KONGU ENGINEERING COLLEGE, PERUNDURAI, ERODE – 638 052
(Autonomous)

M.E. DEGREE IN EMBEDDED SYSTEMS (FULL TIME)

CURRICULUM

(For the candidates admitted from academic year 2014 – 15 onwards)

SEMESTER – I

Course Code	Course Title	Hours/ Week			Credit	Maximum Marks		
		L	T	P		CA	ESE	Total
	THEORY							
14AMT15	Applied Mathematics for Electronic Engineers	3	1	0	4	40	60	100
14COT11	Statistical Signal Processing	3	1	0	4	40	60	100
14EST11	Digital System Design for Embedded Systems	3	1	0	4	40	60	100
14EST12	Microcontroller System Design and Analysis	3	1	0	4	40	60	100
14EST13	Design of Embedded Systems	3	0	0	3	40	60	100
14EST14	Real Time Systems	3	0	0	3	40	60	100
	PRACTICAL							
14ESL11	Microcontroller System Design Laboratory	0	0	3	1	100	0	100
				Total	**23**			

CA - Continuous Assessment, ESE – End Semester Examination

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CURRICULUM

(For the candidates admitted from academic year 2014 – 15 onwards)

SEMESTER – II

Course Code	Course Title	Hours/ Week			Credit	Maximum Marks		
		L	T	P		CA	ESE	Total
	THEORY							
14EST21	RTOS for Embedded Applications	3	0	0	3	40	60	100
14EST22	Embedded Linux	3	1	0	4	40	60	100
14EST23	ASIC for Embedded Systems	3	0	0	3	40	60	100
14EST24	Industrial Microcontrollers	3	0	0	3	40	60	100
	Elective-I (Professional)	3	0	0	3	40	60	100
	Elective-II (Professional)	3	0	0	3	40	60	100
	PRACTICAL							
14ESL21	Embedded Systems Laboratory	0	0	3	1	100	0	100
14ESP21	Mini Project	0	0	6	2	50	50	100
				Total	**22**			

CA - Continuous Assessment, ESE – End Semester Examination

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M.E. DEGREE IN EMBEDDED SYSTEMS (FULL TIME)

CURRICULUM

(For the candidates admitted from academic year 2014 – 15 onwards)

SEMESTER – III

Course Code	Course Title	Hours/ Week			Credit	Maximum Marks		
		L	T	P		CA	ESE	Total
	THEORY							
	Elective-III (Professional)	3	0	0	3	40	60	100
	Elective-IV (Professional)	3	0	0	3	40	60	100
	Elective-V (Open)	3	0	0	3	40	60	100
	PRACTICAL							
14ESP31	Project Work – Phase I	0	0	12	6	50	50	100
				Total	**15**			

CA - Continuous Assessment, ESE – End Semester Examination

SEMESTER – IV

Course Code	Course Title	Hours/ Week			Credit	Maximum Marks		
		L	T	P		CA	ESE	Total
	PRACTICAL							
14ESP41	Project Work – Phase II	0	0	24	12	100	100	200
				Total	**12**			

CA - Continuous Assessment, ESE – End Semester Examination

Total Credits: 72

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M.E. DEGREE IN EMBEDDED SYSTEMS (PART TIME)

CURRICULUM

(For the candidates admitted from academic year 2014 – 15 onwards)

SEMESTER – I

Course Code	Course Title	Hours/ Week			Credit	Maximum Marks		
		L	T	P		CA	ESE	Total
	THEORY							
14AMT15	Applied Mathematics For Electronic Engineers	3	1	0	4	40	60	100
14EST12	Microcontroller System Design and Analysis	3	1	0	4	40	60	100
14EST13	Design of Embedded Systems	3	0	0	3	40	60	100
	PRACTICAL							
14ESL11	Microcontroller System Design Laboratory	0	0	3	1	100	0	100
				Total	**12**			

CA - Continuous Assessment, ESE – End Semester Examination

SEMESTER – II

Course Code	Course Title	Hours/ Week			Credit	Maximum Marks		
		L	T	P		CA	ESE	Total
	THEORY							
14EST21	RTOS for Embedded Applications	3	0	0	3	40	60	100
14EST23	ASIC for Embedded Systems	3	0	0	3	40	60	100
14EST24	Industrial Microcontrollers	3	0	0	3	40	60	100
	PRACTICAL							
14ESL21	Embedded Systems Laboratory	0	0	3	1	100	0	100
				Total	**10**			

CA - Continuous Assessment, ESE – End Semester Examination

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M.E. DEGREE IN EMBEDDED SYSTEMS (PART TIME)

CURRICULUM

(For the candidates admitted from academic year 2014 – 15 onwards)

SEMESTER – III

Course Code	Course Title	Hours/ Week			Credit	Maximum Marks		
		L	T	P		CA	ESE	Total
	THEORY							
14COT11	Statistical Signal Processing	3	1	0	4	40	60	100
14EST11	Digital System Design for Embedded Systems	3	1	0	4	40	60	100
14EST14	Real Time Systems	3	0	0	3	40	60	100
				Total	**11**			

CA - Continuous Assessment, ESE – End Semester Examination

SEMESTER – IV

Course Code	Course Title	Hours/ Week			Credit	Maximum Marks		
		L	T	P		CA	ESE	Total
	THEORY							
14EST22	Embedded Linux	3	1	0	4	40	60	100
	Elective-I (Professional)	3	0	0	3	40	60	100
	Elective-II (Professional)	3	0	0	3	40	60	100
	PRACTICAL							
14ESP21	Mini Project	0	0	6	2	50	50	100
				Total	**12**			

CA - Continuous Assessment, ESE – End Semester Examination

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M.E. DEGREE IN EMBEDDED SYSTEMS (PART TIME)

CURRICULUM

(For the candidates admitted from academic year 2014 – 15 onwards)

SEMESTER – V

Course Code	Course Title	Hours/ Week			Credit	Maximum Marks		
		L	T	P		CA	ESE	Total
	THEORY							
	Elective – III (Professional)	3	0	0	3	40	60	100
	Elective – IV (Professional)	3	0	0	3	40	60	100
	Elective – V (Open)	3	0	0	3	40	60	100
	PRACTICAL							
14ESP31	Project Work – Phase I	0	0	12	6	50	50	100
				Total	**15**			

CA - Continuous Assessment, ESE – End Semester Examination

SEMESTER – VI

Course Code	Course Title	Hours/ Week			Credit	Maximum Marks		
		L	T	P		CA	ESE	Total
	PRACTICAL							
14ESP41	Project Work – Phase II	0	0	24	12	100	100	200
				Total	**12**			

CA - Continuous Assessment, ESE – End Semester Examination

Total Credits: 72

LIST OF ELECTIVES					
Course Code	**Course Title**	**Hours/Week**			**Credit**
		L	**T**	**P**	
14ESE01	Software Technology for Embedded Systems	3	0	0	3
14ESE02	Soft Computing and Optimization Techniques	3	0	0	3
14ESE03	Design of Embedded Control Systems	3	0	0	3
14ESE04	Wireless Embedded Systems	3	0	0	3
14ESE05	Embedded Buses and Data Acquisition Techniques	3	0	0	3
14ESE06	RISC processor Architecture and Programming	3	0	0	3
14ESE07	Cyber Physical System *	3	0	0	3
14ESE08	HDL for Embedded FPGA Processor	3	0	0	3
14ESE09	Computers in Networking and Digital control	3	0	0	3
14ESE10	Distributed Embedded Computing	3	0	0	3
14CCE04	Robotics	3	0	0	3
14ESE11	Mobile Application Development using ANDROID	3	0	0	3
14ESE12	Embedded Automotive Networking With CAN *	3	0	0	3
14ESE13	Embedded Networking	3	0	0	3
14ESE14	Network on Chip	3	0	0	3
14ESE15	Medical Imaging Systems	3	0	0	3
14ESE16	Solar and Energy Storage System	3	0	0	3
14ESE17	System on Chip	3	0	0	3
14ESE18	Micro Systems Design	3	0	0	3
14COE05	Digital Image Processing and Multi Resolution Analysis	3	0	0	3

*- Open Elective

14AMT15 APPLIED MATHEMATICS FOR ELECTRONIC ENGINEERS

(Common to VLSI Design & Embedded Systems)

3 1 0 4

UNIT – I **9**

Vector Spaces: Definition – Subspaces – Span – Linear dependence and independence – Basis and dimension – Row space, Column space and Null Space – Rank and nullity.

UNIT – II **9**

Inner Product Spaces: Inner products – Angle and Orthogonality in inner product spaces – Orthonormal Bases – Gram-Schmidt Process – QR-Decomposition – Orthogonal Projection – Least square technique – Orthogonal matrices.

UNIT – III **9**

Graph Theory: Introduction of graphs – Isomorphism – Subgraphs – Walks, paths and circuits – Connected graphs – Eulerian Graphs – Hamiltonian Paths and circuits – Digraph – Some types of digraphs – Connectedness – Adjacency matrix and incidence matrix of graphs – Shortest path algorithms – Dijkstra's algorithm – Warshall's algorithm – Trees – Properties of trees – Spanning trees – Minimal spanning trees – Prim's Algorithm – Kruskal's algorithm.

UNIT – IV **9**

Stochastic Process: Definition – Classification of Stochastic Processes – Markov Chain -Transition Probability Matrices – Chapman Kolmogorov Equations - Classification of States – Continuous Time Markov Chains – Poisson Process - Birth and Death Processes.

UNIT – V **9**

Queuing Theory: Markovian queues – Single and Multi-server Models – Little's formula – Machine Interference Model - Non- Markovian Queues – Pollaczek Khintchine Formula.

Lecture: 45, Tutorial: 15, TOTAL: 60

REFERENCE BOOKS:

1. Howard Anton, Chris Rorres, "Elementary Linear Algebra" John Wiley & Sons, 2010.
2. David C Lay, "Linear Algebra and Its Applications", Pearson Education, 2009.
3. Richard Bronson, Gabriel B.Costa, "Linear Algebra", Academic Press, Second Edition, 2007.
4. Narsing Deo, "Graph Theory with Applications to Engineering and Computer science", Prentice Hall of India limited, 2005.
5. Roy D.Yates and David J Goodman, "Probability and Stochastic Processes – A friendly Introduction for Electrical and Computer Engineers", John Wiley & Sons, 2005.
6. Donald Gross and Carl M. Harris, "Fundamentals of Queuing theory", 2nd edition, John Wiley and Sons, New York (1985).

Course Outcomes:

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

- handle problems in linear algebra
- adopt graph theoretical concepts in electronics
- process information using random process

14COT11 STATISTICAL SIGNAL PROCESSING

(Common to Communication Systems, VLSI Design, Embedded Systems & Computer and Communication Engineering)

3 1 0 4

Pre-requisites: Digital Signal Processing

UNIT – I **9**

Discrete Random Signal Processing: Discrete time random process – Random process: Ensemble averages- Gaussian process – stationary process – The autocovariance and autocorrelation matrices – ergodicity – white noise the power spectrum. Filtering random process – spectral factorization. Parseval's theorem – Wiener Khintchine relation.

UNIT – II **9**

Spectrum Estimation and Analysis: Non parametric methods: Periodogram, performance of periodogram, modified periodogram, Bartlett's method, Welch's method.

Parametric methods: AR model – Yule-Walker method, MA model – ARMA model.

UNIT – III **9**

Linear Prediction: Forward and backward linear predictions, Solution of the normal equations – Levinson-Durbin algorithms. Least mean squared error criterion – The FIR Wiener filter – filtering – linear prediction and The IIR Wiener filters – Non causal IIR Wiener filter – the causal IIR Wiener filter.

UNIT – IV **9**

Adaptive Filter: Concepts of adaptive filter – FIR adaptive filters – LMS algorithm – Applications: Noise cancellation-Adaptive recursive filers– AR lattice structure and ARMA process, lattice – ladder filters.

UNIT – V **9**

Overview of speech processing : Speech Fundamentals: Articulatory Phonetics – Production and Classification of Speech Sounds; Acoustic Phonetics – acoustics of speech production; Short time Homomorphic Filtering of Speech; Linear Prediction (LP) analysis: Basis and development, LPC spectrum.

Lecture: 45, Tutorial: 15, TOTAL: 60

REFERENCE BOOKS:

1. Hayes, Monson H. "Statistical Digital Signal processing and Modeling", John Wiley and Sons, Inc., 1996
2. Proakis, John G. and Manolakis, Dimitris G. "Digital Signal Processing: Principles Algorithms and Applications", PHI, 2006.
3. Ifeachor, Emmanuel C. and Jervis, Barrie N. "Digital Signal Processing: A Practical Approach", Addison-Wesley Publishing Company, 2002.

Course Outcomes:

On completion of the course the students will be able to

- demonstrate the concepts of discrete random signal processing in real time applications
- estimate and analyze the spectrum using parametric and non-parametric approach
- design an adaptive filter and various error minimization algorithm for speech quality improvement

14EST11 DIGITAL SYSTEM DESIGN FOR EMBEDDED SYSTEMS

3 1 0 4

Pre-requisites: Digital logic Devices , VLSI Design

UNIT – I **9**

Synchronous Sequential Circuit Design :Analysis of Clocked Synchronous Sequential Networks (CSSN) Modeling of CSSN – State Stable Assignment and Reduction – Design of CSSN – Design of Iterative Circuits – ASM Chart– ASM Realization

UNIT – II **9**

Asynchronous Sequential Circuit Design :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 –Mixed Operating Mode Asynchronous Circuits.

UNIT – III **9**

Fault Diagnosis and Testability Algorithms :Fault Table Method – Path Sensitization Method – Boolean Difference Method – Kohavi Algorithm – Practical PLA's

UNIT – IV **9**

Synchronous Design using Programmable Devices: Programming Techniques -Re-Programmable Devices Architecture- Function blocks, I/O blocks, Interconnects, Realize combinational, Arithmetic, Sequential Circuit with Programmable Array Logic - Designing with PLD-PROM,PAL,PLA, Sequential PLDs

UNIT – V **9**

Logic Synthesis , Simulation and Architectures: Overview of digital design with Verilog, hierarchical modeling concepts, modules and port definitions, gate level modeling, data flow modeling, behavioral modeling, task & functions, logic synthesis-simulation-Design - Ripple carry Adders, Carry Look ahead adders, Design of Arithmetic circuits for Full adder, Shift Registers, Multiplexer, Comparator.

Lecture:45, Tutorial:15, TOTAL: 60

REFERENCE BOOKS:

1. Givone Donald G., "Digital Principles and Design", Tata McGraw-Hill, New Delhi, 2002.
2. Biswas Nripendra N, "Logic Design Theory", Prentice Hall of India, New Delhi, 2001
3. Ming-Bo Lin**, "**Digital System Design and Practices: Using Verilog HDL and FPGAs", Wiley Publisher, New York, 2008.
4. Yarbrough, John M., "Digital Logic Applications and Design", Thomson Learning, Singapore, 2001.
5. Roth Charles H., "Fundamentals of Logic Design", Thomson Learning, Singapore, 2005

Course Outcomes:

On completion of the course the students will be able to

- design synchronous and asynchronous circuits for application development
- analyze and design digital systems with Verilog

14EST12 MICROCONTROLLER SYSTEM DESIGN AND ANALYSIS

3 1 0 4

Pre-requisite : Digital Electronics, Microprocessor and Microcontroller

UNIT I **9**

8051 Architecture: Architecture – memory organization – addressing modes – instruction set – Timers - Interrupts -I/O ports, Interfacing I/O Devices – Serial Communication

UNIT II **9**

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

UNIT III **9**

PIC Microcontroller: Architecture – memory organization – addressing modes – instruction set – PIC progrmming in Assembly & C –I/O port, Data Conversion, RAM & ROM Allocation, Timer programming, MPLAB.

UNIT IV **9**

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

UNIT V **9**

System design – Case study: Interfacing LCD Display and touch screen – Keypad Interfacing .ADC, DAC and Stand alone Data Acquisition System, Interfacing –Flash and EEPROM memories.–SPI Bus Protocol and DS1307 RTC Interfacing , Motor - DC Motor Control using PWM– Relay and Stepper Motor interfacing

Lecture:45, Tutorial:15, TOTAL: 60

REFERENCE BOOKS

1 Muhammad Ali Mazidi, Janice G. Mazidi and Rolin D. McKinlay, 'The 8051 Microcontroller and Embedded Systems' Prentice Hall, 2005

2 Muhammad Ali Mazidi, Rolin D. Mckinlay, Danny Causey ' PIC Microcontroller and Embedded Systems using Assembly and C for PIC18', Pearson Education 2008

3 Myke Predko, "Programming and customizing the 8051 microcontroller", Tata McGraw Hill 2001

4 John Iovine, 'PIC Microcontroller Project Book ', McGraw Hill 2000

Course Outcomes:

On completion of the course the students will be able to

- do programming for various applications using 8-bit microcontroller
- program the ports and peripherals of microcontroller
- interface peripherals using various interfacing techniques

14EST13 DESIGN OF EMBEDDED SYSTEMS

3 0 0 3

UNIT – I **9**

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

UNIT – II **9**

Partitioning Decision: Hardware / Software duality – Coding Hardware – ASIC revolution - Managing the Risk – Co-verification – Execution environment – Memory organization –System startup – Hardware manipulation – Memory mapped access –Speed and code density.

UNIT – III **9**

Emulator: Interrupt Service routines – Watch dog timers – Flash memory Basic toolset – Host Based debugging – Remote debugging – ROM emulators – logic Analyzer – Caches – Computer optimization – Statistical profiling.

UNIT – IV **9**

IN Circuit Emulators: Bullet proof run control – Real time trace – Hardware break points – Overlay memory – Timing constraints – Usage issues – Triggers

UNIT – V **9**

Testing: Bug tracking – reduction of risks & costs – Performance – Unit testing – Regression testing – Choosing test cases – Functional tests – Coverage tests – Testing embedded software – Performance testing – Maintenance

TOTAL: 45

REFERENCE BOOKS:

1. Arnold S. Berger, “Embedded System Design” CMP books, USA 2002.
2. Sriram Iyer, “Embedded Real time System Programming”, Tata McGraw-Hill, 2008.
3. Ronald C Arkin, “Behaviour-based Robotics”, The MIT Press, 1998.

Course Outcomes:

On completion of the course the students will be able to

- design embedded based applications
- use various tools for hardware- software debugging
- validate and test embedded systems

14EST14 REAL TIME SYSTEMS

3 0 0 3

Pre-requisites: Computer Programming, Operating System

UNIT – I **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 **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 **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 **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 **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

REFERENCE BOOKS:

1. C.M. Krishna, Kang G. Shin, “Real – Time Systems”, McGraw – Hill International Editions, 2010.
2. Stuart Bennett, “Real Time Computer Control – An Introduction”, Prentice Hall of India, 1998.
3. Peter D.Lawrence, “Real Time Micro Computer System Design – An Introduction”, McGraw Hill, 1988.
4. S.T. Allworth and R.N.Zobel, “Introduction to real time software design”, Macmillan, 2nd Edition, 1987
5. R.J.A Buhur, D.L Bailey, “An Introduction to Real – Time Systems”, Prentice – Hall International, 1999.
6. Philip. A. Laplante, “Real Time System Design and Analysis”, Prentice Hall of India, 3rd Edition, April 2004.

Course Outcomes:

On completion of the course the students will be able to

- implement scheduling algorithms for the design of real time systems
- use programming languages and tools to build a real time system
- evaluate and identify the various real time system models

14ESL11 MICROCONTROLLER SYSTEM DESIGN LABORATORY

0 0 3 1

LIST OF EXPERIMENTS:

1. Simulation and implementation of Switch/ Keypad and LED using 89c51 Microcontroller
2. Simulation and implementation of device ON / OFF using 89c51 microcontroller (Relay and LED).
3. Simulation and implementation of LCD
4. Simulation and implementation of 7 segment/ widget display using 89c51 microcontroller.
5. Simulation and implementation of motor – speed and direction using 89c51 microcontroller
    i. Stepper Motor
    ii. DC Motor
6. Interrupt programming using 89c51 microcontroller.
7. Serial Communication using PIC18F45x microcontroller
8. Simulation and implementation of Real Time Clock using PIC18F45x microcontroller
9. Programs for timers using PIC18F45x microcontroller.
10. PWM / GPS generation using PIC18F45x microcontroller.
11. I2C / Bluetooth communication using PIC18F45x microcontroller.
12. Interrupt /GSM programming using PIC18F45x microcontroller.

TOTAL: 45

REFERENCES / MANUALS / SOFTWARE:

- Proteus Professional
- CCS Compiler, UMPS

Course Outcomes:

On completion of the course the students will be able to

- program an 8-bit microcontroller
- interface different peripherals with microcontrollers
- design and develop embedded based projects and products

14EST21 RTOS FOR EMBEDDED APPLICATIONS

3 0 0 3

Pre-requisites: Operating System basics

UNIT – I **9**

Review of Operating Systems: Basic Principles - Operating System Structures – System Calls – Files – Processes – Design and Implementation of processes – Communication between processes – Introduction to Distributed operating system – Distributed scheduling.

UNIT – II **9**

Introduction to RTOS –Advantage and Disadvantage of Using RTOS – Multitasking – Tasks -Real Time Kernels – Scheduler - Non-preemptive Kernels - Preemptive Kernels –Reentrancy- Reentrant Functions – Round Robin Scheduling - Task Priorities -Static Priorities – Mutual Exclusion – Deadlock – Inter task Communication –Message Mailboxes – Message Queues - Interrupts - Task Management – Memory Management -Time Management – Clock Ticks.

UNIT – III **9**

µC/OS-II: Introduction - µC/OS-II Features - Goals of µC/OS-II - Hardware and Software Architecture – Kernel structures: Tasks –Task States – Task Scheduling – Idle Task – Statistics Task – Interrupts Under µC/OS-II – Clock Tick - µC/OS-II Initialisation. Task Management: Creating Tasks – Task Stacks – Stack Checking – Task's Priority – Suspending Task – Resuming Task. Time Management: Delaying a Task – Resuming a Delayed Task – System Time. Event Control Blocks- Placing a Task in the ECB Wait List – Removing a Task from an ECB wait List.

UNIT – IV **9**

Semaphore and Mailboxes: Semaphore Management: Overview – Signaling a Semaphore. Message Mailbox Management: Creating a Mailbox – Deleting Mailbox – Waiting for a Message box – Sending Message to a Mailbox- Status of Mailbox .Message Queue Management: Creating Message Queue – Deleting a Message Queue – Waiting for a Message at a Queue – Sending Message to a Queue – Flushing a Queue.

UNIT – V **9**

Memory Management: Memory Control Blocks – Creating Partition- Obtaining a Memory Block – Returning a Memory Block .Getting Started with µC/OS-II – Installing µC/OS-II – Porting µC/OS-II: Development Tools – Directories and Files – Testing a Port - IAR Workbench with µC/OS-II - Case study of coding for an Automatic Chocolate Vending Machine using MUCOS RTOS.

TOTAL: 45

REFERENCE BOOKS:

1. Jean J. Labrosse, "MicroC/OS – II The Real Time Kernel", CMP Books, 2nd Edition, 2002.
2. Rajkamal, "Embedded Systems Architecture, Programming and Design", Tata McGraw-Hill, New Delhi", 2003.
3. Steve Furbe, "ARM System-on-Chip Architecture", Addison-Wesley Professional, 2nd Edition 2000.

Course Outcomes:

On completion of the course the students will be able to

- work with real time Operating Systems
- create real time optimized scheduling algorithms
- Port RTOS to desired target boards

14EST22 -EMBEDDED LINUX

3 1 0 4

Pre-requisites: Basics in C Programming, Operating System

UNIT – I **9**

Fundamentals of Linux :Basic Linux System Concepts: Working with Files and Directories - Introduction to Linux File system - Basic Linux commands and concepts – Logging in - Shells - Basic text editing - Advanced shells and shell scripting – Linux File System –Linux programming - Processes and threads in Linux - Inter process communication -Linux System calls.

UNIT – II **9**

Various Distributions And Cross Platform Tool Chain :Introduction - History of Embedded Linux - Embedded Linux versus Desktop Linux -Commercial Embedded Linux Distribution - Choosing a distribution - Embedded Linux Distributions - Architecture of Embedded Linux - Linux kernel architecture - User space – Linux startup sequence - GNU cross platform Tool chain.

UNIT – III **9**

Host-Target Setup And Overall Architecture :Real Life Embedded Linux Systems - Design and Implementation Methodology - Types of Host/Target Development Setups - Types of Host/Target Debug Setups - Generic Architecture of an Embedded Linux System - System Startup - Types of Boot Configurations – System Memory

UNIT – IV **9**

Kernel Configuration And Root File System :Selecting a Kernel - Configuring the Kernel - Compiling the Kernel - Installing the Kernel - Basic Root File system Structure - Libraries - Kernel Modules and Kernel Images - Device Files - Main System Applications - System Initialization - **Setting Up the Bootloader –** U-boot.

UNIT – V **9**

Embedded Storage And Driver :Memory Technology Device (MTD) –MTD Architecture - MTD Driver for NOR Flash – The Flash Mapping drivers – MTD Block and character devices – mtdutils package – Embedded File Systems – Optimizing storage space-Porting Roadmap –Linux serial driver – Ethernet driver –USB gadgets – Watchdog timer – Kernel Modules

Lecture:45, Tutorial:15, TOTAL: 60

REFERENCE BOOKS:

1. Paul Cobbaut ,"Linux Fundamentals" , GNU Free Documentation License 2013
2. Karim Yaghmour, "Building Embedded Linux Systems", O'Reilly Publications, 2003
3. P.Raghavan ,Amol Lad , SriramNeelakandan, "Embedded Linux System Design and Development", Auerbach Publications 2006
4. William von Hagen, 'Ubuntu Linux Bible 3rd Edition', Wiley Publishing Inc., 2010
5. Jonathan Corbet,Alessandro Rubini,"Linux Device Drivers" , O'Reilly Publications, 2011

Course Outcomes:

On completion of the course the students will be able to

- use Linux Operating System architecture for the development of real time systems
- build stand alone target system
- recognize various embedded storage devices
- install driver software for gadgets

14EST23 ASIC FOR EMBEDDED SYSTEMS

3 0 0 3

Pre-requisites: VLSI Design

UNIT – I **9**

Introduction to ASICs, CMOS Logic and ASIC Library Design: Types of ASICs - Design flow - CMOS transistors - Combinational Logic Cell – Sequential logic cell - Data path logic cell - Transistors as Resistors - Transistor Parasitic Capacitance- Logical effort.

UNIT – II **9**

Programmable ASICs, Programmable ASIC Logic Cells And Programmable ASIC I/O Cells : Anti fuse - static RAM - EPROM and EEPROM technology - Actel ACT - Xilinx LCA –Altera FLEX - Altera MAX DC & AC inputs and outputs - Clock & Power inputs - Xilinx I/O blocks.

UNIT – III **9**

Programmable ASIC Interconnect: Actel ACT -Xilinx LCA - Xilinx EPLD - Altera MAX 5000 and 7000 - Altera MAX9000 - Altera FLEX

UNIT – IV **9**

Logic Synthesis: Design systems - Half gate ASIC –Schematic entry - Low level design language - PLA tools -EDIF- CFI design representation.-simulation-Logic synthesis

UNIT – V **9**

Physical Design: ASIC floor planning- placement and routing – power and clocking strategies.

TOTAL: 45

REFERENCE BOOKS:

1. M. J. Smith, " Application Specific Integrated Circuits", Pearson, 2003.
2. Douglas J. Smith, "HDL Chip Design", Madison, AL, USA: Doone Publications, 1996.

Course Outcomes:

On completion of the course the students will be able to

- design ASIC logic cells, I/O cells, interconnect and architecture
- analyze high performance algorithms for ASIC design

14EST24 INDUSTRIAL MICROCONTROLLERS

3 0 0 3

Pre-requisites: Microprocessor and Microcontroller

UNIT – I **9**

16 - Bit Microcontroller: Introduction to the S12 and S12X Microcontroller – Interrupts- Clock Generation- Resets- Parallel Ports - Timer Functions ,Serial Communication Interface (SCI)

UNIT – II **9**

Peripheral Interface And Embedded C Serial Peripheral Interface (SPI)- Inter-Integrated Circuit (I2C) Interface- Hardware and Software Development Tools ,C Language Programming –Types - operators –expressions-control flow-input and output-functions and program structures-pointers-arrays-structures-unions -Writing C program to perform simple I/O

UNIT – III **9**

Development Tools and Applications: Codewarrior tools - Project IDE - Compiler - Assembler and Debugger - JTAG and hardware debuggers - Code optimization - Real time clock with I2C programming-Interfacing with serial EPROM

UNIT – IV **9**

ColdFire Processor: Introduction to ColdFire Core- User and Supervisor Programming Model-Addressing modes- Special instructions,- Multiply-Accumulate Unit-EMAC-Exceptions and Interrupt controller- cache

UNIT – V **9**

Peripheral Interface with MCF5222X Microprocessor: MCF 5222X Microprocessor- UART- I2C-ADC- Timers. Cryptographic Acceleration Unit Interfacing SDRAM and Flash to Cold Fire processor

TOTAL: 45

REFERENCE BOOKS:

1. Huang Han-Way, “The HCS12/9S12: An Introduction to Hardware and Software Interfacing”, Second Edition, 2006
2. Cady Fredrick M., “Assembly and C Programming for the Free scale HCS12 Microcontroller”, Second Edition, Oxford University Press,New York, 2008
3. BannouraMunir, Bettelheim Rudan, and Soja Richard, “ColdFire Microprocessors & Microcontrollers” –AMT Publishing
4. Valvano Jonathan W., “Embedded Microcomputer Systems: Real Time Interfacing”, Second Edition, Thomson Asia, Singapore, 2001

Course Outcomes:

On completion of the course the students will be able to

- use the architecture of S12X microcontroller for industrial applications
- debug and develop embedded applications using ColdFire processor

14ESL21 EMBEDDED SYSTEMS LABORATORY

0 0 3 1

LIST OF EXPERIMENTS:

1. Interfacing of Switch and LED using S12X Controller
2. Serial Communication Interface using S12X Controller
3. ADC Programming using S12X Controller
4. CAN bus Programming using S12X Controller
5. Bluetooth/Zigbee interfacing using S12X Controller
6. IR/RFID interfacing using S12X Controller
7. EEPROM Programming using S12X Controller
8. Interfacing of Switch and LED using COLDFIRE Processor
9. Linux porting on Friendly ARM mini 2440/ UART Programming using COLDFIRE Processor
10. Linux based I/O communication on Friendly ARM mini 2440/ ADC Programming using COLDFIRE Processor

TOTAL: 45

REFERENCES / MANUALS / SOFTWARE:

- Codewarrier tool

Course Outcomes:

On completion of the course the students will be able to

- program an 16-bit and 32- bit microcontroller and microprocessor respectively
- interface and program various wired and wireless communication protocols
- hands-on experience on porting OS onto an ARM

14ESE01 SOFTWARE TECHNOLOGY FOR EMBEDDED SYSTEMS

3 0 0 3

Pre-requisites: C programming, Linux

UNIT – I **9**

Programming Embedded Systems: Overview of Embedded C - Compilers and Optimization - Programming and Assembly – Register usage conventions – Typical use of addressing options – Instruction sequencing – Procedure call and return – Parameter passing – Retrieving parameters – Everything in pass by value – Temporary variables - Embedded Program – Role of Infinite loop – Compiling, Linking and locating – downloading and debugging – Emulators and simulators processor.

UNIT – II **9**

C programming tool chain in linux-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 **9**

Embedded C and Embedded OS: 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 Important design considerations when using Embedded OS+.

UNIT – IV **9**

Embedded JAVA: Embedded Java and J2ME- Software Development process: Analysis – Design- Implementation – Testing – Validation- Debugging - Software maintenance-Smart Card basics – Java card technology overview – Java card objects – Java card applets – working with APDU

UNIT – V **9**

Web Architectural Framework: Simple Patterns-Basics – Client/server model- Domain Names and IP address – Internet Infrastructure and Routing – URL – TCP/IP protocols - Embedded as Web Client Embedded Web servers - HTML - Web security - Case study : Web-based Home Automation system.

TOTAL: 45

REFERENCE BOOKS:

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. H.M. Deitel ,P.J.Deitel, A.B. Golldberg " Internet and World Wide Web – How to Program" Third Edition , Pearson Education , 2001.
4. Bruce Powel Douglas, "Real-Time UML, Second Edition: Developing Efficient Object for Embedded Systems, 2nd Edition ,1999, Addison-Wesley
5. Michael J Pont, "Embedded C", Pearson Education, 2007.
6. Zhiqun Chen, 'Java Card Technology for Smart Cards: Architecture and Programmer's Guide', Addison-Wesley Professional, 2000.
7. Zhiqun Chen, 'Java Card Technology for Smart Cards: Architecture and Programmer's Guide', Addison-Wesley Professional, 2000.

Course Outcomes:

On completion of the course the students will be able to

- apply software design methodologies for embedded systems
- work with software tools for building prototypes in embedded systems
- use embedded C, JAVA, UML to design and develop embedded software and products

14ESE02 SOFT COMPUTING AND OPTIMIZATION TECHNIQUES

(Common to Embedded Systems & Communication Systems)

3 0 0 3

Pre-requisites: Soft Computing

UNIT – I **9**

Neural Networks: Introduction to soft Computing-Neural Networks -Supervised Learning Neural Networks – Perceptrons - Back propagation Multilayer perceptrons – Radial Basis Function Networks – Support Vector Machine – Extreme Learning Machine

UNIT – II **9**

Fuzzy Logic: Fuzzy Sets – Basic Definition and Terminology - Fuzzy Rules and Fuzzy Reasoning - Extension principle and Fuzzy Relations – Fuzzy Inference Systems –Fuzzy Models – De-fuzzification methods

Neuro Fuzzy Modelling: Adaptive Neuro-Fuzzy Inference Systems – Architecture – Hybrid Learning Algorithm

UNIT – III **9**

Hybrid Systems-Integration of Neural Networks and Fuzzy Logic : Sequential hybrid stystems-Auxillary hybrid systems-embedded hybrid systems-neuro-fuzzy hybids- Fuzzy back propagation networks- simplified fuzzy ARTMAP- Fuzzy Associative memory

UNIT – IV **9**

Genetic Algorithm: Fundamentals of genetic algorithm- encoding- fitness function – reproduction- Genetic Modeling – Inheritance operators - cross over, mutation, inversion, deletion, bit wise operators – generation cycle – schema theorem - Application

UNIT – V **9**

Particle Swarm Optimization: Introduction , Features of PSO , Basic Principles, Canonical PSO Algorithm Foraging Strategies ,Self organization and stigmetry , Comparison with GA- Application

Ant Colony Optimization: Introduction- From real to Artificial Ants , ACO Meta Heuristics

TOTAL : 45

REFERENCE BOOKS:

1. Jang, J.S.R., C.T.Sun and E.Mizutani., “Neuro-Fuzzy and Soft Computing”, PHI, Pearson Education, 2004.
2. Rajasekaran S and Pai, G.A.V., “Neural Networks, Fuzzy Logic and Genetic Algorithms”, Prentice Hall of India, New Delhi, 2003
3. Eberhart, R., Simpson, P. and Dobbins, R.,” Computational Intelligence PC Tools”, AP Professional, Boston 1996.
4. Goldberg, Davis E., “Genetic Algorithms: Search, Optimization and Machine Learning” Addison Wesley, New York, 1989
5. Ross Timothy J., “ Fuzzy Logic Engineering Applications” John Wiley and Sons, 2004

Course Outcomes:

On completion of the course the students will be able to

- utilize the soft computing techniques and their role in building intelligent machines
- interpret the working of fuzzy systems
- solve optimization problems

14ESE03 DESIGN OF EMBEDDED CONTROL SYSTEMS

3 0 0 3

Pre-requisites: Microprocessor and Microcontroller

UNIT – I **9**

Introduction: Embedded System - Interfacing a Microprocessor to the Analog World-Position and Velocity Measurements-The World of Sensors-Actuators-Motor Control-Feedback Systems-Haptic Interfaces and Virtual Environments-Applications of Embedded Control system.

UNIT – II **9**

Interface With Communication Protocol: 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 – III **9**

Embedded System Organization: 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-8bit–ISA- EISA bus.

UNIT – IV **9**

Design of Software For Embedded Control: 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 **9**

Case Studies With Embedded Controller: A low-cost web-based infrared remote control system for energy management of aggregated air conditioners .PWM motor speed controller-Serial communication interface.

TOTAL: 45

REFERENCE BOOKS:

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. MichealKhevi, "The M68HC11 Microcontroller application in Control, Instrumentation & Communication", PH New Jersey, 1997.
4. Muhammad Ali Mazidi, Rolin D. Mckinlay, and Danny Causey, "PIC Microcontroller and Embedded Systems- Using Assembly and C for PIC18", Pearson Education, 2008.
5. Yu-Chi Wu ,Meng-Jen Chen , Bo-Sen Chang , Ming-Tsung Tsai " A low-cost web-based infrared remote control system for energy management of aggregated air conditioners", Energy and Buildings ,Elsevier, volume 72 (2014) pp.24–30

Course Outcomes:

On completion of the course the students will be able to

- apply the basics of sensors and actuators in embedded platform
- interface various peripherals using communication buses
- develop applications based on embedded controller

14ESE04 WIRELESS EMBEDDED SYSTEMS

3 0 0 3

Pre-requisites: Wireless Communications, Computer Networks

UNIT – I **9**

Wireless Embedded Systems for Real-Time Applications :Introduction - Wireless PAN- Blue tooth-Over all architecture-Protocol Stack-Physical Connection-MAC Mechanism-Connection Management-Security-Zigbee- Protocol Architecture-Physical layer-MAC Layer-Zigbee Layer-Applications-Home RF - Wi Fi. Introduction to wireless LAN, Wireless PAN, Wireless MAN.

UNIT – II **9**

CDMA, GSM and GPRS :OFDM Channel-GSM: Services-System Architecture- Radio Sub system-Channel Types-Frame structure-Signal Processing- GPRS-Reference Architecture- Protocol Layers-Short Messaging Services

UNIT – III **9**

Overview of Wireless Sensor Networks : Challenges for Wireless Sensor Networks- Characteristic requirements for WSN – Network Topology – Localization – Time Synchronization - Energy efficient MAC protocols –SMAC – Energy efficient and robust - routing – Data Centric routing.

Smart Sensors : Primary sensors- filters- converter – compensation – Non-linearity- Noise and interference – Drift – Information coding – Data coding – Data Communication- Standards for smart sensor interface – Film sensors – Semiconductor IC technology.

UNIT – IV **9**

Sensor Technologies and Applications :MEMS – Nano sensors. Product-Bands and Standards-Wireless Geo location: System Architecture-Technologies- Standard for E-911 Service- Wireless Home Networking-Need-Technologies- Home Access Networks-Embedded Wireless Control using GSM-RFID.

UNIT – V **9**

Pervasive Devices : 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.

TOTAL: 45

REFERENCE BOOKS:

1. Pahalavan, Kaveh and Krishnamoorthy, Prasanth., "Principles of Wireless Networks", Prentice Hall of India, New Delhi, 2005.
2. Iyer S. V. and Gupta P., "Embedded Real-time System Programming", Tata McGraw-Hill, New Delhi, 2006
3. Rappaport, Theodore S., "Wireless Communications: Principles and Practice", Prentice Hall of India, New Delhi, 2007.
4. Patranabis, D., "Sensors and Transducers", Wheeler Publishing, Allahabad, 1997.
5. Marko Gargenta,"Learning Android", O'Reilly,2011
6. Jan Axelson 'Embedded Ethernet and Internet Complete', Penram publications
7. Michel Banatre, Pedro Jose Marron, and Anibal Ollero, "Cooperating Embedded Systems and Wireless Sensor Networks", John Wiley & Sons Inc, 2008.
8. Brian Fling,"Mobile Design & Development,O'Reilly,2011

9. Brian Fling ,’’Mobile Design and Development: Practical Concepts and Techniques for Creating Mobile Sites and Web Apps (Animal Guide)’’ O'Reilly Media,2009
10. Bhaskar Krishnamachari, ‘Networking wireless sensors’, Cambridge press 2005

Course Outcomes:

On completion of the course the students will be able to

- integrate various wireless standards in embedded environment
- realize the characteristics of wireless sensor networks
- use modern pervasive devices for embedded environment

14ESE05 EMBEDDED BUSES AND DATA ACQUISITION TECHNIQUES

3 0 0 3

Pre-requisites: Basics in Measurements & Instrumentation, Digital Circuits

UNIT – I **9**

Data Acquisition Systems : 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 **9**

Interfacing and Data Transmission :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 **9**

Instrumentation Bus :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 - Field bus, Mod bus, GPIB, IEEE-488, VME, VXI, Network buses – Ethernet – TCP/IP protocols; CAN bus- basics, Message transfer, Fault confinement.

UNIT – IV **9**

Virtual Instrumentation :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 **9**

Case Studies :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

REFERENCE BOOKS:

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” 3rd Edition, Pearson Education, 2003.
5. Buchanan, “Computer buses”, Arnold, London, 2000.
6. Jonathan W Valvano, “Embedded Microcomputer Systems”, Asia Pvt. Ltd., Brooks/Cole, Thomson, 2001.

Course Outcomes:

On completion of the course the students will be able to

- identify, formulate and design data acquisition system in multidisciplinary environment
- interface various peripherals using buses
- design real time embedded applications
- apply the principles of VI to develop embedded products

14ESE06 RISC PROCESSOR ARCHITECTURE AND PROGRAMMING

3 0 0 3

Pre-requisites: Microprocessor and Microcontroller

UNIT – I **9**

AVR Microcontroller Architecture :Architecture – memory organization – addressing modes – instruction set – programming techniques –Assembly language & C programming

Peripheral of AVR Microcontroller: I/O Memory – EEPROM – I/O Ports –SRAM –Timer –UART – Interrupt Structure- Serial Communication with PC – ADC/DAC Interfacing

UNIT – II **9**

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

UNIT – III **9**

CACHES and MMU :The Memory Hierarchy and Cache Memory – Cache Architecture - Cache Policy –Co Processor and Caches – Flushing and Cleaning Cache Memory – Cache Lockdown – Caches and Software Performance. MMU: Moving from an MPU to an MMU – Virtual Memory – Details of ARM MMU – The Caches and Write Buffer – Co Processor and MMU configuration

UNIT – IV **9**

Programming of Optimized Primitives :Double Precision Integer Multiplication – Integer Normalization and count Leading Zeros – Division – Square Roots – Transcendental Functions : Log, exp, sin, cos – Endian Reversal and Bit Operations – Saturated and Rounded Arithmetic – Random Number Generation- Writing Assembly Code – Profiling and Cycle Counting – Instruction Scheduling – Register Allocation – Conditional Execution – Looping Constructs – Bit Manipulation – Efficient Switches – Handling Unaligned Data

UNIT – V **9**

ARM Application Development :Introduction to DSP on ARM –FIR Filter – IIR Filter – Discrete fourier transform – Exception Handling – Interrupts – Interrupt handling schemes- Firmware and boot loader – Example: Standalone - Embedded Operating Systems – Fundamental Components - Example Simple little Operating System

TOTAL: 45

REFERENCE BOOKS:

1. Andrew N. Sloss, Dominic Symes, Chris Wright, John Rayfield “ARM System Developer”s Guide Designing and Optimizing System Software”, Elsevier 2007
2. Steve Furber, “ARM System on chip Architecture”, Addision Wesley,2009
3. Dananjay V. Gadre “Programming and Customizing the AVR microcontroller”, McGraw Hill 2001
4. Trevor Martin, “The Insider's Guide To The Philips ARM7-Based microcontrollers,An Engineer's Introduction To The LPC2100 Series”, Hitex (UK) Ltd
5. ARM Architecture Reference Manual
6. LPC213x User Manual

7 www.nxp.com

8 www.arm.com

Course Outcomes:

On completion of the course the students will be able to

- analyze the different types of RISC architectures
- demonstrate memory access and sharing among different functions and protocols
- develop a system using RISC processor for various real time applications

14ESE07 CYBER PHYSICAL SYSTEM

(Common to Embedded Systems & Information Technology)

3 0 0 3

UNIT – I **9**

Introduction – Embedded Computing – Design Methodologies – Model based design – formal methods - Computational models – Reliability – Safety – Security – Applications

UNIT – II **9**

Design of Embedded Systems: Embedded processors – Multiprocessor architectures – Operating system and Middleware considerations – hardware/software co-design algorithms.

UNIT – III **9**

Sensor based Cyber Physical Systems – Wireless sensor and actuator networks – wireless implanted microsystems – Mobile cyber physical sysems.

UNIT – IV **9**

Consumer Applications: Cyber Physical System For Smart Grid Applications – Transportation – Energy Efficient Buildings – Cyber Physical Medication Systems.

UNIT – V **9**

Security: Securing Cyber Physical Infrastructures –Robustness of Internet Infrastructure – Privacy in Smart Grid – Case Study: Stuxnet

TOTAL: 45

REFERENCE BOOKS:

1. Lee Edward, SeshiaSanjitArunkumar, “Introduction to Embedded Systems – A Cyber Physical Systems Approach”, First Edition, 2012.
2. Marilyn Wolf, “High-Performance Embedded Computing: Applications in Cyber-Physical Systems and Mobile Computing”, Second Edition,2014.
3. Fei Hu, “Cyber-Physical Systems: Integrated Computing and Engineering Design” CRC Press, First Edition, 2014.
4. Sanjal Das, Krishna Kant, Nan Zhang, “Handbook on Securing Cyber-Physical Critical Infrastructure”, Morgan Kaufmann, 2012.

Course Outcomes:

On completion of the course the students will be able to

- analyze various design constraints in an embedded system
- use various methods/algorithms for hardware- software co-design
- develop applications based on cyber physical system concepts

14ESE08 HDL FOR EMBEDDED FPGA PROCESSOR

3 0 0 3

Pre-requisites: Digital Logic Circuits, VLSI Design

UNIT – I **9**

System Verilog: Introduction- Design Hierarchy- Data types- Operators and language constructs. Functional coverage- assertion- Interfaces and test bench structures

UNIT – II **9**

Modeling with Verilog HDL: Overview of digital design using Verilog-HDL-Hierarchical Modeling concepts-Basic Concepts-Gate level Modeling-Dataflow Modeling-Behaviour Modeling-Tasks and Functions-Switch level modeling

UNIT – III **9**

Logic Synthesis with Verilog HDL: Verilog HDL Synthesis-Synthesis Design Flow-Verification of the gate level net list-Modeling for logic synthesis-Example of sequential circuit synthesis.

UNIT – IV **9**

Digital System Design: Design of a Serial Adder with accumulator- Design of Binary Multiplier- Multiplication of signed binary number- Design of a binary divider- Binary decoder- Binary encoder- Multiplexer-Demultiplexer- State Graph for a control network

UNIT – V **9**

Embedded FPGA Processor: An overview of advanced FPGAs and programmable SOCs - Architecture and configuration of Spartan II and Virtex II FPGAs- Apex and Cyclone FPGAs- Virtex II PRO kits and Nios kits- OMAP- ASIC physical design issues- system partitioning- interconnect delay models and measurement of delay.

TOTAL: 45

REFERENCE BOOKS:

1. Stuart Sutherland, Simon Davidmann, and Peter Flake, "System Verilog for Design: "A Guide to Using SystemVerilog for Hardware Design and Modeling", 2nd Edition, Springer, 2010
2. Janick Bergeron, Eduard Cerny, Alan Hunter, Andy Nightingale "Verification Methodology Manual for SystemVerilog", Springer, 2005
3. Chris Spear SystemVerilog for Verification: "A Guide to Learning the Testbench Language Features", 3rd Edition, Springer, 2012
4. Samir Palnitkar, "Verilog HDL: A Guide to Digital Design and Synthesis", Pearson Education, New Delhi, 2003.

Course Outcomes:

On completion of the course the students will be able to

- classify various modeling techniques in Verilog
- implement a reconfigurable processor based on model FPGAs

14ESE09 COMPUTERS IN NETWORKING AND DIGITAL CONTROL

3 0 0 3

Pre-requisites: Computer Networks

UNIT – I **9**

Network Fundamentals: 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 **9**

Data Communication: 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 **9**

Virtual Instrumentation: 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 **9**

Measurement and control through Internet: 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 **9**

VI Based Measurement and Control: 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

REFERENCE BOOKS:

1. Wayne Tomasi, "Introduction to Data communications and Networking" Pearson Education, 2007.
2. Al Williams, "Embedded Internet Design", 2nd Edition, TMH, 2007.
3. Douglas E.Comer, "Internetworking with TCP/IP", Vol. 1, 3rd 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" 4th Edition, TMH, 2007.
6. Krishna Kant, "Computer based Industrial control",PHI, 2002.
7. Gary Johnson, "LabVIEW Graphical Programming", 2nd 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, 2005.

Course Outcomes:

On completion of the course the students will be able to

- realize the concepts of networking in both analog and digital control systems
- design and develop embedded products for measurements and controls
- develop data acquisition system using VI

14ESE10 DISTRIBUTED EMBEDDED COMPUTING

3 0 0 3

Pre-requisites: Computer Networks, Basics of Java, Computer Architecture

UNIT – I **9**

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

UNIT – II **9**

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

UNIT – III **9**

Embedded Computing Architecture: Synthesis of the information technologies of distributed embedded systems – Analog/digital co-design – optimizing functional distribution in complex system design – Validation and fast prototyping of multiprocessor system-on-chip – A new dynamic scheduling algorithm for real-time multiprocessor systems.

UNIT – IV **9**

Distributed Computing Using Java :IO streaming – Object serialization – Networking – Threading – RMI – multicasting – distributed databases – embedded java concepts – case studies.

UNIT – V **9**

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

TOTAL: 45

REFERENCE BOOKS:

1. Sape Mullender, "Distributed Systems", Addison-Wesley, 1993.
2. George Coulouris and Jean Dollimore, "Distributed Systems – concepts and design", Addison –Wesley 1988.
3. Bernd Kleinjohann, "Architecture and Design of Distributed Embedded Systems", C-lab, University at Paderborn, Germany, Kluwer Academic Publishers, Boston, April 2001, 248 pp.
4. Dietel and Dietel, "JAVA How to Program", Prentice Hall 1999.
5. Sape Mullender, "Distributed Systems", Addison-Wesley, 1993.

Course Outcomes:

On completion of the course the students will be able to

- utilize the concepts to develop web technology
- recognize the various embedded agents and distributed computing
- establish new network routing agent

14CCE04 ROBOTICS

(Common to CAD/CAM & Embedded Systems)

3 0 0 3

Pre-requisites: Kinematics of Machinery, Fundamentals of Instrumentation and measurements

UNIT – I **9**

Introduction and Robot Kinematics: Definition need and scope of Industrial robots – Robot anatomy – Work volume – Precision movement – End effectors – Sensors. Robot Kinematics – Direct and inverse kinematics – Robot trajectories – Control of robot manipulators – Robot dynamics – Methods for orientation and location of objects.

UNIT – II **9**

Robot Drives and Control: Controlling the Robot motion – Position and velocity sensing devices – Design of drive systems – Hydraulic and Pneumatic drives – Linear and rotary actuators and control valves – Electro hydraulic servo valves, electric drives – Motors – Designing of end effectors – Vacuum, magnetic and air operated grippers.

UNIT– III **9**

Robot Sensors: Transducers and Sensors – Tactile sensor – Proximity and range sensors – Sensing joint forces – Robotic vision system – Image Representation - Image Grabbing –Image processing and analysis – Edge Enhancement – Contrast Stretching – Band Rationing - Image segmentation – Pattern recognition – Training of vision system.

UNIT– IV **9**

Robot Cell Design and Application: Robot work cell design and control – Safety in Robotics – Robot cell layouts – Multiple Robots and machine interference – Robot cycle time analysis. Industrial application of robots.

UNIT – V **9**

Robot Programming, Artificial Intelligence and Expert Systems: Methods of Robot Programming – Characteristics of task level languages lead through Programming methods – Motion interpolation. Artificial intelligence – Basics – Goals of artificial intelligence – AI techniques – problem representation in AI – Problem reduction and solution techniques - Application of AI and KBES in Robots.

TOTAL : 45

REFERENCE BOOKS:

1. K.S.Fu, R.C. Gonzalez and C.S.G. Lee, “Robotics Control, Sensing, Vision and Intelligence”, Mc Graw Hill, 1987.
2. Yoram Koren,” Robotics for Engineers’ Mc Graw-Hill, 1987.
3. Richard. D, Klafter, Thomas, A, Chmielewski, Michael Negin, “Robotics Engineering – An Integrated Approach”, Prentice-Hall of India Pvt. Ltd., 1984
4. Deb, S.R.” Robotics Technology and Flexible Automation”, Tata Mc Graw-Hill, 1994.
5. Mikell, P. Groover, Mitchell Weis, Roger, N. Nagel, Nicholas G. Odrey,” Industrial Robotics Technology, Programming and Applications”, Mc Graw-Hill, Int. 1986.
6. Timothy Jordanides et al ,”Expert Systems and Robotics “, Springer –Verlag, New York, May 1991.

Course Outcomes:

On completion of the course the students will be able to

- express the concept of developmental stages in robotics
- create and evaluate newer techniques and processes in the factories of future
- assess and implement robotic process for specific application in their work flow
- selectively increase the mobility and speed of robots for specific application
- enhance the productivity of robots for specific applications by selecting the appropriate programming language and techniques

14ESE11 MOBILE APPLICATION DEVELOPMENT USING ANDROID

3 0 0 3

Pre-requisites: C, C++, Java programming

UNIT – I **9**

Introduction to Mobile Development: Mobile computing-History of mobile environments – early mobile phones to smartphones and tablets, Development for mobile environments, Differences from traditional application development, Trends in mobile development

UNIT – II **9**

Mobile Development: Introduction, Advantages, Limitations, Features useful for mobiles – Geolocation, offline web applications, offline web storage, animations, 2D/3D graphics, Audio/Video etc. , Frameworks -- HTML5 , Phone Gap (Apache Cordova) framework and jQuery Mobile framework.

UNIT – III **9**

Introduction to Android: Android Overview -- Features, Architecture, Applications, Application frameworks, Libraries, Runtime, Kernel, Android Ecosystem – Application stores, publishing, Android Development Tools – Android SDK, Android emulator, Development on hardware devices

UNIT – IV **9**

Basic Android Development: Writing Android Applications, Activity Lifecycle, Multi device support, Fragments, Data storage, Intents, Data sharing, Audio playback, Photo capture

UNIT – V **9**

Advanced Android Development: Animations. OpenGL ES, Wireless connections, Data syncing, Location aware applications, Best practices for development, Security, Distribution and Monetizing

TOTAL: 45

REFERENCE BOOKS:

1. Ed Burnette, "Hello Android: Introducing Google's Mobile Development Platform", The Pragmatic Programmers, 3rd edition, 2010
2. http://developer.android.com
3. http://www.html5rocks.com/en/mobile
4. http://mobilehtml5.org/

Course Outcomes:

On completion of the course the students will be able to

- apply the concepts of mobile computing for different applications
- design Android OS
- develop applications for smart phones

14ESE12 EMBEDDED AUTOMOTIVE NETWORKING WITH CAN

3 0 0 3

Pre-requisites: Computer Networks

UNIT – I **9**

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

UNIT – II **9**

CAN data link layer: Principles of bus arbitration – Frame formats – Error detection & error handling – fault confinement - Extended frame format – Time triggered communication

UNIT – III **9**

CAN Physical layer :Physical signaling – Transmission media – Network topology – Bus medium access – Physical layer standards – Measures for improving the Electromagnetic Compatibility

UNIT – IV **9**

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

UNIT – V **9**

CAN higher layer protocols :CAN application layer – Protocol architecture – CAN message specification – Allocation of message identifiers – Network management – Layer management – Higher layer protocols - CAN open - DeviceNet – SAEJ1939 – Time triggered CAN

TOTAL: 45

REFERENCE BOOKS:

1. Konrad Etschberger, Controller Area Network , IXXAT Automation GmbH,2001
2. Wolfhard Lawrenz, CAN System Engineering: From Theory to Practical Applications, Springer,1997.
3. Glaf P.Feiffer, Andrew Ayre and Christian Keyold "Embedded Networking with CAN and CAN open". Embedded System Academy 2005.
4. http://www.can-cia.org/can
5. http://www.semiconductors.bosch.de/en/20/can/3-literature.asp

Course Outcomes:

On completion of the course the students will be able to

- realize the importance of CAN protocol layer with respect to OSI layers
- utilize various CAN standards and specifications for embedded syatems
- use the acquired knowledge for automotive applications

14ESE13 EMBEDDED NETWORKING

3 0 0 3

Pre-requisites: Basic of Embedded Bus protocols, Wireless Sensor Network

UNIT – I **9**

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

UNIT – II **9**

USB and CAN Protocols: Firewire 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 **9**

Ethernet and Embedded Basics: 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 Exchanging messages using UDP and TCP.

UNIT – IV **9**

Wireless Embedded and Ethernet Networking: 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 **9**

Wireless Sensor Networks: Introduction – Applications – Network Topology – Localization –Time Synchronization - Energy efficient MAC protocols –SMAC – Energy efficient and robust routing – Data Centric routing.

TOTAL: 45

REFERENCE BOOKS:

1. Frank Vahid, Givargis, "Embedded Systems Design: A Unified Hardware/Software Introduction", Wiley Publications,2009
2. Jan Axelson, "Parallel Port Complete , Penram Publications,2000
3. Dogan Ibrahim, "Advanced PIC microcontroller projects in C", Elsevier 2008
4. Jan Axelson "Embedded Ethernet and Internet Complete", Penram Publications,2003
5. Bhaskar Krishnamachari, "Networking wireless sensors", Cambridge Press 2005

Course Outcomes:

On completion of the course the students will be able to

- analyze various wired and wireless protocols
- design an application using embedded Ethernet
- examine the performance of various routing techniques

14ESE14 NETWORK ON CHIP

3 0 0 3

Pre-requisites: Computer Networks

UNIT – I **9**

ICN Architectures: Introduction – Classification of ICNs - Topologies - Direct Networks - Indirect Networks.

UNIT – II **9**

Switching Techniques :Basic switching techniques - Virtual channels – Hybrid switching techniques Optimizing switching techniques - Comparison of switching techniques – Deadlock- Live lock and Starvation Issues

UNIT – III **9**

Routing Algorithms: Taxonomy of routing algorithms - deterministic routing algorithms - Partially adaptive algorithms - Fully adaptive algorithms - Routing in MINs - Routing in switch-based networks with irregular topologies - Resource allocation policies.

UNIT – IV **9**

Network-On-Chip and Performance Analysis: Network-On-Chip and Performance Analysis: NoC Architectures - Area, energy and reliability constraints - NoC design alternatives

UNIT – V **9**

Quality-of Service: Quality-of Service (QoS) issues in NoC architectures. Performance issues – Analytical and Simulation approaches – Fault-tolerance issues –Case studies.

TOTAL: 45

REFERENCE BOOKS:

1. William J. Dally and Brian Towels, "Principles and Practices of Interconnection Networks", Morgan Kaufmann Publishers, 2003
2. Giovanni Deicheli, Luca Benini, "Networks on Chips: Technology and Tools", Morgan Kaufmann Publishers, 2006
3. J.Duato, S.Yalamanchili, and Li, "Interconnection Networks: An Engineering Approach", Morgan Kaufmann Publishers, 2004.

Course Outcomes:

On completion of the course the students will be able to

- implement the various routing algorithms and topologies
- implement ICN architecture and switching techniques
- examine the performance of network and its issues

14ESE15 MEDICAL IMAGING SYSTEMS

3 0 0 3

Pre-requisites: Digital Signal Processing, , Medical Electronics

UNIT – I **9**

Image Fundamentals: Image perception, MTF of the visual system, Image fidelity criteria, Image model, Image sampling and quantization – two dimensional sampling theory, Image quantization, Optimum mean square quantizer, Image transforms – 2D-DFT and other transforms.

UNIT – II **9**

Image preprocessing :Image enhancement – point operation, Histogram modeling, spatial operations, Transform operations,Image restoration – Image degradation model, Inverse and Weiner filtering. Image Compression –Spatial and Transform methods

UNIT – III **9**

Medical Image Reconstruction :Mathematical preliminaries and basic reconstruction methods, Image reconstruction in CT scanners, MRI, fMRI, Ultra sound imaging., 3D Ultra sound imaging Nuclear Medicine Imaging Modalities-SPECT,PET, Molecular Imaging.

UNIT – IV **9**

Image Analysis and Classification: Image segmentation- pixel based, edge based, region based segmentation. Image representation and analysis, Feature extraction and representation, Statistical, Shape, Texture, feature and image classification – Statistical, Rule based, Neural Network approaches

UNIT – V **9**

Image Registration And Visualization :Rigid body visualization, Principal axis registration, Interactive principal axis registration, Feature based registration, Elastic deformation based registration, Medical image fusion, Image visualization –2D display methods, 3D display methods, virtual reality based interactive visualization.

TOTAL: 45

REFERENCE BOOKS:

1. Atam P.Dhawan, 'Medical Image Analysis', Wiley Interscience Publication, NJ, USA 2003.
2. R.C.Gonzalez and R.E.Woods, 'Digital Image Processing', Second Edition, Pearson Education,2002.
3. Anil. K. Jain, 'Fundamentals of Digital Image Processing', Pearson education, Indian Reprint2003.
4. Alfred Horowitz, 'MRI Physics for Radiologists – A Visual Approach', Second edition Springer Verlag Network, 1991.
5. Kavyan Najarian and Robert Splerstor," Biomedical signals and Image processing",CRC – Taylor and Francis,New York,2006
6. John L.Semmlow,"Biosignal and Biomedical Image Processing Matlab Based applications" Marcel Dekker Inc.,New York,2004

7 Jerry L.Prince and Jnathan M.Links," Medical Imaging Signals and Systems"- Pearson Education Inc. 2006

8 Geoff Dougherty, "Digital Image Processing for Medical Apllications,"Cambridge University Press,India 2009

Course Outcomes:

On completion of the course the students will be able to

- analyze the concepts of digital image processing and transform techniques
- use different imaging modalities for development medical imaging systems

14ESE16 SOLAR AND ENERGY STORAGE SYSTEM

3 0 0 3

Pre-requisites: Electron Devices, Basics of Electricity

UNIT – I **9**

Introduction: Characteristics of sunlight – semiconductors and P-N junctions –behavior of solar cells – cell properties – PV cell interconnection

UNIT – II **9**

Stand Alone PV System: Solar modules – storage systems – power conditioning and regulation - protection – stand alone PV systems design – sizing

UNIT – III **9**

Grid Connected PV Systems: PV systems in buildings – design issues for central power stations – safety – Economic aspect –Efficiency and performance - International PV programs

UNIT – IV **9**

Energy Storage Systems: Impact of intermittent generation – Battery energy storage – solar thermal energy storage –pumped hydroelectric energy storage

UNIT – V **9**

Applications: Water pumping – battery chargers – solar car – direct-drive applications –Space – Telecommunications.

TOTAL: 45

REFERENCE BOOKS:

1. Stuart R.Wenham, Martin A.Green, Muriel E. Watt and Richard Corkish, Applied Photovoltaics, 2007,Earthscan, UK.
2. Eduardo Lorenzo G. Araujo, Solar electricity engineering of photovoltaic systems, Progensa,1994.
3. Frank S. Barnes & Jonah G. Levine, Large Energy storage Systems Handbook , CRC Press, 2011.
4. Solar & Wind energy Technologies – McNeils, Frenkel, Desai, Wiley Eastern, 1990
5. Solar Energy – S.P. Sukhatme, Tata McGraw Hill,1987.

Course Outcomes:

On completion of the course the students will be able to

- design solar PV
- implement various energy storage systems
- design applications based on solar PV

14ESE17 SYSTEM ON CHIP

3 0 0 3

Pre requisites: VLSI Design Techniques

UNIT-I **9**

Digital Systems: Digital system and VLSI-Transistors-Design rules-Layout design and tools-logic gates-static complementary gates-switch logic-alternative gate circuits-delay through resistive interconnect-delay through inductive interconnect.

UNIT-II **9**

Combinational Network: Combinational logic network-standard cell based layout- Combinational network delay-logic and interconnect design-power optimization-switch logic network-combinational logic testing

UNIT-III **9**

Sequential Network: Sequential machines-Latches and Flipflops-Sequential systems and clocking disciplines-Sequential System Design- Power optimization-Design Validation-Sequential testing.

UNIT-IV **9**

Subsystem Design: Subsystem Design-Principles of Shifters-Adders-ALU-Multiplier-High Density Memory-FPGA-PLA- Floor planning methods- off chip connections-Architectural Design –HDL-Register Transfer Design-High Level Synthesis

UNIT-V **9**

Subsystem Architectures: Architecture for low power-SoC and embedded CPUs-Architecture testing.- Chip Design-methodologies-Kitchen Timer Chip-Microprocessor Data Path CAD systems and algorithms-Switch level simulation-layout synthesis-analysis-timing analysis and optimization-logic synthesis-test generation-Sequential machine optimization-scheduling and binding-Hardware/Software co-design.

TOTAL: 45

REFERENCE BOOKS

1. Wolf, Wayne "Modern VLSI Design: System-on-Chip Design", 3rd Edition, Pearson Edition, New Delhi, 2004.
2. Reis, Ricardo. "Design of System on a Chip: Devices and Components", Springer, 2004.
3. Rashinkar P., Paterson and Singh L., "System on a Chip Verification – Methodologies and Techniques", Kluwer Academic Publishers, 2001.
4. Wang, Laung – Terng, Stroud, Charles.E., Touba, Nur.A, "System–on–Chip Test Architectures: Nanometer Design for Testability", Elsevier Inc,2007.
5. www.elsevier.com

Course Outcomes:

On completion of the course the students will be able to

- design a combinational and sequential system network
- utilize the design methodology in subsystems and CAD systems

14ESE18 MICRO SYSTEMS DESIGN

3 0 0 3

Pre-requisites: : Material Science, Basic Instrumentation

UNIT – I **9**

Micromechanics: Overview - Microsystems and microelectronics - Working principle of Microsystems - Micro actuation techniques - Micro sensors – Types – Microactuators – Types – Micropump – Micromotors – Microvalves – Microgrippers - Scaling laws in Miniaturization- Mechanics for MEMS design: Bending of thin plates, Vibration and fracture mechanics

UNIT – II **9**

Materials for MEMS : Substrates and wafer - Single crystal silicon wafer formation - Ideal substrates - Mechanical properties - Silicon compounds - Sio2, SiC, Si3N4 and polycrystalline silicon - Silicon piezoresistors - Gallium Arsenidede - Quartz-piezoelectric crystals - Polymers for MEMS - Conductive polymers

UNIT – III **9**

Fabrication Process: Photolithography - Ion implantation - Diffusion – Oxidation – CVD - Physical vapor deposition - Deposition by epitaxy - Etching process

UNIT – IV **9**

Micro System Design and Manufacturing: Clean room technology - Bulk Micro manufacturing - Surface micro machining – LIGA –SLIGA - Die level, device level and system level practices

UNIT – V **9**

Application of Microsystems: Automotive industry- Biomedical- Consumer products - Aero space and Telecommunications.

TOTAL: 45

REFERENCE BOOKS:

1. Mohamed Gad –el-Hak, "The MEMS Hand Book", CRC press, 2002.
2. Tai – Ran Hsu, "MEMS and Microsystems design and manufactures" Tata McGraw Hill, New Delhi, 2008.
3. Doebelin, E.O., "Measurement Systems: Application & Design", 5th Edition McGraw-Hill Book Co., New Delhi, 2004.
4. Sheingold, D.H., "Transducer Interfacing Handbook: The guide to analog signal conditioning", Analog devices Inc, 1993.
5. Fatilcow. S and Rembold U, "Microsystem Technology and Microrobotics, Springer – verlog Berlin, 1997.
6. Garden, J.W. Varadan.V.K., Osama and Awadelkarim.O., "Microsensors MEMS and Smart Devices", John Wiley & sons Ltd., New York, 2001.

7 IEEE/ASME: Journal on Microelectromechanical Systems.

Course Outcomes:

On completion of the course the students will be able to

- use the principles of microsensors and microactuators for designing microsystems
- fabricate and manufacture microsystem

14COE05 DIGITAL IMAGE PROCESSING AND MULTI RESOLUTION ANALYSIS

(Common to Communication Systems, VLSI Design, Embedded Systems, Computer and Communication Engineering & Mechatronics)

3 0 0 3

Pre-requisites: Digital Signal Processing

UNIT – I **9**

Image Transforms: Orthogonal transforms – FT,DST,DCT, Hartley, Walsh hadamard, Haar, Radon, Slant Wavelet, KL, SVD and their properties

UNIT – II **9**

Image Enhancement and Restoration: Image enhancement - Point operations - contrast stretching - clipping and thresholding - digital negative intensity level slicing - bit extraction. Histogram processing - histogram equalisation -modification. Spatial operations – smoothing spatial filters, sharpening spatial filters. Transform operations. Color image enhancement. Image Restoration – degradation model, Noise models, Unconstrained and Constrained restoration, Inverse filtering – removal of blur caused by uniform linear motion, Wiener filtering, Restoration by SVD and Homomorphic filtering

UNIT – III **9**

Image Compression: Image Compression – Need for data compression – Run length encoding – Huffman coding – Arithmetic coding – predictive coding- transform based compression, - vector quantization – block truncation coding.

Image Segmentation: Point, Edge and line detection -thresholding-Region based approach

Image Representation: boundary based – region based and intensity based description

UNIT – IV **9**

Registration and Multi valued image Processing: Registration – geometric transformation – registration by mutual information

Mutivalued image processing – colour image processing – colour image enhancement- satellite image processing- radiometric correction – other errors- multi spectral image enhancement- medical image processing – image fusion

UNIT – V **9**

Wavelets And Multiresolution Processing : Image Pyramids – Subband coding – The Haar Transform – Multiresolution Expansion – Series Expansion – Scaling Function – Wavelet Function – Wavelet Transform in One Dimension- The Wavelet Series Expansion – The Discrete Wavelet Transform – The Continuous Wavelet Transform – The Fast Wavelet Transform – Wavelet transform in two dimensions– Applications in image denoising and compression

Total : 45

REFERENCE BOOKS:

1. Chanda B, Dutta Majumder D., “Digital Image Processing and analysis”, 2nd Edition, PHI learning, 2011
2. Gonzalez, Rafel C. and Woods, Richard E., "Digital Image Processing", 2nd Edition, Prentice Hall, New York, 2006.
3. Jain, Anil K., "Fundamentals of Digital Image Processing", Prentice Hall of India, New Delhi, 2003.

4. Rosenfield, Azriel and Kak, Avinash C., “Digital Picture Processing”, Academic Press Inc, New York, 1982.
5. Jayaraman. S, Esakkirajan. S, and Veerakumar. T, “Digital Image Processing” Tata McGraw-Hill, New Delhi, 2009

Course Outcomes:

On completion of the course the students will be able to

- analyze and process digital images and color images in various domains
- apply concepts of wavelets in image processing for various applications