSP Architecture with Assembly and C Programs", second edition, PHI Learning 2012.
4. Rashid," Introduction to PSPICE using Orcad for Circuits And Electronics"
5. Jan Axelson 'Embedded Ethernet and Internet Complete', Penram publications
6. Kraig Mitzner, 'Complete PCB Design using ORCAD Capture and Layout', Elsevier
7. Woon-Seng Gan, Sen M. Kuo, 'Embedded Signal Processing with the Micro Signal Architecture', John Wiley & Sons, Inc., Hoboken, New Jersey 2007
8. U. Meyer-Baese 'Digital Signal Processing using Field Programmable Gate Arrays', Springer
9. Dogan Ibrahim, 'Advanced PIC microcontroller projects in C', Elsevier 2008

REFERENCES:

1. A.J. Bouwens, "Digital Instrumentation", TATA McGraw-Hill Edition, 1998.
2. N. Mathivanan, "Microprocessors, PC Hardware and Interfacing", Prentice-Hall India, 2005.
3. H S Kalsi, "Electronic Instrumentation" Second Edition, Tata McGraw-Hill,2006.
4. Joseph J. Carr, "Elements of Electronic Instrumentation and Measurement" Third Edition, Pearson Education, 2003.
5. Buchanan, "Computer busses", Arnold, London,2000.
6. Jonathan W Valvano, "Embedded Microcomputer systems", Asia Pvt. Ltd., Brooks/Cole, Thomson, 2001.

ET7002

REAL TIME OPERATING SYSTEMS

L T P C
3 0 0 3

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 modeling 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

15

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 OVERVIEW OF RTOS

9

RTOS Task and Task state –Multithreaded Preemptive scheduler- Process Synchronisation- Message queues– Mail boxes -pipes – Critical section – Semaphores – Classical synchronisation problem – Deadlocks

UNIT III REAL TIME MODELS AND LANGUAGES

6

Event Based – Process Based and Graph based Models – Real Time Languages – RTOS Tasks – RT scheduling - Interrupt processing – Synchronization – Control Blocks – Memory Requirements.

UNIT IV REAL TIME KERNEL

6

Principles – Design issues – Polled Loop Systems – RTOS Porting to a Target – Comparison and Basic study of various RTOS like – VX works – Linux supportive RTOS – C Executive.

UNIT V RTOS APPLICATION DOMAINS

9

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

TOTAL : 45 PERIODS

REFERENCES:

1. Silberschatz, Galvin, Gagne” Operating System Concepts, 6th ed, John Wiley, 2003
2. D.M.Dhamdhare,” Operating Systems, A Concept-Based Approach, TMH, 2008
3. Raj Kamal, “Embedded Systems- Architecture, Programming and Design” Tata McGraw Hill, 2006.
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”, PHI 1999.
8. Mukesh Sigal and N G Shi “Advanced Concepts in Operating System”, McGraw Hill 2000.

AP7001 COMPUTER ARCHITECTURE AND PARALLEL PROCESSING

L T P C
3 0 0 3

OBJECTIVES

- To expose the students to the fundamentals of interaction of OS with a computer and User computation.
- To teach the fundamental Parallel Processing.
- To study on networking for memory
- To compare types and Functionalities in commercial OS
- To discuss the parallel models development using software

UNIT I THEORY OF PARALLELISM

9

Parallel Computer models – the state of computing, Multiprocessors and Multicomputers and Multivectors and SIMD computers, PRAM and VLSI models, Architectural development tracks, Program and network properties – Conditions of parallelism.

UNIT II PARTITIONING AND SCHEDULING

9

Program partitioning and scheduling, Program flow mechanisms, System interconnect architectures, Principles of scalable performance – performance matrices and measures, Parallel processing applications, speedup performance laws, scalability analysis and approaches.

UNIT III HARDWARE TECHNOLOGIES

9

Processor and memory hierarchy advanced processor technology, superscalar and vector processors, memory hierarchy technology, virtual memory technology, bus cache and shared memory – backplane bus systems, cache memory organizations, shared memory organizations, sequential and weak consistency models.

UNIT IV PIPELINING AND SUPERSCALAR TECHNOLOGIES

9

Parallel and scalable architectures, Multiprocessor and Multicomputers, Multivector and SIMD computers, Scalable, Multithreaded and data flow architectures.

UNIT V SOFTWARE AND PARALLEL PROCESSING

9

Parallel models, Languages and compilers, Parallel program development and environments, UNIX, MACH and OSF/1 for parallel computers.

TOTAL : 45 PERIODS

REFERENCES:

1. Kai Hwang "Advanced Computer Architecture". McGraw Hill International 2001.
2. Dezso Sima, Terence Fountain, Peter Kacsuk, "Advanced computer Architecture – A design Space Approach". Pearson Education, 2003.
3. Carl Homacher, Zvonko Vranesic, Sefwat Zaky, "Computer Organisation", 5th Edition, TMH, 2002.
4. David E. Culler, Jaswinder Pal Singh with Anoop Gupta "Parallel Computer Architecture", Elsevier, 2004.
5. John P. Shen. "Modern processor design Fundamentals of super scalar processors", Tata McGraw Hill 2003.
6. Sajjan G. Shiva "Advanced Computer Architecture", Taylor & Francis, 2008.
7. V.Rajaraman, C.Siva Ram Murthy, "Parallel Computers- Architecture and Programming", Prentice Hall India, 2008.
8. John L. Hennessy, David A. Petterson, "Computer Architecture: A Quantitative Approach", 4th Edition, Elsevier, 2007.
9. Harry F. Jordan Gita Alaghaband, "Fundamentals of Parallel Processing". Pearson Education, 2003.
10. Richard Y. Kain, "Advanced computer architecture – A system Design Approach", PHI, 2003.

ET7003

DESIGN OF EMBEDDED CONTROL SYSTEMS

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

OBJECTIVES

- To expose the students to the fundamentals of Embedded System Blocks
- To teach the fundamental RTOS.
- To study on interfacing for processor communication
- To compare types and Functionalities in commercial software tools
- To discuss the Applications development using interfacing

UNIT I EMBEDDED SYSTEM ORGANIZATION

9

Embedded computing – characteristics of embedded computing applications – embedded system design challenges; Build process of Realtime Embedded system – Selection of processor; Memory; I/O devices-Rs-485, MODEM, Bus Communication system using I²C, CAN, USB buses, 8 bit –ISA, EISA bus;

UNIT II REAL-TIME OPERATING SYSTEM

9

Introduction to RTOS; RTOS- Inter Process communication, Interrupt driven Input and Output - Nonmaskable interrupt, Software interrupt; Thread – Single, Multithread concept; Multitasking Semaphores.

UNIT III INTERFACE WITH COMMUNICATION PROTOCOL

9

Design methodologies and tools – design flows – designing hardware and software Interface . – system integration; SPI, High speed data acquisition and interface-SPI read/write protocol, RTC interfacing and programming;

UNIT IV DESIGN OF SOFTWARE FOR EMBEDDED CONTROL

9

Software abstraction using Mealy-Moore FSM controller, Layered software development, Basic concepts of developing device driver – SCI – Software - interfacing & porting using standard C & C++ ; Functional and performance Debugging with benchmarking Real-time system software – Survey on basics of contemporary RTOS – VXWorks, UC/OS-II

UNIT V CASE STUDIES WITH EMBEDDED CONTROLLER

9

Programmable interface with A/D & D/A interface; Digital voltmeter, control- Robot system; - PWM motor speed controller, serial communication interface.

TOTAL : 45 PERIODS

REFERENCES:

1. Steven F. Barrett, Daniel J. Pack, "Embedded Systems – Design and Applications with the 68HC 12 and HCS12", Pearson Education, 2008.
2. Raj Kamal, "Embedded Systems- Architecture, Programming and Design" Tata McGraw Hill, 2006.
3. Micheal Khevi, "The M68HC11 Microcontroller application in control, Instrumentation & Communication", PH NewJersy, 1997.
4. Chattopadhyay, "Embedded System Design", PHI Learning, 2011.
5. Muhammad Ali Mazidi, Rolin D. Mckinlay, Danny Causey, "PIC Microcontroller and Embedded Systems- Using Assembly and C for PIC18", Pearson Education, 2008.
6. Steven F. Barrett, Daniel J. Pack, "Embedded Systems- Design & Application with the 68HC12 & HCS12", Pearson Education, 2008.
7. Daniel W. Lewis, "Fundamentals of Embedded Software", Prentice Hall India, 2004.
8. Jack R Smith "Programming the PIC microcontroller with MBasic" Elsevier, 2007.
Keneth J. Ayala, "The 8086 Microprocessor: Programming & Interfacing the PC", Thomson India edition,

OBJECTIVES

- To give an insight to the students about the significance of VHDL Programming
- To teach the importance and architectural modelling of programmable logic devices.
- To introduce the construction and design programming
- To teach the basic VLSI design configurations
- To study the Logic synthesis and simulation of digital system with PLD.

UNIT I VHDL FUNDAMENTALS 9

Fundamental concepts- Modeling digital system-Domain and levels of modeling-modeling 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 9

Arrays- unconstrained array types-array operations and referencing- records - Access Types- Abstract Data 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 9

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. 9

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 9

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

TOTAL : 45 PERIODS**REFERENCES**

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 modeling of Digital Systems", McGraw Hill international Editions, Second Editions, 1998.
3. Charles H Roth, Jr. "Digital system Design using VHDL", Thomson ,2006.
4. Douglas Perry, "VHDL Programming by Example", Tata McGraw Hill,4th Edition 2002.

5. Navabi.Z., "VHDL Analysis and Modeling 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.

ET7005

ADHOC NETWORKS

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

OBJECTIVES

- To expose the students to the fundamentals of wireless communication technologies.
- To teach the fundamentals of wireless network routing protocols
- To study on wireless issues in network layers topologies
- To introduce energy management in network routing protocols
- To study the basis of performance metrics for N/W communication technologies

UNIT I WIRELESS LAN, PAN, WAN AND MAN

9

Characteristics of wireless channel, Fundamentals of WLANs, IEEE 802.11 standard, HIPERLAN Standard, First-, Second-, and third- generation cellular systems, WLL, Wireless ATM, IEEE 802.16 standard, HIPERACCESS, AdHoc Wireless Internet.

UNIT II MAC, ROUTING AND MULTICAST ROUTING PROTOCOLS

9

MAC Protocols: Design issues, goals and classification, Contention –based protocols with reservation and scheduling mechanisms, Protocols using directional antennas. Routing protocols: Design issues and classification, Table-driven, On-demand and Hybrid routing protocols, Routing protocols with efficient flooding mechanisms, Hierarchical and power-aware routing protocols. Multicast Routing Protocols: Design issues and operation, Architecture reference model, classification, Tree-based and Mesh-based protocols, Energy-efficient multicasting.

UNIT III TRANSPORT LAYER AND SECURITY PROTOCOLS

9

Transport layer Protocol: Design issues, goals and classification, TCP over AdHoc wireless Networks, Security, Security requirements, Issues and challenges in security provisioning, Network security attacks, Security routing.

Quality of Service: Issues and challenges in providing QoS, Classification of QoS solutions, MAC layer solutions, Network layer solutions, QoS frameworks.

UNIT IV ENERGY MANAGEMENT

9

Need, classification of battery management schemes, Transmission power management schemes, System power management schemes.

Wireless Sensor Networks: Architecture, Data dissemination, Data gathering, MAC protocols, location discovery, Quality of a sensor network.

UNIT V PERFORMANCE ANALYSIS**9**

ABR beaconing, Performance parameters, Route-discovery time, End-to-end delay performance, Communication throughput performance, Packet loss performance, Route reconfiguration/repair time, TCP/IP based applications.

TOTAL : 45 PERIODS**REFERENCES**

1. C. Siva Ram Murthy and B.S. Manoj, AdHoc Wireless Networks: Architectures and protocols, Prentice Hall PTR, 2004
2. C.-K.Toth, AdHoc Mobile Wireless Networks: Protocols and Systems, Prentice Hall PTR, 2001
3. Mohammad Ilyas, The Handbook of AdHoc Wireless Networks, CRC press, 2002
4. Charles E. Perkins, AdHoc Networking, Addison – Wesley, 2000
5. Stefano Basagni, Marco Conti, Silvia Giordano and Ivan Stojmenovic, Mobile AdHoc Networking, Wiley – IEEE press, 2004.

ET7006**ADVANCED DIGITAL SIGNAL PROCESSING****L T P C
3 0 0 3****OBJECTIVES**

- To expose the students to the fundamentals of digital signal processing in frequency domain & its application
- To teach the fundamentals of digital signal processing in time-frequency domain & its application
- To compare Architectures & features of Programmable DSPprocessors
- To discuss on Application development with commercial family of DSP Processors
- To design & develop logical functions of DSPprocessors with Re-Programmable logics & Devices

UNIT I INTRODUCTION TO DIGITAL SIGNAL PROCESSING**12**

Introduction, A Digital Signal-Processing System, The Sampling Process, Discrete Time Sequences, Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Linear Time-Invariant Systems, Decimation and Interpolation, Digital Filters, FIR Filters, IIR Filters.

UNIT II WAVELET TRANSFORM**6**

Introduction to continuous wavelet transform- discrete wavelet transform -orthogonal wavelet decomposition- Multiresolution Analysis-Wavelet function-DWT,bases,orthogonal Basis-Scaling function, Wavelet coefficients- ortho normal wavelets and their relationship to filter banks- Digital filtering interpolation (i) Decomposition filters, (ii) reconstruction, the signal- Example MRA- Haar & Daubechies wavelet.

UNIT III ARCHITECTURES OF COMMERCIAL DIGITAL SIGNAL PROCESSORS**12**

Introduction, categorisation of DSP Processors, Fixed Point (Blackfin), Floating Point (SHARC), TI TMS 320c6xxx & OMAP processors TMS320C54X & 54xx on Basic Architecture – comparison : of functional variations of Computational building blocks, MAC, Bus Architecture and memory, Data Addressing, Parallelism and pipelining, Parallel I/O interface, Memory

Interface, Interrupt, DMA (one example Architecture in each of these case studies).

UNIT IV INTERFACING I/O PERIPHERALS FOR DSP BASED APPLICATIONS 6

Introduction, External Bus Interfacing Signals, Memory Interface, Parallel I/O Interface, Programmed I/O, Interrupts and I / O Direct Memory Access (DMA).-Introduction, Design of Decimation and Interpolation Filter, FFT Algorithm, PID Controller ,Application for Serial Interfacing, DSP based Power Meter, Position control , CODEC Interface .

UNIT V VLSI IMPLEMENTATION 9

Low power Design-need for Low power VLSI chips-Basics of DSP system architecture design using VHDL programming, Mapping of DSP algorithm onto hardware, Realisation of MAC & Filter structure.

TOTAL : 45 PERIODS

REFERENCES:

1. John G. Proakis, Dimitris G. Manolakis, "Digital Signal Processing", Pearson Education 2002.
2. Avatar Sing, S. Srinivasan, "Digital Signal Processing- Implementation using DSP Microprocessors with Examples from TMS320C54xx", Thomson India,2004.
3. Lars Wanhammer, "DSP Integrated Circuits", Academic press, 1999,NewYork.
4. Lyla B Das," Embedded Systems-An Integrated Approach",Pearson2013
5. Ashok Ambardar,"Digital Signal Processing: A Modern Introduction",Thomson India edition, 2007.
6. Raghuvveer M.Rao and Ajit S. Bapardikar, Wavelet transforms- Introduction to theory and applications, Pearson Education, 2000.
7. K.P. Soman and K.L. Ramchandran,Insight into WAVELETS from theory to practice, Eastern Economy Edition, 2008
8. Ifeachor E. C., Jervis B. W , "Digital Signal Processing: A practical approach, Pearson-Education, PHI/ 2002
9. B Venkataramani and M Bhaskar "Digital Signal Processors", TMH, 2nd, 2010
10. Peter Pirsch "Architectures for Digital Signal Processing", John Weily, 2007
11. Vinay K.Ingle,John G.Proakis,"DSP-A Matlab Based Approach",Cengage Learning,2010
12. Taan S.Elali,"Discrete Systems and Digital Signal Processing with Matlab",CRC Press2009.

OBJECTIVES

- To expose the concepts of feed forward neural networks.
- To provide adequate knowledge about feed back neural networks.
- To teach about the concept of fuzziness involved in various systems.
- To expose the ideas about genetic algorithm
- To provide adequate knowledge about of FLC and NN toolbox

UNIT I INTRODUCTION AND ARTIFICIAL NEURAL NETWORKS 9

Introduction of soft computing - soft computing vs. hard computing- various types of soft computing techniques- applications of soft computing-Neuron- Nerve structure and synapse- Artificial Neuron and its model- activation functions- Neural network architecture- single layer and multilayer feed forward networks- McCullochPitts neuron model- perceptron model- Adaline and Madaline- multilayer perception model- back propogation learning methods- effect of learning rule coefficient -back propagation algorithm- factors affecting back propagation training- applications.

UNIT II ARTIFICIAL NEURAL NETWORKS 9

Counter propagation network- architecture- functioning & characteristics of counter- Propagation network-Hopfield/ Recurrent network- configuration- stability constraints-associative memory- and characteristics- limitations and applications- Hopfield v/s Boltzman machine- Adaptive Resonance Theory- Architecture- classifications-Implementation and training-Associative Memory.

UNIT III FUZZY LOGIC SYSTEM 9

Introduction to crisp sets and fuzzy sets- basic fuzzy set operation and approximate reasoning. Introduction to fuzzy logic modeling and control- Fuzzification- inferencingand defuzzification- Fuzzy knowledge and rule bases-Fuzzy modeling and control schemes for nonlinear systems. Self organizing fuzzy logic control- Fuzzy logic control for nonlinear time delay system.

UNIT IV GENETIC ALGORITHM 9

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 and ant colony search techniques for solving optimization problems.

UNIT V APPLICATIONS 9

GA application to power system optimization problem- Case studies: Identification and control of linear and nonlinear dynamic systems using Matlab-Neural Network toolbox. Stability analysis of Neural Network interconnection systems- Implementation of fuzzy logic controller using Matlab fuzzy logic toolbox-Stability analysis of fuzzy control systems.

TOTAL : 45 PERIODS

REFERENCES

- 1.. Laurene V. Fausett, Fundamentals of Neural Networks: Architectures, Algorithms And Applications, Pearson Education,
2. Timothy J. Ross, "Fuzzy Logic with Engineering Applications" Wiley India.
3. Zimmermann H.J. "Fuzzy set theoryand its Applications" Springer international edition, 2011.
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.

ET7007 RISC PROCESSOR ARCHITECTURE AND PROGRAMMING

L T P C
3 0 0 3

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 memeroy management in RISC processor
- To teach the application development with ARM processor

UNIT I AVR MICROCONTROLLER ARCHITECTURE

9

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

UNIT II ARM ARCHITECTURE AND PROGRAMMING

9

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

UNIT III ARM APPLICATION DEVELOPMENT

9

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

9

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

9

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

TOTAL : 45 PERIODS

REFERENCES

1. Steve Furber, 'ARM system on chip architecture', Addison 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.
5. ARM Architecture Reference Manual
6. LPC213x User Manual
7. R. Barnett , L. O' CULL and S. Cox " Embedded C Programming and Atmel AVR", Delmar Cengage Learning, India Edition , 2009.

ET7008

ADVANCED EMBEDDED SYSTEMS

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

OBJECTIVES

- *To teach the* Fundamentals on design attributes of functional units of a Processor
- To discuss on Hardware software partitioning in system design
- To teach intra & Inter processor Communications
- To discuss strategies for processor Communications
- To discuss on Co-Designs

UNIT I INTRODUCTION TO EMBEDDED HARDWARE AND SOFTWARE 9

Terminology – Gates – Timing diagram – Memory – Microprocessor buses – Direct memory access – Interrupts – Built interrupts – Interrupts basis – Shared data problems – Interrupt latency - Embedded system evolution trends – Interrupt routines in an RTOS environment .

UNIT II SYSTEM MODELLING WITH HARDWARE/SOFTWARE PARTITIONING 9

Embedded systems, Hardware/Software Co-Design, Co-Design for System Specification and modelling- Single-processor Architectures&,Multi-ProcessorArchitectures, comparison of Co-Design Approaches, Models of Computation, Requirements for Embedded System Specification, Hardware/Software Partitioning Problem, Hardware/Software Cost Estimation, Generation of Partitioning by Graphical modelling, Formulation of the HW/SW scheduling, Optimization.

UNIT III HARDWARE/SOFTWARE CO-SYNTHESIS 9

The Co-Synthesis Problem, State-Transition Graph, Refinement and Controller Generation, Distributed System Co-Synthesis.

UNIT IV MEMORY AND INTERFACING 9

Memory: Memory write ability and storage performance – Memory types – composing memory – Advance RAM interfacing communication basic – Microprocessor interfacing I/O addressing – Interrupts – Direct memory access – Arbitration multilevel bus architecture – Serial protocol – Parallel protocols – Wireless protocols – Digital camera example.

UNIT V CONCURRENT PROCESS MODELS AND HARDWARE SOFTWARE CO-DESIGN

9

Modes of operation – Finite state machines – Models – HCFSL and state charts language – state machine models – Concurrent process model – Concurrent process – Communication among process –Synchronization among process – Implementation – Data Flow model. Design technology – Automation synthesis – Hardware software co-simulation – IP cores – Design Process Model.

TOTAL : 45 PERIODS

REFERENCES

1. David. E. Simon, "An Embedded Software Primer", Pearson Education, 2001.
2. Tammy Noergaard, "Embedded System Architecture, A comprehensive Guide for Engineers and Programmers", Elsevier, 2006
3. Raj Kamal, "Embedded Systems- Architecture, Programming and Design" Tata McGraw Hill, 2006.
4. Frank Vahid and Tony Gwargie, "Embedded System Design", John Wiley & sons, 2002.
5. Steve Heath, "Embedded System Design", Elsevier, Second Edition, 2004.
6. Ralf Niemann, "Hardware/Software Co-Design for Data Flow Dominated Embedded Systems", Kluwer Academic Pub, 1998.
7. Jorgen Staunstrup, Wayne Wolf, "Harware/Software Co-Design:Principles and Practice", Kluwer Academic Pub, 1997.
8. Giovanni De Micheli, Rolf Ernst Morgon, "Reading in Hardware/Software Co-Design" Kaufmann Publishers, 2001.

OBJECTIVES

- To expose the students to the fundamentals of wireless sensor technology
- To teach the infrastructure of WSN processor and its functions
- To study on challenges in Network communication
- To discuss on interconnectivity of networks
- To study the classification of commercial family of wireless technology

UNIT I OVERVIEW OF WIRELESS SENSOR NETWORKS**12**

Challenges for Wireless Sensor Networks- Characteristic requirements for WSN - Challenges for WSNs – WSN vs Adhoc Networks - Sensor node architecture – Commercially available sensor nodes –Imote, IRIS, Mica Mote, TelosB,-Physical layer and transceiver design considerations in WSNs, introduction to fundamentals of MAC protocols - Low duty cycle protocols and wakeup concepts - Contention-based protocols - Schedule-based protocols -the IEEE 802.15.4 MAC protocol- Energy usage profile, Choice of modulation scheme, Dynamic modulation scaling, Antenna considerations-Applications of sensor networks

UNIT II ISSUES IN PERVASIVE SENSOR NETWORK**9**

Single-Node Architecture - Hardware Components, constraints & challenges in resources- Energy Consumption of Sensor Nodes, Operating Systems for Wireless Sensor Networks – Introduction - Operating System Design Issues - Examples of Operating Systems – TinyOS, Network Architecture -Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts. Data Dissemination-Flooding and Gossiping-Data gathering Sensor Network Scenarios –Optimization, Goals and Figures of Merit – Design Principles for WSNs- Gateway Concepts – Need for gateway

UNIT III PERVASIVE NETWORKING & COMPUTING**12**

Introduction, Networking Infrastructure and Architecture of PERV NET, Mobility management, service discovery, disconnected operation, Dynamic configuration, auto registration, content based routing, Backbone Technology: Electrical Backbone Networks – Optical Backbone Networks – Wireless Backbone Networks – Wireless Access Technology - Pervasive Web Application architecture- Access from PCs and PDAs - Access via WAP

UNIT IV PERVASIVE DEVICES**6**

Introduction with Case study of - PDA - Mobile Phone:Elements – Mobile Information Architecture - Mobile Phone Design - Android Overview – The Stack – Android User Interface – Preferences, the File System, the Options Menu and Intents.

UNIT V EMERGING WIRELESS TECHNOLOGIES**6**

Evolution and Deployment of Cellular Telephone Systems – 1G, 2G, 2.5G, 3G, 4G. Introduction to wireless LAN, Wireless PAN, Wireless MAN, Broadband Satellite and Microwave Systems – Emerging Wireless Technologies – IEEE 802.20 Mobile Broadband Wireless Access.

TOTAL : 45 PERIODS

REFERENCES

1. Debashis saha, Amitava mukherjee ,”Networking Infrastructure for Pervasive Computing, Springer International edition, 2011 (unit 3)
2. Mullet,”Introduction to wireless telecommunications systems and networks”, cengage learning, 2010 (unit 5)
3. Frank Adelstein, Sandeep K S Gupta, Golden G Richard III, Loren Schwiebert, “Fundamentals of mobile and pervasive computing, TMH, 2007.
4. Brian Fling,”Mobile Design & Development,O’Reilly,2011 (unit 4)
5. Marko Gargenta,”Learning Android”, O’Reilly,2011 (unit 4)
6. Holger Karl & Andreas Willig, “Protocols and Architectures for Wireless Sensor Networks” , John Wiley, 2005.
7. Feng Zhao & Leonidas J. Guibas, “Wireless Sensor Networks- An Information Processing Approach”, Elsevier, 2007.
8. Kazem Sohraby, Daniel Minoli and Taieb Znati, “ Wireless Sensor Networks Technology, Protocols, and Applications“, John Wiley & Sons, 2007.’
9. C.Britton Rorabaugh,”Simulating Wireless Communication Systems-Practical Models in C++”,Pearson Edu,2006.
10. Mohammad Ilyas And Imad Mahgaob,”Handbook Of Sensor Networks: Compact Wireless And Wired Sensing Systems”, CRC Press,2005
11. K. Akkaya and M. Younis, “A survey of routing protocols in wireless sensor networks”, Elsevier Ad Hoc Network Journal, Vol. 3, no. 3, pp. 325--349, 2005.
12. Philip Levis, “ TinyOS Programming”,2006 – www.tinyos.net
13. Anna Ha’c, “Wireless Sensor Network Designs”, John Wiley & Sons Ltd, 2003.

ET7010

CRYPTOGRAPHY AND NETWORK SECURITY

L T P C
3 0 0 3

Pre-requisites:Basics of Signal Processing, Mathematics of Transforms, microcontroller

OBJECTIVES

- To expose the students to the fundamentals of data security.
- To teach the fundamentals of mathematical aspects in creating Encryption keys
- To teach the fundamentals of Security in data communication.
- To teach the fundamentals of Secured system operation.
- To teach the fundamentals of Security in wireless communication.

UNIT I SYMMETRIC CIPHERS

9

Overview – classical Encryption Techniques – Block Ciphers and the Data Encryption standard – Introduction to Finite Fields – Advanced Encryption standard – Contemporary Symmetric Ciphers – Confidentiality using Symmetric Encryption.

UNIT II PUBLIC-KEY ENCRYPTION AND HASH FUNCTIONS

9

Introduction to Number Theory – Public-Key Cryptography and RSA – Key Management – Diffie-Hellman Key Exchange – Elliptic Curve Cryptography – Message Authentication and Hash Functions – Hash Algorithms – Digital Signatures and Authentication Protocols.

UNIT III NETWORK SECURITY PRACTICE **9**
Authentication Applications – Kerberos – X.509 Authentication Service – Electronic mail Security – Pretty Good Privacy – S/MIME – IP Security architecture – Authentication Header – Encapsulating Security Payload – Key Management.

UNIT IV SYSTEM SECURITY **9**
Intruders – Intrusion Detection – Password Management – Malicious Software – Firewalls – Firewall Design Principles – Trusted Systems.

UNIT V WIRELESS SECURITY **9**
Introduction to Wireless LAN Security Standards – Wireless LAN Security Factors and Issues.

TOTAL : 45 PERIODS

TEXT BOOKS

1. William Stallings, “Cryptography And Network Security – Principles And Practices”, Pearson Education, 3rd Edition, 2003.

REFERENCES

1. Atul Kahate, “Cryptography and Network Security”, Tata McGraw Hill, 2003.
2. Bruce Schneier, “Applied Cryptography”, John Wiley and Sons Inc, 2001.
3. Stewart S. Miller, “Wi-Fi Security”, McGraw Hill, 2003.
Charles B. Pfleeger, Shari Lawrence Pfleeger, “Security In Computing”, 3rd Edition, Pearson Education, 2003.
5. Mai, “Modern Cryptography: Theory and Practice”, First Edition, Pearson Education, 2003.

ET7011 SMART METER AND SMART GRID COMMUNICATION L T P C
3 0 0 3

Pre-requisites: Basics in Instrumentation, Power system and communication

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 **9**

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 **9**

Smart metering-Smart Meters types- hardware architecture- software architecture-requirements- communication protocols- Real Time Pricing, Smart Appliances, Automatic

Meter Reading- MEMS, Smart Sensors- Smart actuators- Advanced metering infrastructure- spectrum analyzer.

UNIT III SMART GRID AND APPLICATIONS 9

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 9

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 9

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.

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. McGranahan, 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.

REFERENCES:

1. Dietel & Dietel, "JAVA how to program", Prentice Hall 1999.
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.

CL7004

ROBOTICS AND CONTROL

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

OBJECTIVES

- To introduce robot terminologies and robotic sensors
- To educate direct and inverse kinematic relations
- To educate on formulation of manipulator Jacobians and introduce path planning techniques
- To educate on robot dynamics
- To introduce robot control techniques

UNIT I INTRODUCTION AND TERMINOLOGIES: 9

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- vision system-social issues

UNIT II KINEMATICS 9

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

UNIT III DIFFERENTIAL MOTION AND PATH PLANNING 9

Jacobian-differential motion of frames-Interpretation-calculation of Jacobian-Inverse Jacobian- Robot Path planning

UNIT IV DYNAMIC MODELLING 9

Lagrangian mechanics- Two-DOF manipulator- Lagrange-Euler formulation – Newton-Euler formulation – Inverse dynamics

UNIT V ROBOT CONTROL SYSTEM 9

Linear control schemes- joint actuators- decentralized PID control- computed torque control – force control- hybrid position force control- Impedance/ Torque control.

TOTAL : 45 PERIODS

REFERENCES

1. R.K. Mittal and I J Nagrath, " Robotics and Control", Tata MacGrawHill, Fourth Reprint 2003.

2. Saeed B. Niku , "Introduction to Robotics " , Pearson Education, 2002
3. Fu, Gonzalez and Lee Mcgrahill , "Robotics " , international
4. R.D. Klafter, TA Chmielewski and Michael Negin, "Robotic Engineering, An Integrated approach", Prentice Hall of India, 2003.
5. Reza N.Jazar, Theory of Applied Robotics Kinematics, Dynamics and Control, Springer, Fist Indian Reprint 2010.

ET7014

APPLICATION OF MEMS TECHNOLOGY

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

PRE-REQUISITES: Basic Instrumentation ,Material Science, Programming

OBJECTIVES

- To teach the students properties of materials, microstructure and fabrication methods.
- To teach the design and modeling of Electrostatic sensors and actuators.
- To teach the characterizing thermal sensors and actuators through design and modeling
- To teach the fundamentals of piezoelectric sensors and actuators
- To give exposure to different MEMS and NEMS devices.

UNIT I MEMS:MICRO-FABRICATION, MATERIALS AND ELECTRO-MECHANICAL CONEPTS 9

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 9

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

UNIT III THERMAL SENSING AND ACTUATION 9

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

UNIT IV PIEZOELECTRIC SENSING AND ACTUATION 9

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

UNIT V CASE STUDIES 9

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

TOTAL : 45 PERIODS

REFERENCES

1. Chang Liu, “Foundations of MEMS”, Pearson International Edition, 2006.
2. Marc Madou , “Fundamentals of microfabrication”,CRC Press, 1997.
3. Boston , “Micromachined Transducers Sourcebook”,WCB McGraw Hill, 1998.

