NEHRU MEMORIAL COLLEGE (AUTONOMOUS)

Nationally Accredited with "A" Grade by NAAC

PUTHANAMPATTI – 621 007
TIRUCHIRAPPALLI – Dt

SYLLABUS

M.Sc., EMBEDDED SYSTEMS

(UGC INNOVATIVE PROGRAMME)

Post-Graduate Programmes – Course Structure under CBCS
(Candidates are admitted from the year 2015 onwards)

DEPARTMENT OF EMBEDDED SYSTEMS

2015

NEHRU MEMORIAL COLLEGE (AUTONOMOUS)

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PUTHANAMPATTI-621007

TIRUCHIRAPALLI – Dt

Post-Graduate Programmes – Course Structure under CBCS

(Candidates admitted from the year 2015 onwards)

M.Sc., EMBEDDED SYSTEMS

(UGC INNOVATIVE PROGRAMME)

Sem	Course	Sub. Code	Title of the Course	Inst. Hrs/ Week	Credits	Marks		
						Int.	Ext.	Total
I	CC-I		Introduction to Embedded Systems	6	5	40	60	100
	CC-II		Sensors and Signal Conditioning	6	5	40	60	100
	CC-III		The 8051 Microcontroller Architecture and Programming	6	5	40	60	100
	CC-IV		The 8051 Microcontroller Programming Lab	6	3	40	60	100
	CEC-I		Candidate has to choose any one of the course from Group I	6	4	40	60	100
				30	**22**	**200**	**300**	**500**
II	CC-V		Engineering Mathematics	5	5	40	60	100
	CC-VI		Design of Embedded Systems with PIC Microcontroller	5	5	40	60	100
	CC-VII		Real Time Operating Systems	5	5	40	60	100
	CC-VIII		PIC Microcontroller Programming Lab	6	3	40	60	100
	CC-IX		Mini Project	4	4	-	100	100
	OEC-I		Candidate has to choose any one of the course offered by the Department / Other Departments	5	4	40	60	100
				30	**26**	**200**	**400**	**600**
III	CC-X		ARM Cortex Microcontroller and Programming	5	5	40	60	100
	CC-XI		PSoC Architecture and Applications	5	5	40	60	100
	CC-XII		ARM & PSoC Microcontroller Programming Lab	6	3	40	60	100
	CC-XIII		Embedded Networks and Protocols	5	5	40	60	100
	CC-XIV		Mini Project	4	3	-	100	100
	CEC - II		Candidate has to choose any one of the course from Group II	5	4	40	60	100
	SOC- I		Internship	-	4	100	-	100
				30	**29**	**300**	**400**	**700**
IV	CC- XV		Project	18	9	-	100	100
	CEC – III		Candidate has to choose any one of the course from Group III	6	4	40	60	100
	CEC - IV		Candidate has to choose any one of the course from Group IV	6	4	40	60	100
				30	**17**	**80**	**220**	**300**
				120	**94**	**780**	**1320**	**2100**

ELECTIVE COURSES

GROUP– I (SEMESTER-I)

Sub. Code	Title of the Courses	Inst. Hours/ Week	Credits	Marks		
				Int.	Ext.	Total
	The C Programming Language	6	4	40	60	100
	Embedded System Design	6	4	40	60	100
	Advanced Digital System Design	6	4	40	60	100

GROUP– II (SEMESTER-III)

Sub. Code	Title of the Courses	Inst. Hours/ Week	Credits	Marks		
				Int.	Ext.	Total
	Programming In JAVA	5	4	40	60	100
	Embedded Linux	5	4	40	60	100
	VLSI Design	5	4	40	60	100

GROUP– III (SEMESTER-IV)

Sub. Code	Title of the Courses	Inst. Hours/ Week	Credits	Marks		
				Int.	Ext.	Total
	Hardware Software Co – Design	6	4	40	60	100
	Wireless Sensors Networks	6	4	40	60	100
	Hardware Description Language	6	4	40	60	100

GROUP– IV (SEMESTER-IV)

Sub. Code	Title of the Courses	Inst. Hours/ Week	Credits	Marks		
				Int.	Ext.	Total
	Modern Embedded Computing	6	4	40	60	100
	Mechatronics	6	4	40	60	100
	MEMS Technology	6	4	40	60	100

OPEN ELECTIVE COURSE (SEMESTER-II)

Sub. Code	Title of the Courses	Inst. Hours/ Week	Credits	Marks		
				Int.	Ext.	Total
	Principles of Robotics	5	4	40	60	100
	68HC12 and HCS12 Microcontroller Architecture and Applications	5	4	40	60	100
	AVR Microcontroller Architecture and Applications	5	4	40	60	100

COURSE DETAIL

Type of Courses	Number of Courses	Inst. Hours/ Week	Credits
Core	15	92	70
Elective	4	23	16
Open Elective	1	5	4
	20	**120**	**90**
Skill Oriented Course ***(Internship)***	1	-	4
Total	**21**	**120**	**94**

SEM- I	EMBEDDED SYSTEMS	CT	HOURS	CREDITS
	INTRODUCTION TO EMBEDDED SYSTEMS	CC	6	5

Objectives

- To learn the fundamentals of hardware and software of embedded systems.

UNIT-I: Introduction to Embedded Systems

Embedded Systems –Processor Embedded into a System – Embedded Hardware Units and devices in a System – Embedded Software in C System – Embedded System On-Chip – Classification of Embedded Systems – Skills Required for an Embedded System Designer.

UNIT-II: Devices and Communication Buses for Devices Network

I/O Types – Serial Communication Devices – Parallel Devices Path – Wireless Devices – Watchdog Timer – Timer and Counting Devices – Real Time Clock – Serial Bus Communication protocols – parallel Bus Device Protocol.

UNIT-III: Programming Concepts and Embedded Programming

Software Programming in Assembly Language and in High Level Language "C" – C Program Elements:– Header and Source Files –Preprocessor Directives – Program Elements: Macros and Function – Data Types – Data Structures – Modifiers – Statements – Loops and Pointers.

UNIT-IV: Embedded Software Development Process

Introduction to Embedded Software Development Process and Tools – Host and Target Machines – Linking and Locating Software – Getting Embedded Software into the Target System – Issues in Hardware-Software Design and Co-Design.

UNIT-V: Testing, Simulation and Debugging Techniques and Tools

Testing on Host machine – Simulators – Simulator Features – Simulator Possible Inabilities – Simulating Tool Software – Laboratory Tools – In-Circuit Emulator(ICE).

Book for Study

1. Raj Kamal, "*Embedded Systems Architecture, Programming and Design*", TataMcGrew Hill, Second Edition, 2008.
2. Shibu K.V, "*Introduction to Embedded Systems*", McGrew Hill Education, Eight Edition, 2013

Book for Reference

1. Steve Heath, "*Embedded Systems Design*", Elsevier Science, Second Edition, 2008.
1. James K.Peckol, "*Embedded system Design*", John Wiley &Sons, 2010.
2. Elicia White,"*Making Embedded Systems*", O'Reilly Series, SPD, 2011.

SEM- I	EMBEDDED SYSTEMS	CT	HOURS	CREDITS
	SENSORS AND SIGNAL CONDITIONING	CC	6	5

Objectives

- To understand the principle and working of various types of sensors and signal conditioning circuits.

UNIT-I: Principles of Transducers

Classification - static and dynamic characteristics of transducers - Temperature transducers: RTD – Thermistor – Thermocouple - Semiconductor Temperature Sensors

UNIT-II: Displacement Transducers

Potentiometer - Resistive Strain Gauges - Capacitive Transducer – LVDT – Semiconductor – Transducers - Piezoelectric Transducer - Flow Transducers – Magnetic – Ultrasonic - Humidity Sensors

UNIT-III: Optical Sensors and Biological Sensors

Principles of Optical Sensors and Types of Optical Sensors - Biological Sensors - Receptors in the Human Body - Ion Exchange Membrane Electrodes - Enzymatic Biosensors - Basic Principles of MOSFET Biosensors & BIOMEMS - Basic Idea about Smart Sensors.

UNIT-IV: Linear Integrated Circuits

Operational Amplifier - Inverting and Non-Inverting Amplifier – Adder – Subtractor - Differential Amplifier – Integrator - Differentiator - Instrumentation Amplifiers - Transducer Bridge Amplifier - 555 Timer and circuits: Astable Multivibrator, Monostable Multivibrator.

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UNIT-V: Signal Conditioning

Active Filters - Low Pass - High Pass - Band Pass - Band Stop Filters – Attenuator - Wheatstone Bridge Circuit – DeSauty Bridge – Voltage to Frequency Convertor – Frequency to Voltage Convertor – A/D Convertor : Successive Approximation Method – Data Acquisition System – Single Channel and Multi-Channel Data Acquisition System – Reduction of Ground Interference Signals – Input Guarding - IC Dual Regulated Power Supply

Books for Study

1. Patranabis, D, "*Sensors And Transducers*", Second Edition, 2008.
2. A. K. Sawhney And P. Sawhney, "*A Course In Mechanical Measurements And Instrumentation*", Twelth Edition, 2001.
3. Roy Choudhury, "*Linear Integrated Circuits*", New Age International Publisher, Second Edition, 2008.

Books for Reference

1. Ramakant Gayakwad," *Operational Amplifier and Linear Integrated Circuits*", Fourth Edition, 2009.
2. A. K. Sawhney," *A Course in Electrical and Electronic Measurements and Instrumentation*", Fourth Edition, 2009.

SEM- I	EMBEDDED SYSTEMS	CT	HOURS	CREDITS
	THE 8051 MICROCONTROLLER ARCHITECTURE AND PROGRAMMING	CC	6	5

Objectives

- To learn the architecture, programming and general applications of 8051 microcontroller.

UNIT-I: 8051 Microcontroller Architecture

Microcontroller Versus General Purpose Microcontroller - Microcontroller for Embedded Systems – Criteria For Choosing a Microcontroller – Overview of the 8051 – Internal Architecture – Registers – Internal RAM – 8051 Register Banks and Stack – Program Counter – Addressing Modes.

UNIT-II: Instruction Set

Instruction Set – Data Transfer Instructions – Arithmetic – Logical – Boolean Variables Manipulation – Program Branching – Simple Programs: Addition – Subtraction – Multiplication – Division – Direct Bank Register Addressing – Indirect register bank addressing – RAM direct addressing – DPTR pointer register and external memory – stack operation – subroutines.

UNIT-III: I/O Port Programming

I/O Port Pins and their Functions – I/O Bit Manipulation Programs – Polling a Button and Turn on a LED – Button Debouncing – Christmas Light – Stepper Motor – Stack Machines.

UNIT-IV: Timers and Serial Port Programming

Programming 8051 Timers – TMOD Register – TCON Register – Mode 1 Programming – Mode 2 Programming – Program for Generating Square Wave Generator using Mode 1 and Mode 2 – Counter Programming – Pulse Measurement – Basics of Serial Communications – Serial Port Programming – SBUF Register – SCON Register – Simple Program : Transfer and Receive Data Serially – 8051 Interrupts – IE Registers – Interrupt Priority – Simple Program Using Interrupts.

UNIT-V: Applications using 8051 Microcontroller

Interface 0804 with 8051 Microcontroller – LCD Interfacing – DAC Interfacing – Temperature Measurement – DC Motor Control Using PWM – Logic Controller – Pressure Measurement.

Books for Study

1. Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. Mckinlay,"*8051 Microcontroller and Embedded Systems using Assembly and C*", Pearson Education 2007.
2. MykePredko, "*Programming and customizing the 8051 microcontroller*", Tata McGraw Hill 2001.
3. Michael J. Pont, "*Embedded C*", Pearson Education, First Edition,2013.

Book for Reference

1. K.UmaRao, AndhePallavi, "*The 8051 Microcontrollers Architecture, Programming and Applications*", Pearson, Second impression 2011.
2. Kenneth.J.Ayala, "*The 8051 Microcontroller*", Thomson, Third Edition 2007.
3. Zdra Uko Karakehayou, Knud Smed Christengen,"*Embedded System Design with 8051 Microcontroller*", Marcel Dekker Inc, First Edition, 2010.

SEM-I	EMBEDDED SYSTEMS	CT	HOURS	CREDITS
	8051 MICROCONTROLLER PROGRAMMING LAB	**CC**	**6**	**3**

Experiments

1. Interfacing of LED
2. Interfacing of LCD Display
3. Seven Segment Display
4. Stepper Motor
5. Analog to Digital Convertor
6. Digital to Analog Convertor
7. Generating Square Wave using Timer
8. Object Count using LDR/IR Sensor
9. Buzzer
10. Keyboard Interfacing
11. Relay Control
12. DC Motor Control using Pulse Width Modulator.
13. Enabling and Disabling Interrupt.
14. ISR.
15. Program to Interrupt Priority.

SEM- I	EMBEDDED SYSTEMS	CT	HOURS	CREDITS
	THE C PROGRAMMING LANGUAGE	CEC	6	4

Objectives

- To learn the fundamentals of C Language for on embedded system design.

UNIT-I: Data Types

Character Set – Data Types – Modifiers – Access Modifiers- Types of Variables – Storage Specifiers – Different Types of Operators

Unit –II Loops and Decisions

Conditional Statements – If-Nested If- If –Else Statements- Switch- Nested Switch Statement- Conditional Looping: While Loop- Do-While Loop – Break- Continue – Goto Statements

Unit-III Structure, Unions and Pointers

Structure – Initialization of Structure – Nested Structure – Union Operations- Pointers: Pointer Operator – Pointer Void – Pointers And Array – Pointers To Pointers

Unit –IV Arrays

One Dimensional Array – Initialization – One Dimensional Array And Structure- Vector Operations- Random Access- Two Dimensional Array – Multi Dimensional Array

Unit –V Graphics

Text Graphics – Text Mode – Plotting Mathematical Function- Graphical Function- Plotting Mathematical Function – Simple Programs

Books for Study

1. R.B.Patel, *Go Through C*, BPB Publications, New Delhi, 1998.
2. Susant K.Rout, "*Cimple C is Simple*", McGraw Hill, New Delhi, 2008.

Books for Reference

1. Brain W.Kernighan, Dennis M.Ritche," *The C Programming Language*", PHI, Second Edition, 2012.
2. Sachin Kadam, Hanumant Renushe, "C Interview", Himalaya Publishing House, First Edition, 2012.
3. Arunesh Goyal, "*The C Language Programming*", Narosa Publishing, 2008.
4. Yashavant Kanetkar, "*Let U C Work Book*", BPB publications, Nineth Edition, 2010.

SEM- I	EMBEDDED SYSTEMS	CT	HOURS	CREDITS
	EMBEDDED SYSTEM DESIGN	CEC	6	4

Objectives

- To deal with various approaches to building embedded systems.
- To introduces unified view of hardware and software.
- To make the students aware of the various applications of embedded systems.

UNIT-I: Embedded Systems Overview

Introduction – Embedded systems overview – Design Challenge – Processor technology- IC technology- Design technology – Tradeoffs - Custom single purpose processors: Hardware- Introduction- Combinational logic – Sequential logic – custom single purpose processor design- RT level custom single purpose processor design – Optimizing custom single purpose processors.

UNIT-II: General Purpose Processors: Software and Peripherals

Introduction – Basic architecture- operation – Programmer's view- Development Environment- Application specific Instruction set processors- selecting a microprocessor- general purpose processor design – Peripherals: Timers, Counters and Watchdog Timer – UART – Pulse Width Modulators- LCD controllers- Keypad controllers – Analog to Digital converters.

UNIT-III: Memory

Introduction – Memory write ability and storage permanence write ability – common memory types – composing memory – Memory Hierarchy and cache – Advanced RAM.

UNIT-IV: Interfacing

Introduction – communication basics – microprocessor interfacing: I/O addressing – interrupts – Direct memory access – Arbitration – Multilevel bus architectures – Advanced communication principles – serial protocols – parallel protocols- wireless protocols.

UNIT-V: Embedded System Design: Examples

Introduction to a simple digital camera – requirements specification – Design. Control systems: Open loop and Closed loop control systems – General control systems – PID controllers – software coding – PID tuning – Benefits of Computer based control implementation.

Book for Study

1. Frank Vahid, Tony Givargis, "*Embedded System Design: A Unified Hardware/Software Introduction*", Wiley Student Edition, 2008.

Books for Reference

1. Steve Heath, "*Embedded Systems Design*", Elsevier Science, Second Edition,2008
2. Scott MacKenzie, Raphael C.W.Phan, "The 8051 *Microcontroller*", Pearson, 2012.
3. Peter Marweded,"*Embedded System Design,*" Springer, Second Edition, 2011.

SEM- I	EMBEDDED SYSTEMS	CT	HOURS	CREDITS
	ADVANCED DIGITAL SYSTEM DESIGN	CEC	6	4

Objectives

- To provide in-depth understanding of digital systems and their design, from specification and simulation to construction and debugging

UNIT-I: Sequential Circuit Design

Overview of IC technology - Digital hardware components - Design process of digital hardware - Analysis of Clocked Synchronous Sequential Networks ,Modelling of CSSN – State Stable Assignment and Reduction - Analysis of Asynchronous Sequential Circuit – Flow Table Reduction – State Assignment, Problem and the Transition Table – Design of ASC.

UNIT-II: Hardware Description Languages

Introduction to VHDL - Types of modelling - Behavioural Modelling - Transport vs. Inertial Delay - Simulation Deltas - Sequential Processing - Process Statement – Signal Assignment vs. Variable Assignment - Sequential Statements - Data Types -Subprograms and Packages - Predefined Attributes - Configurations – Subprogram Overloading - VHDL synthesis - Design Examples.

UNIT-III: VHDL Code

Design and testing BCD Adders, multiplexer, Demultiplexer, Encoder, Decoder, ALU,RAM, flip flops, registers, Latches Counters circuits using VHDL - Synchronous versus Asynchronous Circuits design - Implement state machines using VHDL codes – Design of a Simple Microprocessor.

UNIT-IV: Programmable Devices

EPROM to Realize a Sequential Circuit – Programmable Logic Devices – Designing a Synchronous Sequential Circuit using a PAL – EPROM – Realization State machine using PLD - Complex Programmable Logic Devices and Field Programmable Gate Arrays - Altera Series FPGAs and Xilinx Series FPGAs.

UNIT-V: Testing Of Logical Circuits

Fault model - Hazards - Fault diagnosis and testability algorithms, Fault Table Method –Path Sensitization Method – Boolean Difference Method - Kohavi Algorithm – Tolerance Techniques - Test Generation – Masking Cycle - DFT Schemes - Built-in Self Test.

Books for Study

1. Dueck, "*Digital Design with CPLD Application and VHDL*", Mixed Media, Revised, 2011
2. Stephen Brown and Zvonk Vranesic, "*Fundamentals of digital logic with VHDL Design*" 3rd Edition, McGraw Hill, 2013.

Books for Reference

1. John M Yarbrough, "*Digital Logic Applications and Design*" Cengage Learning .9th Indian, 2012.
2. Nripendra N Biswas, "*Logic Design Theory*" Prentice Hall of India, 2001.

SEM-II	EMBEDDED SYSTEMS	CT	HOURS	CREDITS
	ENGINEERING MATHEMATICS	CC	5	5

Objectives

- To develop the ability to apply the concepts of Matrix theory and Linear programming in engineering problems.
- To achieve an understanding of the basic concepts of one dimensional random variables and apply in engineering problems.

UNIT-1: Ordinary Differential Equations

Basic Concepts and Ideas – Geometrical meaning of y'= f(x,y) – Direction Fields – Separable Differential Equations – Modeling: Separable Equations – Exact Differential Equations - Integrating Factors- Linear Differential Equations – Bernoulli Equations – Modeling: Electric circuits – Homogeneous Linear Equations of Second Order – Second-Order Homogenous Equations with Constant Coefficients – Case of Complex Roots – Complex Exponential Function – Nonhomogeneous Equations – Solution by Undetermined Coefficients.

UNIT-2: Laplace Transforms

Laplace Transform – Inverse Transform – Linearity – Shifting – Transforms of Derivatives and Integrals – Differential Equations – Unit Step Function – Second Shifting Theorem – Dirac's Delta Function – Differentiation and Integration of Transforms – Convolution – Integral Equations – Partial Fractions – Differential Equations – Systems of Differential Equations

UNIT-3: Linear Algebra, Vector Calculus

Basic Concepts – Matrix Addition – Scalar Multiplication - Matrix Multiplication – Linear Systems of Equations – Rank of Matrix – Determinants – Cramer's Rule – Inverse of a Matrix – Gauss-Jordian Elimination – Eigenvalues - Eigenvectors – Symmetric – Skew-Symmetic – Orthogonal Matrices – Complex Matrices: Hermitian – Skew-Hermitian – Unitary – Similarity of Matrices – Basic of Eigenvectors – Diagonalization

UNIT-4: Fourier Analysis And Partial Differential Equations

Periodic Functions – Trignometric Series – Fourier Series – Functions of Any Period p =2L – Even and Odd Functions – half-Range Expansions – Fourier Integrals – Fourier Cosine and Sine Transforms – Fourier Transform – Basic Concepts.

UNIT-5: Statistics

Data: Representation - Average – Spread – Experiment – Outcomes – Events – Probability – Permutations – Combinations – Random Variable – Probability Distribution – Binomial – Poisson – Hypergeometric Distribution – Normal Distribution – Introduction Random Sampling – Estimation of Parameters – Confidence Intervals – Testing of Hypotheses –Goodness of Fit x^2 – Test.

Books for Study:

1. ERWIN KREYSZIG, "*Advanced Engineering Mathematics*", John – Wiley, Singapore, 2005.

Books for Reference:

1. Taha, H.A., "*Operations Research, An introduction*"**,** Pearson education, Tenth Edition, New Delhi, 2010.
2. Andrews L.C. and Phillips R.L., "*Mathematical Techniques for Engineers and Scientists*", Prentice Hall of India Pvt.Ltd., New Delhi, 2005.
3. Elsgolts, L., "*Differential Equations and the Calculus of Variations*", MIR Publishers, Moscow, 1973.

SEM-II	EMBEDDED SYSTEMS	CT	HOURS	CREDITS
	DESIGN OF EMBEDDED SYSTEMS WITH PIC MICROCONTROLLER	CC	5	5

Objectives

- To understand the function of RISC architecture and On-Chip peripherals of PIC microcontroller.

UNIT-I: Introduction to the PIC18 Microcontroller

Overview of the PIC Microcontroller-Memory organization – CPU Registers – Addressing Mode – PIC 18 Instruction Format – Assembler Directives – Control Directives – Data Directives – Macro Directives – Listing Directives – Object Directives

UNIT-II: Assembly Language Programming

Writing Programs to perform Arithmetic Computations – Program Loops – Logic Instructions – Rotate Instructions - Perform Multiplication and division Using Rotate Instructions- Signed Arithmetic – Unsigned/ Signed Division Operation - The Stack – Subroutines – String Programming – Examples of Subroutines calls

UNIT-III: Parallel Ports and Serial Peripheral Interface

I/O Addressing – Overview of PIC 18 Parallel Ports – Interfacing of Single Output Devices – LED- Seven Segment Display – LCD- Keyboard – D/A Convertors - PIC 18 Serial Communication Interface – USART Related Registers - USART Asynchronous Mode – SPI Mode - Digital Temperature Sensors – DS1306 Real Time Clock

UNIT-IV: Timers, CCP Modules and Interrupts

Timers: Overview of PIC18 Timer Functions - Timers – Capture /Compare / PWM Modules - CCP: CCP in Compare Mode – CCP in PWM Mode - Interrupts: Basics of Interrupts - Resets- PIC 18 Interrupts – Interrupts Operation

UNIT-V: I^2C,A/D Convertors and Applications

The I^2C Protocol – Registers for I^2C Operation - I^2C Master Mode and Slave Mode - A/D Convertor : Basics of A/D Conversion – PIC 18 A/D convertor – Procedure for Performing A/D Conversion - Humidity Measurement - Distance Measurement using LVDT/ Ultrasonic Sensor – Object Counting.

Book for Study

1. Han-Way Huang, "*PIC Microcontroller an Introduction to Software and Hardware Interfacing*", Delmar Cengage Learning, New Delhi,2012.

Books for Reference

1. Muhammad Ali Mazidi, Rolin D. McKinlay, Danny Causey, "*PIC Microcontroller and Embedded Systems Using Assembly and C For PIC 18*", Always Learning,2012.
2. Tim Wilmshurst,"*Designing Embedded Systems With PIC Microcontrollers Principles and Applications*", Newness An Imprint of Elsevier, Second Edition,2010.

SEM-II	EMBEDDED SYSTEMS	CT	HOURS	CREDITS
	REAL TIME OPERATING SYSTEMS	CC	5	5

Objectives

- To provide an understanding of RTOS essentials, advantages and trade-offs.
- To impart the basic knowledge and understanding about the methods and techniques of robust real-time systems.

UNIT-I: Real-Time Systems Concept

Foreground/background systems - Non-preemptive kernel, Preemptive kernel – Critical sections: resources – multitasking - context switching – scheduling - reentrancy – task priorities - mutual exclusion - semaphores - Deadlock - Synchronization - Event Flags -inter task communications - interrupts -Clock Tick -Memory Requirements.

UNIT-II: Kernel Structure

Tasks - Task States - Task control blocks - Ready List - Task Scheduling - Idle Task – CPU usage- Microcontroller /OS-II features **-** Interrupts under µC/OS-II-Task Management - Create a task delete a task - check the size of a task's stack - Change a Task's Priority - Suspend and resume a task - Time Management.

UNIT-III: Task and Time Management

Creating a Task – Task Stacks – Stack Checking – Deleting a Task – Requesting to Delete a Task Changing a Task's Priority – Suspending a Task – Resuming a Task – Getting Information about a Task – Delaying a task – Resuming a Delayed Task – System Time.

UNIT-IV: Event Control Blocks and Semaphore Management

Placing a Task in the ECB Wait List – Removing a Task from an ECB Wait List – Finding the Highest Priority Task Waiting on an ECB – List of Free ECBs – Initializing an ECB – Making a Task Ready – Making a Task Wait for an Event – Making a Task Ready Because of a Timeout – Creating a Semaphore – Deleting a Semaphore – Waiting on a Mutex (Blocking) – Signaling a Semaphore – Getting a Semaphore Without Waiting (Non – Blocking).

UNIT-V: RTOS APPLICATION DOMAINS

Case Studies - RTOS for Image Processing – Embedded RTOS for Network Communication – RTOS for Fault - Tolerant Applications – RTOS for Control Systems.

Book for Study

1. Jean J. Labrosse "Micro C/OS-II, The Real-Time Kernel", The CMP Book Publisher, Second Edition, 2002

Books for Reference

1. Raj Kamal, "*Embedded Real Time Operating Systems*", TataMcGrew Hill, Second Edition 2008.
2. Peter D.Lawrence, "*Real Time Micro Computer System Design – An Introduction*", McGraw Hill, 1988.
3. Stuart Bennett, "*Real Time Computer Control – An Introduction*", Prentice Hall of India, 1998.

SEM-II	EMBEDDED SYSTEMS	CT	HOURS	CREDITS
	PIC MICROCONTROLLER PROGRAMMING LAB	CC	6	3

Experiments

PIC Microcontroller Interfacing:

1. LED.
2. LCD.
3. Seven Segment Display.
4. Stepper Motor.
5. Analog to Digital Convertor.
6. Digital to Analog Convertor.
7. Pulse Width Modulation.
8. Temperature Measurement.
9. Capacitance Measurement.
10. Distance Measurement using Ultrasonic Sensor.
11. Resistance Measurement.
12. Pulse Measurement.
13. Simple Program to Transfer and Receive Data Serially.
14. RTC.
15. EEPROM.
16. I^2C and SPI Devices.
17. CAN.

SEM-II	EMBEDDED SYSTEMS	CT	HOURS	CREDITS
	PRINCIPLES OF ROBOTICS	OEC	5	4

Objectives

- To know the basic components of an industrial robot.
- To know the mathematical modelling and robotic control systems.

UNIT-I: Fundamentals of Robotics

Definition – Classification – History- Robots components-Degrees of freedom – Robot Joints-Robot Coordinates-Robot Reference frames – Robot Workspace- Robot languages – - Robot Applications: Actuators- Sensors-Position, velocity and acceleration sensors-Torque sensors-Tactile and touch sensors proximity and range sensors- Social Issues.

UNIT-II: Kinematics of Robots

Robot as Mechanism- Matrix Representation- Homogenous Transformation Matrices – Denavit-Hartenberg Representation- Inverse of Transformation Matrix – Forward and Inverse kinematics- Solution and Programming - Degeneracy and dexterity.

UNIT-III: Differential Motion and Velocities

Jacobian- Differential Motion of Frames-Interpretation- Calculation of Jacobian – Inverse Jacobian – Design-Lagrangian mechanics- Dynamic equations-static force analysis

UNIT-IV: Robot Control Systems

Hydraulic - Pneumatic and Electric Actuators- Trajectory Planning Decentralized - PID control-Non-Linear Decoupling control.

UNIT-V: Image Processing & Vision Systems

Two and Three Dimensional Images – Spatial and Frequency Domain Representation- Noise and Edges- Convolution Masks- Processing Techniques – Thresholding- Noise Reduction edge detection – Segmentation-Image analysis and Object Recognition

Book for Study

1. Saeed B. Niku ,''Introduction to Robotics '', Pearson Education, 2002.

Books for Reference

1. Fu, Gonzalez and Lee Mcgrahill ,''Robotics '', International Publisher.
2. R.D. Klafter, TA Chmielewski and Michael Negin, "Robotic Engineering, An Integrated Approach", Prentice Hall of India, 2003.

SEM-II	EMBEDDED SYSTEMS	CT	HOURS	CREDITS
	68HC12 AND HCS12 MICROCONTROLLER ARCHITECTURE	OEC	5	4

Objectives

- To know the architecture of Motorola family and programming techniques.

UNIT-I: Architecture of 68HC12 and HCS12 Microcontroller
Introduction to the 68HC12 and HCS12 Microcontrollers – Block Diagram - HCS12 Microcontroller Features - HCS12 Family – Product Numbering System – HCS12 Variants.

UNIT-II: 68HC12/ HCS12 System Description
The 68HC12 Hardware System – The HCS12 Hardware System – Modes of Operation – Normal Operating Modes – The B32 EVB Modes of Operation –Hardware Pins Assignments – Register Block – Register Block Reallocation – Port System – Port Description – The B32 Memory System – The 32 Memory Map – Memory Resource Remapping.

UNIT-III: 68HC12/ HCS12 System Programming
Reset and Exception Systems the 68HC12 – Resets – Interrupts – Exception Vector – Exception Priority – Interrupt System Associated Register – The Timing System – The Standard Timer Module – Components of the Timer Module – Free Running Counter – Free Running Counter Associated Registes.

UNIT-IV: Serial Communication
Serial Communications-The Multiple Serial Interface – Serial Communication Terminology – The 68HC12 Serial Communication Interface – Hardware Description – The SCI Transmitter – The SCI Receiver – SCI Register – SCI Transmitter and Receiver Operation – Programming the Serial Communications Interface.

UNIT-V: Basic Input / Output Interfacing Concepts
Input Devices – Switches – DIP Switches – Keypads – Output Devices – Light Emitting Diodes – Seven Segment Displays – Tristate Logic Indicator Circuit - Electronic Switching Device – Optical Isolation.

Book for Study

1. Steven F.Barrett, Daniel J.Pack, "*Embedded Systems Design and Applications with the 68HC12 and HCS12*",Pearson Publications, 2008.

Book for Reference

1. Motorola, "*Designer Manual for 68HC12 Microcontroller*", *DRM049 Rev. 0, 09/2003.*

SEM-II	EMBEDDED SYSTEMS	CT	HOURS	CREDITS
	AVR MICROCONTROLLER ARCHITECTURE AND APPLICATIONS	OEC	5	4

Objectives

- To impart the architecture and on - chip peripheral of AVR microcontroller.

UNIT–I: Introduction to AVR Microcontroller
History of the AVR Family – Features of AVR Family – Architecture – General Purpose Register – Data Memory – AVR Status Register – Program Counter and Program ROM Space in the AVR – RISC Architecture in the AVR.

UNIT-II: Instruction Set
Data Transfer Instructions – Bit and Bit Test Instructions – Arithmetic and Logical Instructions – MCU Control Instruction - Addressing Modes – Simple Programs: Addition – Subtraction – Multiplication – Division.

UNIT-III: I/O Programming and Timers
ATMega32 Pin connection – I/O Port pins and their functions – DDR Role – I/O Bit Manipulation and Programming – Timers:TCCR0 Register – TIFR Register – Time Delay Calculation – Prescaler and generating a large time delay - Timer0, Timer1, Timer 2 Programming Concept – Counter Programming.

UNIT-IV: Interrupts and Serial Communication
AVR Interrupts – Programming Timer Interrupts – Programming External Hardware Interrupts – Interrupts Priority – Interrupt Programming In C – Simple Programs using Interrupts - AVR Serial Port Programming – Serial Port Register – Simple Program to Transfer and Receive Data Serially.

UNIT-V: Interfacing Techniques using AVR Studio
LCD Interfacing – Keyboard Interfacing – ADC programming in AVR – Interfacing the LM34 to the AVR – Waveform Generator – using Timer – DC Motor – MAX 7221 Interfacing and Programming (Seven Segment Display) -

Book for Study

1. Muhammad Ali Mazidi, "*The AVR Microcontroller and Embedded Systems Using Assembly and C*", Prentice Hall, 2010.

Book for Reference

1. Steven Frank Barrett, Daniel J. Pack, "*Atmel AVR Microcontroller Primer: Programming and Interfacing*", Morgan & Claypool Publishers, 2008.

SEM-III	EMBEDDED SYSTEMS	CT	HOURS	CREDITS
	ARM CORTEX MICROCONTROLLER AND PROGRAMMING	CC	5	5

Objectives

- To know the architecture of ARM Cortex microcontroller

UNIT-I: Cortex –M Processor Architecture

Architecture – Register – Memory – Stack – Operating Mode – Reset – Tiva TM4C123 Launchpad Architecture – Tiva® TM4C123 LaunchPad I/O pins – ARM Cortex™ Assembly Language – Syntax – Addressing Mode and Operands – Memory Access Instructions – Logical Operation – Shift Operation – Arithmetic Operations – Functions and Control Flow – Stack Usage.

UNIT-II: Design of I/O Interface

Flowcharts – Digital Logic and Open Collector – Parallel I/O Ports – Phase Lock Loop – NVIC on the ARM® Cortex - M Processor – SysTick Timer – Edge Triggered Interfacing – Configuring Digital Output Pins – UART Interface – DAC Operation – Analog to Digital Converters.

UNIT-III: High Speed Interfacing

The need for speed – High Speed I/O Applications – General Approaches to High – Speed Interface – Fundamental Approach to DMA – Programming Flash EEPROM – Secure Digital Card Interface – Camera Interface.

UNIT-IV: High Speed Network

Fundamentals – Controller Area Networks – Simple Closed - Loop Control Systems – Controllers.

UNIT-V: Applications

Blink the On - Board LED – Bitwise Operations – Demonstrate Recovering The JTAG Interface – Hello World Example Program for Displaying – Interrupt Preemption and Tail-Chaining Blinking of RGB LED's using System Clock – Generate Wave forms in Different Duty Cycle - USB – Serial Communications - Stepper Motor Graphical LCD Interface.

Book for Study

1. Jonathan W Valvano, "Embedded Systems Real – Time Operating Systems for ARM® Cortex™ – M Microcontroller", Volume 3, Second Edition, 2014.

Books for Reference

1. Andrew N.Sloss, Dominic Symes and Chris Wright, "ARM system Developers guide – Designing and optimizing system software", Elsevier, 2012.

2. Steve Furber, "ARM System-On-Chip", 2nd Edition, Pearson, 2013.

SEM-III	EMBEDDED SYSTEMS	CT	HOURS	CREDITS
	PSoC ARCHITECTURE AND APPLICATIONS	CC	5	5

Objectives

- To understand the architecture of programming system on chip.
- To know the hardware and software co-design and programming.

UNIT-I: Overview and Cortex M3 Microcontroller

Top Level Architecture – Features – CPU System – Memory – System Wide Resources – Digital System – Analog System – Cortex – M3 Microcontroller – Features Registers – Operating Modes – Pipelining – Thumb – 2 Instruction Set – Memory Map – Nested Vector Interrupt Controller – PSoC 5LP Cache Controller – PHUB and DMA Controller.

UNIT-II: System Wide Resources and I/O System

Clocking System – Features – Internal Oscillator – External Oscillator – Clock Distribution – Clock Divider – I/O System – I/O Drive Modes – Digital I/O Controlled – By Port Register and DSI – Analog I/O – LCD Drive – Cap Sense – Port Interrupt – Controller Unit.

UNIT-III: Timer, Counter, PWM, Digital Filter Block

Features – Working of Timer - Pulse Width Modulator – Operating Modes – I^2C – Working – Programming - Digital Filter Block Working.

UNIT-IV: Analog System

Switched Capacitor – Working – Operating Modes – Comparators – Operational Amplifier – LCD Direct Drive – Cap Sense – Working – Programming.

UNIT-V: DAC and ADC

Digital to Analog Convertor – Current DAC – Voltage DAC – Delta Sigma Modulator – Analog Interface – Decimator – ADC Conversion Time – Successive Approximation Register ADC - Programming.

Books for Study

1. *PSoC® Programmable System-on-Chip, Technical Reference Manual,* Document No.001-78426, Cypress Semiconductor Corporation, USA.
2. Robert Asdhy," *Designer's Guide to the Cypress PSoC",* Elsevier, First Edition, 2005.

Book for Reference

1. PredragMićaković,"*Architecture and Programming of PSoC Microcontrollers*", mikroElektronika.

SEM-III	EMBEDDED SYSTEMS	CT	HOURS	CREDITS
	ARM & PSoC PROGRAMMING LAB	CC	6	3

Experiments

ARM Programming Lab:

1. Interfacing of LED.
2. Stepper Motor.
3. Timer Programming.
4. Graphical LCD Interfacing.
5. Voltage Measurement.
6. USB.
7. Interrupt Programming.
8. Serial Communication - USB.
9. PLL – Varying Clock.

PSoC Programming Lab:

1. ADC Differential Mode.
2. ADC – SAR – PRISM
3. ADC – Single Ended Mode
4. CAN Example Control
5. Capsense – CSD – Design
6. CharLCD – Custom Font
7. Comparator – Non Inverting
8. Counter
9. Design – 16 Channel
10. Design – I^2CM
11. Design – SPIM
12. Design – SPIM Test
13. PGA
14. PRISM LED
15. VDAC 8

SEM-III	EMBEDDED SYSTEMS	CT	HOURS	CREDITS
	EMBEDDED NETWORKS AND PROTOCOLS	CC	5	5

Objectives

- Obtain a broad understanding of the technologies and applications for the emerging and exciting domain of embedded wireless networks.
- Get in-depth hands-on experience in designing and developing a real operational embedded network system.

UNIT-I: Ethernet Basics

Elements of a network – Components – Modular Design – The Network Protocol Stack – Client and Server – Requirements for Internet Communications – A Word about Web Servers - Inside Ethernet – Advantages – Limits – Using a PC for Network Communications The IEEE 802.3 Standard – Frames.

UNIT-II: Building a Network

Building a Network: Hardware options – Components and configurations – Other Options – Cables – Cable Type for Different Uses – Twisted Pair Cable – Fiber Optic Cable – Coaxial Cable Connections for Harsh Environment – Supplying Power – Going Wireless – Media Systems – Interfacing to Ethernet Controllers – Using Repeater Hub, Ethernet Switches and Routers.

UNIT-III: Design Choices

Complete Solutions - Special-Purpose Modules - Hardware - Ethernet Controller Basics - The ASIX AX88796 - Realtek RTL8019AS -SMSC LAN91C96 - Cirrus Logic CS8900A

UNIT-IV: Using The Internet In Local And Internet Communications

Considerations in Obtaining Internet Service - Technologies for Connecting - Static and Dynamic IP Addresses - Connecting Multiple Computers to the Internet - Communicating through a Firewall - Obtaining and Using a Domain Name - What IP Does - IP Addresses -The IP Header - Assigning an IP Address to a Host - Matching an IP Address to an Ethernet Interface - The Internet Control Message Protocol (ICMP).

UNIT-V: Email for Embedded Systems

Email for Embedded Systems: Sending and Receiving Messages - E-mail Protocols – Using FTP: FTP Clients and Servers - Inside the File Transfer Protocol – Keeping Devices and Network secure: Limiting Access with Passwords - Four Rules for Securing Your Devices and Local Network.

Book for Study

1. Jan Axelson, "*Embedded Ethernet and Internet Complete*", Penram publications,2007.

Books for Reference

1. Gregory J. Pottie, William J. Kaiser "*Principles of Embedded Networked Systems Design*", Cambridge University Press, Second Edition, 2005.
2. Dominique Paret, "*Multiplexed Networks for Embedded Systems- CAN, LIN, Flexray, Safe-by-Wire*", John Wiley & Sons Ltd, 2007.

SEM- III	EMBEDDED SYSTEMS	CT	HOURS	CREDITS
	PROGRAMMING IN JAVA	CEC	5	4

Objectives

- To learn the fundamentals of JAVA Language for an embedded system.

UNIT-I: Java Language

Evolution of Java – Overview of java: Object-Oriented Programming -Two Paradigms Abstraction -The Three OOP Principles - A First Simple Program - Entering the Program - Compiling the Program - A Closer Look at the First Sample Program - A Second Short Program - Two Control Statements - The if Statement -The for Loop - Using Blocks of Code - Lexical – Whitespace - Identifiers - Literals - Comments - Separators - The Java Keywords - The Java Class Libraries.

UNIT-II: Variables, Operations and Expressions

Primitive Types - Variables – Types conversion and casting – Operators – Expressions – Managing Input and Output Operations – Control Statements: if, else-if, goto, switch, while-do, do-while, for break and continue.

UNIT-III: Arrays and Strings

Dimensional Arrays: One, Two and Multi – Dynamic Array - String Manipulation – Functions: Defining and Accessing Functions – Passing Parameter to Functions – Recursion - Passing Arrays to Functions - Passing Strings to Functions

UNIT-IV: Structures, Unions and Pointers

Defining Structure – Declaring Structure Variable - Accessing Structure Members – Structure Initialization – Arrays of Structures – Arrays within Structures – Structures and Functions – Unions – Pointers.

UNIT-V: File Management, Dynamic Memory Allocation and Linked Lists in C

Defining and Opening and Closing a File – Input / Output Operations on Files – Error Handling During I/O Operations – Random Access to Files – Concepts of Dynamic Memory Allocation - Concepts of Linked Lists – Advantages of Linked Lists – Types of Linked Lists – Creating a Linked List – Inserting and Deleting an Item – Application of Linked Lists – Preprocessor.

Book for Study

1. E. Balagurusamy, "*Programming In JAVA*" – Tata McGraw Hill Publication, Fifth Edition.

Book for Reference

1. Jerry Lee Ford, JR, "*Programming for the Absolute Beginner*", Thomson Publication, Second Edition.

SEM- III	EMBEDDED SYSTEMS	CT	HOURS	CREDITS
	EMBEDDED LINUX	CEC	5	4

Objectives

- To learn the fundamentals of adapting Linux to an embedded system.
- To shorten the learning curve by providing a guided tour of the relevant points within the architecture of Linux systems.

UNIT-I: Introduction to Embedded Linux

Embedded Linux today - open source and the GPL – Standards and relevant bodies – BIOS Versus Bootloader – Anatomy of Embedded System – Storage Consideration – Embedded Linux Distributions

UNIT-II: The Linux Kernel

Kernel version and source repositories – Kernel Construction – Kernel building system - Kernel Configuration – Composite Kernel Image – Initialization Flow of control – Command – line processing – subsystem Initialization – The *init* Thread – Root file system – Kernel last boot steps – The *init* process – Initial RAM Disk – Using *initramfs.*

UNIT-III: Bootloaders and Device Drivers

Role and Challenges of a Bootloader – Das U-Boot – Porting U-Boot – Device Tree Blob - Other Bootloaders – Device Drivers Concepts – Module utilities – Driver method – File system – ext2 – ext3 – ext4 – JFFS2 – *cramfs* – Network and Pseudo file system – Other file system

UNIT-IV: Embedded Development Environment and Kernel debugging Techniques

Cross- Development Environment – host system Requirements – Hosting Target Boards – GNU Debugger – Data Display Debugger- Tracing and profiling tools – Binary and Miscellaneous Binary Utilities – KGDB for Kernel Debugging - Kernel Debugging Techniques – Hardware-Assisted Debugging.

UNIT-V: Linux and Real Time

Real Time – Kernel preemption - Real Time Kernel Patch – Real Time Kernel Performance analysis – USB – USB Overview – Configuring USB – Virtual USB Tools.

Book for Study

1. Christopher Hallinan, "*Embedded Linux Primer*", Pearson Education, Second Edition,2007.

Book for Reference

1. P. Raghavan, Amol Lad, SriramNeelakandan, "*Embedded Linux System Design and Development*", Auerbach Publications 2006.

SEM-III	EMBEDDED SYSTEMS	CT	HOURS	CREDITS
	VLSI DESIGN	CEC	5	4

Objectives

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

UNIT-I: CMOS Design

Overview of Digital VLSI Design Methodologies - Logic design with CMOS-transmission Gate Circuits - Clocked CMOS - Dynamic CMOS Circuits - Bi-CMOS Circuits - Layout Diagram - Stick Diagram - IC Fabrications – Trends in IC Technology.

UNIT-II: Programmable Logic Devices

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

UNIT-III: Basic Construction, Floor Planning, Placement and Routing

System Partition – FPGA Partitioning – Partitioning Methods - Floor Planning – Placement Physical Design Flow – Global Routing – Detailed Routing – Special Routing- Circuit Extraction – DRC.

UNIT-IV: Analog VLSI Design

Introduction to Analog VLSI - Design of CMOS 2 Stage - 3 Stage Op-Amp – High Speed and High Frequency Op-Amps - Super MOS - Analog Primitive Cells - Realization of Neural Networks.

UNIT-V: Logic Synthesis and Simulation

Overview of Digital Design with Verilog HDL - Hierarchical Modelling Concepts - Modules and Port Definitions - Gate Level Modelling - Data Flow Modelling - Behavioural Modelling – Task and Functions - Verilog and Logic Synthesis – Simulation -Design Examples - Ripple Carry Adders - Carry Look a Head Adders – Multiplier –ALU - Shift Registers – Multiplexer – Comparator -Test Bench.

Books for Study

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.

Books for Reference

1. Mohamed Ismail ,Terri Fiez,"*Analog VLSI Signal and Information Processing*", McGraw Hill International Editions, 1994.
2. Samir Palnitkar, "*Veri Log HDL, A Design Guide to Digital and Synthesis*", Second Edition, Pearson, 2005.
3. John P. Uyemera "*Chip Design for Submicron VLSI CMOS Layout and Simulation*", Cengage Learning India Edition", 2011.

SEM-IV	EMBEDDED SYSTEMS	CT	HOURS	CREDITS
	HARDWARE SOFTWARE CO- DESIGN	CEC	6	4

Objective

- To provide advanced knowledge in the design of complex computer systems, in particular Embedded Systems.
- To analyze and explain the control-flow and data-flow of a software program and a cycle-based hardware description.

UNIT-I: Models and Architecture

Co-Design Models – Models – Finite State Machines – Dataflow Chart - Hierarchical Concurrent Finite-State Machines – Programming Languages – Program State Machine – Architecture – Controller Architecture – Datapath Architecture – FSMD Architecture – CISC Architecture – RISC Architecture - VLIW Architecture – Parallel Architecture

UNIT-II: Languages and A Generic Co-Design Methodology

Concurrency - State Transitions - Hierarchy - Programming Constructs -Behavioral Completion - Exception Handling – Timing – Communication - Process Synchronization - Generic Co-design Methodology-System Specification - Allocation and Partitioning – Scheduling - Communication Synthesis - Analysis and Validation Flow - Backend

UNIT-III: Prototyping And Emulation

Prototyping and Emulation Techniques - Prototyping and Emulation Environments - The Weaver Prototyping Environment - Quickturn Emulation Systems - Mentor SimExpress Emulation System - Zycad Paradigm RP and XP - Aptix Prototyping System - Arkos (Synopsys) and CoBalt (Quickturn) Emulation Systems - Future Developments in Emulation and Prototyping.

UNIT-IV: Target Architectures

Architecture Specialization Techniques - Component specialization techniques - System Specialization - System Specialization Techniques - Memory Architectures - System Communication Infrastructure - Target Architectures and Application System Classes - Architectures for Control-Dominated Systems - Architectures for High-Performance Control - Architectures for Data-Dominated Systems - Mixed Systems and Less Specialized Systems - Selected co-design problems

UNIT-IV: Design Specification and Verification

Design - Co-design - The Co-design Computational Model - Concurrency – Components – Non-determinism - Concurrency in Standard Languages - Synchronous and Asynchronous Computations - Classification of High-Level Languages - Coordinating Concurrent Computations – Classification - Shared State Versus Messages - Open Versus Closed Operations - Blocking Versus Non-blocking Operations - Remote Procedure Calls

Book for Study

1. Jorgen Staunstrup, Wayne Wolf, "Hardware / Software Co- Design Principles and Practice", Springer, 2009.

Book for Reference

1. Kluwer, "Hardware / Software Co- Design Principles and Practice", academic publishers, 2002.

SEM - IV	EMBEDDED SYSTEMS	CT	HOURS	CREDITS
	WIRELESS SENSOR NETWORKS	CEC	6	4

Objectives

- To impart knowledge on wireless sensor networks.

UNIT-I: Introduction and Applications of Wireless Sensor Networks

Background of Sensor Network Technology – Applications of Sensor Networks – Architectural Elements – Challenges and Hurdles – Range of Applications – Home Control – Building Automation – Industrial Automation – Sensor and Robots – Highway Monitoring.

UNIT-II: Wireless sensor and Technology

Sensor Mode Technology – Hardware and Software – Sensor Taxonomy –Wireless Network Operating Environment – Wireless Network Trends – Radio Technology Principle – Available Wireless Technology – Campus Application – MAN/WAN Applications.

UNIT–III: MAC and Routing Protocols

Fundamentals of MAC protocol – MAC Protocol for Wireless Sensor Networks – Data Dissemination and Gathering – Routing Challenges and Design Issues in Wireless Sensor Networks.

UNIT –IV: Transport Protocols and Network Management

Traditional Transport Control Protocols – Design Issues – Examples – Performance of Transport Control Protocols – Network Management Requirements – Network Management Models.

UNIT–V: Operating System for Wireless Sensor Networks and Traffic Management

Operating System Design Issues – Examples of Operating System - Wireless Sensor Networks Design Issues – Performance Modeling of Wireless Sensor Networks – Basic Models - Network Models.

Books for study

1. Kazem Sohraby, Daniel Minoli, Taieb Znati, "*Wireless Sensor Networks, Technology*", Protocol and Applications, Wiley, 2014.
2. Feng Zhao, Leonidas Guibas, "*Wireless Sensor Networks*", Elsevier, First Indian Reprint, 2005.

Books for Reference

1. Jaganathan Sarangapani, Wireless Ad Hoc, "*Wireless Sensor Networks,Protocols, Performance and Control*", CRC press, First Indian Reprint, 2009.
2. Anantharam Swami, Qing Zhao, Yao-Win Hung, Lang Long,"*Wireless Sensor Networks, Signal Processing and Communication Perspective*", Wiley, India, 2009.

SEM-IV	EMBEDDED SYSTEMS	CT	HOURS	CREDITS
	HARDWARE DESCRIPTION LANGUAGES	CEC	6	4

Objectives

- This paper is a thorough introduction to the VHDL language.
- The emphasis is on writing solid synthesizable code and enough simulation code to write a viable test bench.
- The information gained can be applied to any digital design by using a top-down synthesis design approach.

UNIT-I: Introduction to Hardware Design

Digital System Design Process - Hardware Description Language - Hardware Simulation - Hardware Synthesis - Levels of Abstraction.

UNIT-II: Basic Concepts in VHDL

VHDL History - Existing Languages - VHDL Requirements - The VHDL Language - Characterizing Hardware Languages - Objects and Classes - Signal Assignments - Concurrent and Sequential Assignments.

UNIT-III: Design Methodology, Design Organization and Parameterization

Elements of VHDL - Top down Design - Top down Design with VHDL - Subprograms, Controller Description - VHDL Operators - Conventions and Syntax - Definition and Usage of Subprograms - Packaging Parts and Utilities - Design Parameterization - Design Configuration - Design Libraries.

UNIT-IV: VLSI System Components Circuits and System Level Physical Design

Multiplexers – Decoders – Comparators – Priority Encoders – Shift Registers – Arithmetic Circuits – Ripple Carry Adders – Carry Look Ahead Adders – High-Speed Adders – Multipliers – Physical Design – Delay Modeling – Cross Talk – Floor Planning – Power Distribution – Clock Distribution – Basics of CMOS Testing

UNIT-V: Verilog Hardware Description Language

Overview of Digital Design with Verilog HDL – Hierarchical Modeling Concepts – Modules and Port Definitions – Gate level Modeling – Data Flow Modeling – Behavioral Modeling – Task and Functions – Test Bench

Books for Study

1. Neil H. E. Weste and Kamran Eshraghian, "*Principles of CMOS VLSI Design*", Third Edition, Pearson, 2012.
2. John P. Uyemura, "*Introduction to VLSI Circuits and Systems*", Wiley India, 2013.
3. J. Bhasker, "A VHDL Primer", PHI Learning, Third Edition, 2013.

Books for Reference

1. J. Bhasker, A VHDL Synthesis Primer, Star Galaxy, Second Edition, 1998.
2. J. Bhasker, A Verilog HDL Primer, BS Publication, Third Edition, 2012.
3. Pucknell, "Basic VLSI Design", Prentice Hall of India Publication, Third Edition 2012.
4. Wayne Wolf, "*Modern VLSI Design System on Chip*", Prentice Hall of India Publication, Fourth Edition, 2012

SEM-IV	EMBEDDED SYSTEMS	CT	HOURS	CREDITS
	MODERN EMBEDDED COMPUTING	CEC	6	4

Objective

- To introduce embedded computing system design using a unified view of software and hardware.
- To provide an overview of embedded systems and their design challenges

UNIT-I: Principles of Modern Embedded Systems
Embedded Computer System – Applications and Form Factors – Power – System Resources and Features – User Assumptions – Transition Inevitable – Range of Embedded Systems Exits – Embedded Platform Characteristics – Central Processing Unit (CPU) – Integration Level – Power Consumption – Form Factor – Expansion – Application Specific Hardware – Certification – Reliability/Availability – User Interfaces – Connectivity – Security.

UNIT-II: Embedded Graphics and Multimedia Acceleration
Screen Display – Display Engine – Window Management – Screen Composition – Embedded Panels – Display Query and Timing – Copy Protection – Graphics Stack – Accelerated Media Decode – Lip Syncing – Video Capture and Encoding – Video Capture – Media Frameworks – GStreamer - OpenMAX™.

UNIT-III: Network Connectivity
Networking Basics – Layering and Network Software – Node Operation and Network Hardware – Sockets and a Simple Example –TCP/IP Networking – Governance, The IETE – RFCs – Addresses – Packets – Routes – Port Numbers – Byte Ordering – OS Tools – Supporting Protocols – Services – Ethernet – Protocol Description – Ethernet MAC Addresses – Ethernet Packet Format – A Gigabit Ethernet Controller and Its Features.

UNIT-IV: Application Frameworks
Android – Android Framework Architecture – Android Application Architecture – Android Development Environment – Deployment – Qt- Qt Application Development Framework – Qt Modules – Signal and Slots –Qt Creator.

UNIT-V: Developing an Embedded Systems
Example Designs – Intel Atom E6XX Series Platforms – Architecture Overview –Platform Controller Hub – Intel Platform Controller Hub EG20T – OKI Semiconductor ML7213 and ML7213V – ST Microelectronics.

Book for Study

1. Peter Barry, Patrick Crowley, "*Modern Embedded Computing: Designing Connected, Pervasive, Media-Rich Systems*", Morgan Kaufmann, 1st Edition.

Book for Reference

1. Joseph A. Fisher, Paolo Faraboschi, Cliff Young, "*Embedded Computing*", Morgan Kaufmann Publication.

SEM-IV	EMBEDDED SYSTEMS	CT	HOURS	CREDITS
	MECHATRONICS	CEC	6	4

Objective

- To learn the application of embedded systems in mechatronics.

UNIT-I: Mechatronics Systems and Manufacturing
Synergy of Systems – Definition of Mechatronics – Applications of Mechatronics – Objective – Advantages – Disadvantages - Production Unit – Input/Output and Challenges in Mechatronic Production Units – Knowledge required for Mechatronics in Manufacturing – Main Features of Mechatronics in Manufacturing - Computer Integrated Manufacturing .

UNIT-II: Electronics and Computing Elements in Mechatronics
Passive Electrical Components – Active Elements – Digital Electronic Components – Analog Computer – Analog to Digital Conversion – Digital to Analog Conversion – Illustrate Examples.

UNIT-III: Motion Control Devices
Hydraulic and Pneumatic Actuators – Electrical Actuators – DC Servomotor – Brushless Permanent Magnet DC Motor – AC Servometer – Stepper Motor – Microactuators – Drive Selection and Applications – Examples.

UNIT-IV: Intelligent Systems and Their Applications
Artificial Neural Network – Genetic Algorithm – Fuzzy Logic Control – Non verbal Teaching – Design of Mechatronic Systems – Integrated Systems.

UNIT-V: Applications
Slip Casting Process – Pick and Place Robot – Autotronics – Bionics – Avionics.

Book for Study

1. K.K.Appuu kuttan,*"Introduction to Mechatronics"*, Oxford University Press, 2007.

Book for Reference

1. J. Edward Carryer, Matthew Ohline, Thomas Kenny, *"Introduction to Mechatronic Design"*, Pearson Education, First Edition, 2010.

SEM-IV	EMBEDDED SYSTEMS	CT	HOURS	CREDITS
	MEMS TECHNOLOGY	CEC	6	4

Objectives

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

UNIT-I: MEMS: Micro-Fabrication, Materials and Electromechanical

Overview of Micro Fabrication – Silicon and other Material Based Fabrication Processes – Concepts: Conductivity of Semiconductors - Crystal Planes and Orientation - Stress and Strain Flexural Beam Bending Analysis - Torsional Deflections - Intrinsic Stress - Resonant Frequency and Quality Factor.

UNIT-II: Electrostatic Sensors and Actuation

Principle – Material - Design and Fabrication of Parallel Plate Capacitors as Electrostatic Sensors and Actuators – Applications.

UNIT-III: Thermal Sensing and Actuation

Principle – Material - Design and Fabrication of Thermal Couples - Thermal Bimorph Sensors - Thermal Resistor Sensors - Applications.

UNIT-IV: Piezoelectric Sensing and Actuation

Piezoelectric Effect - Cantilever Piezo Electric Actuator Model - Properties of Piezoelectric Materials - Applications.

UNIT-V: Case Studies

Piezoresistive Sensors - Magnetic Actuation - Micro Fluidics Applications - Medical Applications - Optical MEMS - NEMS Devices

Book for Study

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.

Book for Reference

1. M.H.Bao "*Micromechanical Transducers :Pressure Sensors, Accelerometers And Gyroscopes*", Elsevier, Newyork, 2000.
2. P. RaiChoudry," *MEMS and MOEMS Technology and Applications*", PHI, 2012.
3. Stephen D. Senturia, "*Microsystem Design*", Springer International, Second Edition, 2011.