RAJALAKSHMI ENGINEERING COLLEGE
(AN AUTONOMOUS INSTITUTION AFFILIATED TO ANNA UNIVERSITY)

M.E. EMBEDDED SYSTEM TECHNOLOGIES
CHOICE BASED CREDIT SYSTEM

CURRICULUM I TO IV SEMESTERS

SEMESTER I

Sl.No	CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	MA17174	Applied Mathematics for Electrical	FC	5	3	2	0	4
2	ET17101	Real Time Systems	PC	3	3	0	0	3
3	ET17102	Advanced Digital System Design	PC	3	3	0	0	3
4	ET17103	Microcontroller Based System Design	PC	3	3	0	0	3
5	ET17104	Design of Embedded Systems	PC	3	3	0	0	3
6	ET17E--	Professional Elective- I	PE	3	3	0	0	3
PRACTICAL								
7	ET17111	Embedded System Laboratory I	PC	4	0	0	4	2
		TOTAL		**24**	**18**	**2**	**4**	**21**

SEMESTER II

Sl.No	CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	ET17201	VLSI Architecture and Design Methodologies	PC	3	3	0	0	3
2	ET17202	Embedded Networking	PC	5	3	2	0	4
3	ET17203	Wireless and Mobile Communication	PC	3	3	0	0	3
4	ET17204	Software for Embedded Systems	PC	3	3	0	0	3
5	ET17E--	Professional Elective- II	PE	3	3	0	0	3
6	ET17E--	Professional Elective- III	PE	3	3	0	0	3
PRACTICAL								
7	ET17211	Embedded System Laboratory II	PC	4	0	0	4	2

TOTAL		**24**	**18**	**2**	**4**	**21**

SEMESTER III

Sl.No	CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	ET17E--	Professional Elective–IV	PE	3	3	0	0	3
2	ET17E--	Professional Elective–V	PE	3	3	0	0	3
3	ET17E--	Professional Elective–VI	PE	3	3	0	0	3
PRACTICAL								
4	ET17311	Project Work (Phase I)	EEC	12	0	0	12	6
5	ET17312	IOT Applications for Embedded Systems	EEC	4	0	0	4	2
TOTAL				**25**	**9**	**0**	**16**	**17**

SEMESTER IV

S.No	CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
PRACTICALS								
1	ET7411	Project Work (Phase II)	EEC	24	0	0	24	12
TOTAL				**24**	**0**	**0**	**24**	**12**

TOTAL NUMBER OF CREDITS=71

SEMESTER I
ELECTIVE I

S.No	CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
THEORY							
1	ET17E11	Digital Instrumentation	3	3	0	0	3
2	ET17E12	Real Time Operating Systems	3	3	0	0	3
3	ET17E13	Parallel Processing Architecture	3	3	0	0	3

SEMESTER II
ELECTIVE II & III

4	ET17E21	Design of Embedded Control Systems	3	3	0	0	3
5	ET17E22	Programming with VHDL	3	3	0	0	3
6	ET17E23	Adhoc Networks	3	3	0	0	3
7	ET17E24	Advanced Digital Signal Processing	3	3	0	0	3
8	PX17E25	Soft Computing Techniques	3	3	0	0	3
9	ET17E26	RISC Processor Architecture and Programming	3	3	0	0	3

SEMESTER III
ELECTIVE IV,V & VI

10	ET17E31	Advanced Embedded Systems	3	3	0	0	3
11	ET17E32	Pervasive Devices and Technology	3	3	0	0	3
12	ET17E33	Cryptography and Network Security	3	3	0	0	3
13	ET17E34	Smart Meter and Smart Grid Communication	3	3	0	0	3
14	ET17E35	Computer in Networking and Digital Control	3	3	0	0	3
15	ET17E36	Distributed Embedded Computing	3	3	0	0	3
16	ET17E37	Robotics and Control	3	3	0	0	3
17	ET17E38	Application of MEMS Technology	3	3	0	0	3
18	ET17E39	Digital Image Processing and Applications	3	3	0	0	3

SEMESTER-I

MA 17174 APPLIED MATHEMATICS FOR ELECTRICAL ENGINEERS L T P C
3 2 0 4

COURSE 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 15

The Cholesky decomposition - generalized Eigen vectors, canonical basis - QR factorization - least squares method - singular value decomposition.

UNIT II CALCULUS OF VARIATIONS 15

Concept of variation and its properties – Euler's equation – functional dependent on first and higher order derivatives – functional dependent 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 15

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 15

Formulation – graphical solution – simplex method – two phase method - transportation and assignment models

UNIT V FOURIER SERIES 15

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.

TOTAL: 75 PERIODS

OUTCOMES:

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

- analyze and solve system of equations using the techniques of matrix decomposition and least square sense.
- use the concept of MGF and probability distribution for solving problems that arise from time to time.
- make decisions using the principles of optimality on the problems of dimensionality.
- use Calculus of variations to solve variation problems arising in Engineering applications

- use generalized Fourier series in solving problems in Sturm-Liouville systems.

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. Grewal, B.S., Higher Engineering Mathematics, 42nd edition, Khanna Publishers, 2012.
4. O'Neil, P.V., Advanced Engineering Mathematics, Thomson Asia Pvt. Ltd., Singapore, 2003.
5. Johnson R. A. and Gupta C. B., "Miller & Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 7th Edition, 2007.
6. Oliver C. Ibe, "Fundamentals of Applied Probability and Random Processes, Academic Press, (An imprint of Elsevier), 2010.
7. Elsgolts, L., Differential Equations and the Calculus of Variations, MIR Publishers, Moscow,1973.
8. Andrews L.C. and Phillips R.L., Mathematical Techniques for Engineers and Scientists, Prentice Hall of India Pvt. Ltd., New Delhi, 2005.
9. Taha, H.A., "Operations Research, An introduction"**,** 10th edition, Pearson education, New Delhi, 2010

ET17101 REAL TIME SYSTEMS L T P C
3 0 0 3

COURSE 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

OUTCOMES:

At the end of the course the student will be able to:

- realise the process delivers insight into scheduling and computational processes with improved design strategies.
- realise the process delivers insight into disciplining various embedded design strategies
- improve Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in real-time systems design.
- improve Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in real-time systems design.
- analyse the process delivers insight into automated process with improved design strategies.

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

ET17102 ADVANCED DIGITAL SYSTEM DESIGN LT P C
3 0 0 3

COURSE 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/O blocks, 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

OUTCOMES:

At the end of the course the student will be able to:

- analyze the process delivers insight into incorporating switching logics, with improved design strategies.
- synthesize theError free circuitry design of computation logics of processors.

- obtain the processor scheduling algorithms of real time system
- improve Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in digital design for embedded systems.
- determine the process delivers insight into involving the capacities of a controllable of processes with improved design strategies.

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. 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.Oldfeild,Richard C.Dorf,"Field Programmable Gate Arrays",Wiley India Edition,2008

ET17103 MICROCONTROLLER BASED SYSTEM DESIGN L T P C
3 0 0 3

COURSE OBJECTIVES

- To teach 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 understand the Microchip PIC 8bit peripheral system Design
- To 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 – RTOS Lite – Full RTOS – Task creation and run – LCD digital clock/thermometer using Full RTOS

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, MICRO C Pro.

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 - sensor 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

OUTCOMES:

At the end of the course the student will be able to:

- analyze the process delivers insight into involving the capacities of a programmable microcontroller for system interface.
- design the automation of processes with improved design strategies.
- design on memory management, application development in PIC processor
- design, development and programming on software tools in micro controllers with peripheral interfaces.
- improve Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design

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 McGraw Hill 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

ET17104 DESIGN OF EMBEDDED SYSTEMS L T P C

3 0 0 3

COURSE 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

Bullet 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

OUTCOMES:

At the end of the course the student will be able to:

- analyze the process of delivers insight into scheduling and disciplining various computational processes with improved design strategies.
- analyze different EDLC Phases &Testing of embedded system
- synthesize the different in-circuit emulator for real time hardware
- determine aspects required in developing a new embedded processor, different Phases & modelling of embedded system
- improve Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design.

REFERENCES

1. James K.Peckol, "Embedded system Design",JohnWiley&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",Pearson2013
5. Arnold S. Berger – "Embedded System Design", CMP books, USA 2002.
6. ARKIN, R.C., Behaviour-based Robotics, The MIT Press, 1998.

ET17111 EMBEDDED SYSTEM LABORATORY I L T P C
0 0 4 2

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 Microcontrollers 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 Microcpontrollers 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 Microcontrollers 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 Microcontrollers 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	Microcontrollers 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

TOTAL: 60 PERIODS

SEMESTER-II

ET17201 VLSI ARCHITECTURE AND DESIGN METHODOLOGIES **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To give an insight to the students about the significance of CMOS technology
- 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-EPROM and EEPROM technology – Re-Programmable Devices Architecture- Function blocks, I/O blocks, Interconnects, Xilinx-XC9500,Cool Runner - XC-4000,XC5200, SPARTAN, Virtex - Altera MAX 7000-Flex 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.

TOTAL 45 PERIODS

OUTCOMES:

At the end of the course the student will be able to:

- analyze the process delivers insight into developing design logic/arithmetic functionalities of various embedded design strategies.
- analyze the computational arithmetic/logic functionalities evolvable in processors.
- determine the ASIC construction and design algorithms specific process.
- write the program for logic separation and simulation of digital system with Verilog HDL
- improve employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design.

REFERENCES:

1. M.J.S Smith, “Application Specific integrated circuits”,Addition Wesley Longman Inc.1997.
2. Kamran Eshraghian, Douglas A.pucknell and Sholeh Eshraghian,”Essentials of VLSI circuits and system”, Prentice Hall India,2005.
3. Wayne Wolf, “ Modern VLSI design “ Prentice Hall India,2006.
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.

ET17202 EMBEDDED NETWORKING L T P C
3 2 0 4

COURSE OBJECTIVES

- Serial communication protocols
- 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 15

Embedded Networking: Introduction – Serial/Parallel Communication – Serial communication protocols -RS232 standard – RS485 – Synchronous Serial Protocols -Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I^2C) – PC Parallel port programming -ISA/PCI Bus protocols - Firewire

UNIT II USB AND CAN BUS 15

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 15

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 15

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 15

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

TOTAL: 75 PERIODS

OUTCOMES:

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

- analyse the process delivers insight onto design of automation, communication systems through wired, wireless technology for monitoring and control of grid.
- evaluate the process delivers insight onto role of various communication standards applicable in automation
- data transfer and communication in systems like large industrial processes
- synthesize the instrument based internet protocol for CAN bus systems
- design attributes of functional units of network processes synthesize the sensor network

communication protocols

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

ET17203 WIRELESS AND MOBILE COMMUNICATION L T P C
3 0 0 3

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 – 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, Zigbee, 6LowPAN.

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 – WML scripts.

TOTAL : 45 PERIODS

OUTCOMES:

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

- deliver insight into categorizing various embedded & communication protocols for networking of distributed static & mobile systems.
- evaluate the wireless network routing protocols
- analyse the current and future cellular mobile communication systems
- determine the appropriate wireless standard for mobile routing
- provide improved eemployability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design

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.

ET17204 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 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

OUTCOMES:

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

- analyze the process delivers insight into various programming languages.
- design the compatible embedded process development with improved design & programming skills.
- synthesize the GNU C Programming Tool Chain in Linux
- design the time driven architecture for serial Interface with a case study
- 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. Stephen Kochan, "Programming in C", 3rd Edition, Sams Publishing, 2009.
3. Michael J Pont, "Embedded C", Pearson Education, 2007.
4. Zhiqun Chen, 'Java Card Technology for Smart Cards: Architecture and Programmer's Guide', Addison-Wesley Professional, 2000.

ET17211 EMBEDDED SYSTEM LABORATORY II L T P C
0 0 4 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 &	Fixed Point & Floating Point DSP	2 set each

	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 based	Processors With IDE, Board Support 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
5	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= 60 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

Subject Code	Subject Name	Category	L	T	P	C
ET17311	PROJECT WORK (PHASE I)	EEC	0	0	12	6

Course Objectives:

- To develop the ability to solve a specific problem right from the identification from the extensive literature review till the successful solution of the same.
- To train the student in preparing comprehensive project report

Students work on a topic approved by the head of the department and prepares a comprehensive project report after completing the work to the satisfaction. The progress of the project is evaluated based on a minimum of two reviews. The review committee may be constituted by the Head of the Department. A project report has to be submitted at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

Total Contact Hours	**:**	**180**

Course Outcomes:

- On Completion of the Phase-I project work, the students will be in a position to take up their Phase-II project work and find the solution by formulating the proper methodology.

ET17312 **IOT APPLICATION FOR EMBEDDED SYSTEMS** **L T P C**
0 0 4 2

COURSEOBJECTIVES:

- To implement the basic concepts of ARDUINO.
- To develop applications using ARDUINO.
- To understand fundamentals of programming such as variables, conditional and iterative Execution, methods etc.
- To develop applications using IoT concepts.
- To implement features of IoT to solve real world problems.

LIST OF EXPERIMENTS:

1. Interfacing and configuration of LED using digital pin of ARDUINO
2. Interfacing and configuration of Buzzer using digital pin of ARDUINO
3. Interfacing and configuration of switches using digital pin of ARDUINO
4. Interfacing of potentiometers using analog pin of ARDUINO
5. Interfacing of moisture, light, flame, temperature & humidity, IR, PIR, Gas, Piezo Vibration, and Sound sensor with ARDUINO
6. Interfacing of Actuators with ARDUINO

7. Interfacing of GSM withARDUINO
8. IoT using ARDUINO
9. Smart Irrigation System using IoT
10. Smart Water Monitoring using IoT
11. Smart Building using IoT
12. Automated Street Lighting using IoT
13. Temperature Monitor using IoT
14. Smart Irrigation System using GSM Modem.
15. Introduction to IoT using Raspberry Pi (interfacing with basic sensors and actuators)

OUTCOMES:

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

- apply the concepts of data acquisition system.
- discuss different programming structures to represent real world problems.
- acquire the concepts of Graphical User Interfaces.
- design various ways of algorithms to solve the problems
- Explain the principles of the internet of things.

SEMESTER IV

Subject Code	Subject Name	Category	L	T	P	C
ET17411	PROJECT WORK (PHASE II)	EEC	0	0	24	12

Course Objectives:

- To develop their own innovative prototype/algorithm for Embedded related application.
- To train the students in preparing the project reports and to face reviews and viva voce examination.

Students work on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report has to be submitted at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

Total Contact Hours	**:**	**360**

Course Outcomes:

- On Completion of the project work students will be in a position to take up any challenging practical problems and find the solution by formulating the proper methodology.

PROFESSIONAL ELECTIVES (PE)

SEMESTER-I

ET17E11 DIGITAL INSTRUMENTATION L T 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 discuss the case studies on industrial process measurements.

UNIT I DATA ACQUISITION SYSTEMS 9

Overview of A/D converter, types and characteristics – Sampling, Errors. Objective – Building blocks of Automation systems –Counters – Modes of operation- Frequency, Period, Time interval measurements, Prescaler, Heterodyne converter for frequency measurement, Single and Multi channel Data Acquisition systems.

UNIT II INTERFACING AND DATA TRANSMISSION 9

Data transmission systems – 8086 Microprocessor based system design – Peripheral Interfaces – Time Division Multiplexing (TDM) – Digital Modulation – Pulse Modulation – Pulse Code Format – Interface systems and standards – Communications.

UNIT III INSTRUMENTATION BUS 9

Introduction, Modem standards, Basic requirements of Instrument Bus standards, Bus communication, interrupt and data handshaking , Interoperability, interchangeability for RS-232, USB, RS-422, RS-485.

UNIT IV VIRTUAL INSTRUMENTATION 9

Block diagram and Architecture – Data flow techniques – Graphical programming using GUI – Real time Embedded system –Intelligent controller – Software and hardware simulation of I/O communication blocks-peripheral interface – ADC/DAC – Digital I/O – Counter , Timer.

UNIT V CASE STUDIES 9

PC based DAS, Data loggers, PC based industrial process measurements like flow, temperature, pressure and level development system, CRT interface and controller with monochrome and colour video display.

TOTAL : 45 PERIODS

OUTCOMES:

- Ability to understand the fundamentals building blocks of a digital instrument.
- Ability to understand the different methods of Data Transmission System.
- Acquire the concept of various instrumentation Bus.
- Acquire detail knowledge on building blocks of a "Virtual Instrumentation System.
- Acquire detail knowledge on industrial process measurements.

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.

ET17E12 REAL TIME OPERATING SYSTEMS L T 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.
- To discuss the application development using RTOS.

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 Premptive 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 9

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

OUTCOMES:

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

- distinguish a real-time system from other systems.
- identify the functions of operating system.
- evaluate the need for real-time operating system.
- implement the real-time operating system principles.
- design an application using RTOS

REFERENCES:

1. Silberschatz,Galvin,Gagne" Operating System Concepts,6th ed,John Wiley,2003
2. D.M.Dhamdhere," Operating Systems,A Concept-Based Approch,TMH,2008
3. Raj Kamal, "Embedded Systems- Architecture, Programming and Design" Tata McGraw Hill, 2006.
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.

ET17E13 PARALLEL PROCESSING ARCHITECTURE L T 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 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 TECHNOLGIES 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

OUTCOMES :

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

- realize the fundamentals of interaction of OS with a computer and User computation.
- analyse the fundamentals of Parallel Processing.
- design a network for memory organization
- compare and analyse functionalities in commercial OS
- analyse the parallel models development using software

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.

PROFESSIONAL ELECTIVES (PE)

SEMESTER-II

ET17E21 DESIGN OF EMBEDDED CONTROL SYSTEMS L T P C

3 0 0 3

COURSE 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 Real time Embedded system – Selection of processor; Memory; I/O devices-Rs-485, MODEM, Bus Communication system using I^2C, 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 – Non maskable 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

OUTCOMES :

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

- analyse the blocks of Embedded System
- realize working of RTOS.
- design an interfacing system for processor communication
- analyse and compare commercial software tools for real time application
- develop an applications using interfacing logic.

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,India edition,

ET17E22 PROGRAMMING WITH VHDL L T P C
3 0 0 3

COURSE 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 Date types- -basic modeling constructs-entity declarations-Architecture bodies-behavioral description-structural descriptions- design Processing, case study: A pipelined Multiplier accumulator.

UNIT III SUBPROGRAMS , PACKAGES AND FILES 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

OUTCOMES:

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

- model complex digital systems at several level of abstractions; behavioral and structural, synthesis and rapid system prototyping.
- develop and simulate register-level models of hierarchical digital systems
- develop a formal test bench from informal system requirements
- design and model complex digital system independently or in a team
- analyse and simulate digital system with PLD.

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.

ET17E23 ADHOC NETWORKS L T P C
3 0 0 3

COURSE 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, Date 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

OUTCOMES:

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

- analyse the fundamentals of wireless communication technologies.

- analyse the fundamentals of wireless network routing protocols
- determine the wireless issues in network layers topologies
- apply energy management concepts in network routing protocols
- evaluate the performance metrics for N/W communication technologies

REFERENCES

1. C. Siva Ram Murthy and B.S. Manoj, AdHoc Wireless Networks: Architectures and protocols, Prentice Hall PTR, 2004
2. C.-K.Toh, 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.

ET17E24 ADVANCED DIGITAL SIGNAL PROCESSING L T P C

3 0 0 3

COURSE OBJECTIVES

- To give an insight to the students about discrete time signals.
- To teach the design of IIR and FIR filters.
- To introduce the design of adaptive digital filters.
- To give an insight to the students about the significance of sampling rate.
- To compare Architectures & features of different Programmable DS processors.

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- Multi-resolution Analysis-Wavelet function-DWT based orthogonal Basis-Scaling function, Wavelet coefficients- ortho normal wavelets and their relationship to filter banks- Digital filtering interpolation-Decomposition filters-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 6

APPLICATIONS

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

OUTCOMES:

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

- comprehend the knowledge & concepts of digital signal processing techniques.
- comprehend the design of IIR,
- design the FIR and Adaptive Filters.

- realize the different blocks of Programmable DS processors.
- realize MAC & Filter structure.

REFERENCES:

1. John G. Proaks, 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. Raghuveer M.Rao and Ajit S. Bapardikar, Wavelet transforms- Introduction to theory and applications, Pearson Education, 2000.

PX17E25 SOFT COMPUTING TECHNIQUES L T P C

3 0 0 3

COURSE OBJECTIVES

- To expose the concepts of feed forward neural networks.
- To provide adequate knowledge about feedback 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- inferencing and 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

OUTCOMES:

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

- analyse the basic ANN architectures, algorithms and their limitations.
- verify the different operations on the fuzzy sets.
- develop the ANN based models and control schemes for non-linear system.
- expertise in the use of different ANN structures and online training algorithm.
- model fuzzy logic control of non-linear systems.

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 theory and 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.

ET17E26 RISC PROCESSOR ARCHITECTURE AND PROGRAMMING

L T P C
3 0 0 3

COURSE OBJECTIVES

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

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

OUTCOMES:

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

- Analyse different blocks of 8 bit RISC processor
- Develop the program using 16 bit RISC processor
- Implement DSP using ARM processor
- Analyse memory management concepts in RISC processor
- Develop an application using ARM processor

REFERENCES

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

PROFESSIONAL ELECTIVES (PE)

SEMESTER III

ET17E31 ADVANCED EMBEDDED SYSTEMS L T P C
3 0 0 3

COURSE OBJECTIVES

- To study the Fundamentals on design attributes of functional units of a Processor.
- To discuss on Hardware software partitioning in system design.
- To impart knowledge on intra & Inter processor Communications.
- To discuss strategies for processor Communications.
- To provide knowledge 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**

Co-Synthesis Problem, State-Transition Graph, Refinement and Controller Geneation, 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.

UNITV 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

OUTCOMES

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

- Obtain the design attributes of functional units of a Processor.
- Analyze the Hardware software partitioning in system design.
- Evaluate the intra & Inter processor Communications.
- Determine the various embedded networking protocols, memory in processors.
- Analyze and highlight the importance of various embedded development strategies.

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. Frank Vahid and Tony Gwargie, “Embedded System Design”, John Wiley & sons, 2002.
4. Steve Heath, “Embedded System Design”, Elsevier, Second Edition, 2004.
5. Ralf Niemann, “Hardware/Software Co-Design for Data Flow Dominated Embedded Systems”, Kluwer Academic Pub, 1998.

6. Jorgen Staunstrup, Wayne Wolf, "Harware/Software Co-Design:Principles and Practice",Kluwer Academic Pub, 1997.
7. Giovanni De Micheli, Rolf Ernst Morgon, "Reading in Hardware/Software Co-Design" Kaufmann Publishers, 2001.
8. Raj Kamal, "Embedded Systems- Architecture, Programming and Design" Tata McGraw Hill, 2006.

ET17E32 PERVASIVE DEVICES AND TECHNOLOGY L T P C

3 0 0 3

COURSE OBJECTIVES

- To impart knowledge on the fundamentals of wireless sensor technology
- To understand the infrastructure of WSN processor and its functions.
- To know the challenges in Network communication.
- To learn the 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 protocol – 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 Microware Systems – Emerging Wireless Technologies – IEEE 802.20 Mobile Broadband Wireless Access.

TOTAL: 45 PERIODS

OUTCOMES:

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

- determine the appropriate model of WSN.
- obtain the knowledge of WSN to solve any engineering problem related to WSN.
- analyze the Wireless Backbone Networks.
- evaluate the secure solutions for identified WSN.
- analyze the various emerging wireless technology.

REFERENCES

1. Debashis saha, Amitava mukherjee ,"Networking Infrastructure for Pervasive Computing, Springer International edition, 2011.
2. Mullet, "Introduction to wireless telecommunications systems and networks", cengage learning, 2010
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.
5. Marko Gargenta,"Learning Android", O'Reilly,2011.
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.

ET17E33 CRYPTOGRAPHY AND NETWORK SECURITY L T P C
3 0 0 3

COURSE OBJECTIVES

- To provide practical survey of principles and practices of Cryptography and network security.

- To understand the basic issues to be addressed by network security capability.

- To impart knowledge on the principles of number theory and the practice of network security and cryptographic algorithms.
- To learn different encryption and decryption schemas.
- To provide basic concepts about system security and attacks.

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

OUTCOMES

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

- evaluate the security of commercial security products organizational policies and software design.
- analyze the construction of the security within the software design or software deployment.
- evaluate the Speaking cogently about security using the terms of art.
- determine the Making of data transmission security by the process of Authentication.
- analyse the security among the systems by making the firewall and security standards efficient.

REFERENCES

1. William Stallings, “Crpyptography and Network security Principles and Practices”, Pearson/PHI, 5th ed, 2012.
2. Wade Trappe, Lawrence C Washington, “Introduction to Cryptography with coding theory”, 2nd ed, Pearson, 2007.
3. W. Mao, “Modern Cryptography – Theory and Practice”, Pearson Education, Second Edition, 2007.
4. Charles P. Pfleeger, Shari Lawrence Pfleeger – Security in computing Third Edition – Prentice Hall of India 2006.

ET17E34 SMART METER AND SMART GRID COMMUNICATION L T P C
3 0 0 3

COURSE OBJECTIVES

- To learn the fundamentals of automated meters and Grids.
- To impart knowledge on functional components of Smart meters
- To provide knowledge on need of smart grid for power systems
- To learn the significance of microgrid and its needs
- To understand 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 Prizing, 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.

OUTCOMES:

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

- analyze the fundamentals of automated meters and grids.
- determine the functional components of smart meters grid of power systems
- obtain the need of smart grid for power systems
- analyze the significance of microgrid and its needs.
- evaluate the communication protocols for power system

REFERENCES

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

ET17E35 COMPUTER IN NETWORKING AND DIGITAL CONTROL L T P C
3 0 0 3

COURSE OBJECTIVES

- To understand the fundamentals of Network Layers for Data communications.
- To impart knowledge on digital data communication techniques.
- To learn the Graphical programming using GUI for instrument building.
- To provide Knowledge on internet based communication standards and working principles.
- To learn the case studies to be developed in Virtual Environment Tools.

UNIT I NETWORK FUNDAMENTALS 9

Data communication networking – Data transmission concepts – Communication networking - Overview of OSI- TCP/IP layers – IP addressing - DNS – Packet Switching – Routing –Fundamental concepts in SMTP, POP, FTP, Telnet, HTML, HTTP, URL, SNMP,ICMP.

UNIT II DATA COMMUNICATION 9

Sensor data acquisition, Sampling, Quantization, Filtering ,Data Storage, Analysis using compression techniques, Data encoding – Data link control – Framing, Flow and Error control, Point to point protocol, Routers, Switches , Bridges – MODEMs, Network layer – Congestion control , Transport layer- Congestion control, Connection establishment.

UNIT III VIRTUAL INSTRUMENTATION 9

Block diagram and Architecture – Data flow techniques – Graphical programming using GUI – Real time system – Embedded controller – Instrument drivers – Software and hardware simulation of I/O communication blocks – ADC/DAC – Digital I/O – Counter , Timer, Data communication ports.

UNIT IV MEASUREMENT AND CONTROL THROUGH INTERNET 9

Web enabled measurement and control-data acquisition for Monitoring of plant parameters through Internet – Calibration of measuring instruments through Internet, Web based control – Tuning of controllers through Internet

UNIT V VI BASED MEASUREMENT AND CONTROL 9

Simulation of signal analysis & controller logic modules for Virtual Instrument control – Case study of systems using VI for data acquisition, Signal analysis, controller design, Drives control.

TOTAL : 45 PERIODS

OUTCOMES

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

- Analyze the fundamentals of Network Layers for Data communications.
- Evaluate various digital data communication techniques.
- Obtain Graphical programming using GUI for instrument building.
- Determine the internet based communication standards and working principles.
- Analyze the case studies developed in Virtual Environment Tools.

REFERENCES

1. Wayne Tomasi, “Introduction to Data communications and Networking” Pearson Education, 2007.
2. Al Williams, “Embedded Internet Design”, Second Edition, TMH, 2007.
3. Douglas E.Comer, “Internetworking with TCP/IP, Vol. 1”, Third Edition, Prentice Hall,1999.
4. Cory L. Clark, “LabVIEW Digital Signal Processing and Digital Communication”, TMH edition 2005.
5. Behrouza A Forouzan,”Data Communications and Networking” Fourth edition, TMH, 2007.
6. Krishna Kant,”Computer based Industrial control”,PHI,2002.
7. Gary Johnson, “LabVIEW Graphical Programming”, Second edition, McGraw Hill, Newyork, 1997.
8. Kevin James, ”PC Interfacing and Data Acquisition: Techniques for measurement, Instrumentation and control, Newnes, 2000.
9. Cory L. Clark,”LabVIEW Digital Signal processing and Digital Communications” Tata McGRAW-HILL edition, 2005.

ET17E36 DISTRIBUTED EMBEDDED COMPUTING L T P C
3 0 0 3

COURSE OBJECTIVES

- To learn the fundamentals of Network communication technologies.
- To study the fundamentals of Internet
- To provide Java based Networking
- To impart knowledge on network routing Agents
- To study the basis for network on-chip technologies

UNIT I THE HARDWARE INFRASTRUCTURE 9

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

UNIT II INTERNET CONCEPTS 9

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

UNIT III DISTRIBUTED COMPUTING USING JAVA 9

IO streaming – Object serialization – Networking – Threading – RMI – multicasting – distributed databases – embedded java concepts – Smart Card basics – Java card technology overview – Java card objects – Java card applets – Web Technology for Embedded Systems.

UNIT IV EMBEDDED AGENT 9

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

UNIT V EMBEDDED COMPUTING ARCHITECTURE 9

Synthesis of the information technologies of distributed embedded systems – analog/digital co-design – optimizing functional distribution in complex system design – validation and fast prototyping of multiprocessor system-on-chip – a new dynamic scheduling algorithm for real-time multiprocessor systems.

TOTAL : 45 PERIODS

OUTCOMES

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

- Analyse the fundamentals of Network communication technologies
- Determine the JAVA concepts for distributed computing.
- Evaluate the internet based communication for decentralized control mechanism of system.
- Analyse various network routing Agents.
- Analyze the network on-chip technologies for Embedded computing Architecture.

REFERENCES

1. Dietel & Dietel, "JAVA how to program", Prentice Hall 1999.
2. Sape Mullender, "Distributed Systems", Addison-Wesley, 1993. 36
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.

ET17E37 ROBOTICS AND CONTROL L T P C
3 0 0 3

COURSE OBJECTIVES

- To learn about the robot terminologies and robotic sensors
- To study the direct and inverse kinematic relations
- To understand the concept of formulation of manipulator Jacobians and introduce path planning techniques
- To impart knowledge on robot dynamics
- To provide knowledge on 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

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

- Analyze the robot terminologies and robotic sensors
- Obtain the direct and inverse kinematic relations
- Analyze the formulation of manipulator Jacobians and describe path planning techniques

- Obtain robot dynamics
- Analyze various robot control techniques

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.

ET17E38 APPLICATION OF MEMS TECHNOLOGY L T P C
3 0 0 3

COURSE OBJECTIVES

- To impart knowledge on the properties of materials, microstructure and fabrication methods.
- To learn about the design and modeling of Electrostatic sensors and actuators.
- To study the characteristics of thermal sensors and actuators
- To impart knowledge on the fundamentals of piezoelectric sensors and actuators
- To provide exposure to different MEMS and NEMS devices.

UNIT I MEMS: 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 thermo 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- MEMS and NEMS Devices

TOTAL : 45 PERIODS

OUTCOMES

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

- determine materials for fabrication ,analyze and fabricate
- obtain the design and fabricate electrostatic sensors and actuators
- analyze the deign and fabricate Thermal sensors and actuators
- obtain the piezo electric effect and design piezo electric actuators
- analyze the MEMS technology to various applications and develop MEMS devices

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.
4. M.H.Bao "Micromechanical transducers :Pressure sensors, accelerometers and gyroscopes",
5. Elsevier, Newyork, 2000.
6. P. RaiChoudry" MEMS and MOEMS Technology and Applications", PHI, 2012.
7. Stephen D. Senturia, " Microsystem Design", Springer International Edition, 2011.

ET17E39 DIGITAL IMAGE PROCESSING AND APPLICATIONS **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To impart knowledge on fundamentals of image analysis.
- To understand the different image enhancement methods.
- To study the image segmentation and feature analysis.
- To learn the multi resolution analysis and compressions.
- To learn the various application of image processing

UNIT I FUNDAMENTALS OF IMAGE PROCESSING **9**

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

UNIT II IMAGE ENHANCEMENT **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.

UNIT III IMAGE SEGMENTATION AND FEATURE ANALYSIS 9

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

UNIT IV MULTI RESOLUTION ANALYSIS AND COMPRESSIONS 9

Multi Resolution Analysis: Image Pyramids – Multi resolution expansion – Wavelet Transforms, Image compression: Fundamentals – Models – Elements of Information Theory – Error free compression – Lossy Compression – Compression Standards.

UNIT V APPLICATION OF IMAGE PROCESSING 9

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

OUTCOMES

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

- analyze the signal processing algorithms and techniques in image enhancement and image restoration.
- evaluate the image processing issues and techniques.
- obtain multi resolution techniques to real world problems.
- analyze the image processing problems and techniques.
- evaluate the various different digital compositing and colour image processing.

REFERENCES

1. Rafael C.Gonzalez and Richard E.Woods, "Digital Image Processing", 2nd Edition, Pearson Education, 2009.
2. Milan Sonka, Valclav Halavac and Roger Boyle, "Image Processing, Analysis and Machine Vision", 2nd Edition, Thomson Learning, 2014.
3. Anil K.Jain, "Fundamentals of Digital Image Processing". Pearson Education, 2003