COURSE STRUCTURE AND SYLLABUS

For

M.Tech

EMBEDDED SYSTEMS

(*Applicable for batches admitted from 2016-17*)

PRAGATI ENGINEERING COLLEGE

(AUTONOMOUS)

Permanently Affiliated to JNTUK, Kakinada, Accredited by NAAC with "A" Grade
Recognized by UGC 2(f) and 12(b) under UGC act, 1956
1-378, ADB Road, Surampalem – 533 437
Near Peddapuram, E.G.Dist, Andhra Pradesh

PRAGATI ENGINEERING COLLEGE : SURAMPALEM
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I Semester

S.No.	Subject Code	Subject	L	P	C
1	16021T01	Embedded System Design	4	-	3
2	16021T02	Microcontrollers for Embedded System Design	4	-	3
3	16021T03	Embedded Real Time Operating Systems	4	-	3
4	16021T04	Signal Processing for Embedded Systems	4	-	3
5	**Elective I**		4	-	3
	16021D01	1. Digital System Design			
	16021D02	2. Network Security & Cryptography			
	16021D03	3. Advanced Computer Architecture			
6	**Elective II**		4	-	3
	16021D04	1. Embedded Computing			
	16021D05	2. Embedded Control Systems			
	16021D06	3. Advanced Operating System			
7	16021L01	Embedded C-Laboratory	-	3	2
Total Credits					**20**

II Semester

S.No.	Subject Code	Subject	L	P	C
1	16022T05	Hardware Software Co-Design	4	-	3
2	16022T06	DSP Integrated Circuits	4	-	3
3	16022T07	Embedded Networking	4	-	3
4	16022T08	CPLD and FPGA Architectures and Applications	4	-	3
5	**Elective III**		4	-	3
	16022D07	1. Sensors and Actuators			
	16022D08	2. Micro Electro Mechanical System Design			
	16022D09	3. Internet Protocols			
6	**Elective IV**		4	-	3
	16022D10	1. System on Chip Design			
	16022D11	2. Embedded Linux			
	16022D12	3. Multimedia and Signal Coding			
7	16022L02	Embedded Systems Laboratory	-	3	2
Total Credits					**20**

III Semester

S.No.	Subject Code	Subject	L	P	C
1	16023P01	Seminar -I	-	-	2
2	--	Project Work Part-I	-	-	18
Total Credits			-	-	**20**

IV Semester

S.No.	Subject Code	Subject	L	P	C
1	16024P03	Seminar -II	-	-	2
2	16023P02	Project Work Part-II	-	-	18
Total Credits			-	-	**20**

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	4	**0**	**3**

EMBEDDED SYSTEM DESIGN

UNIT-I

Introduction An Embedded System-Definition, Examples, Current Technologies, Integration in system Design, Embedded system design flow, hardware design concepts, software development, processor in an embedded system and other hardware units, introduction to processor based embedded system design concepts.

UNIT-II

Embedded Hardware Embedded hardware building blocks, Embedded Processors – ISA architecture models, Internal processor design, processor performance, Board Memory – ROM, RAM, Auxiliary Memory, Memory Management of External Memory, Board Memory and performance.

Embedded board Input / output – Serial versus Parallel I/O, interfacing the I/O components, I/O components and performance, Board buses – Bus arbitration and timing, Integrating the Bus with other board components, Bus performance.

UNIT-III

Embedded Software Device drivers, Device Drivers for interrupt-Handling, Memory device drivers, On-board bus device drivers, Board I/O drivers, Explanation about above drivers with suitable examples.

Embedded operating systems – Multitasking and process Management, Memory Management, I/O and file system management, OS standards example – POSIX, OS performance guidelines, Board support packages, Middleware and Application Software – Middle ware, Middleware examples, Application layer software examples.

UNIT-IV

Embedded System Design, Development, Implementation and Testing Embedded system design and development lifecycle model, creating an embedded system architecture, 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. Implementing the design-The main software utility tool, CAD and the hardware, Translation tools, Debugging tools, testing on host machine, simulators, Laboratory tools, System Boot-Up.

UNIT-V

Embedded System Design Case Studies Case studies Processor design approach of an embedded system– Power PC Processor based and Micro Blaze Processor based Embedded system design on Xilinx platform-NiosII Processor based Embedded system design on Altera platform-Respective Processor architectures should be taken into consideration while designing an Embedded System

TEXTBOOKS:

1. Tammy Noergaard "Embedded Systems Architecture: A Comprehensive Guide for Engineers and Programmers", Elsevier(Singapore) Pvt.Ltd.Publications, 2005.

2. Frank Vahid, Tony D. Givargis, "Embedded system Design: A Unified Hardware/Software Introduction", John Wily & Sons Inc.2002.

REFERENCES:

1. Peter Marwedel, "Embedded System Design", Science Publishers, 2007.

2. Arnold S Burger, "Embedded System Design", CMP,2001.

3. Rajkamal, "Embedded Systems: Architecture, Programming and Design", TMH Publications, Second Edition, 2008.

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MICROCONTROLLERS FOR EMBEDDED SYSTEM DESIGN

Unit 1:

ARM Architecture ARM Design Philosophy, Registers, PSR, Pipeline, Interrupts and Vector Table, Architecture Revision, ARM Processor Families.

Unit 2:

ARM Programming Model-I Instruction Set: Data Processing Instructions, Branch, Load, Store Instructions, PSR Instructions, Conditional Instructions.

Unit 3:

ARM Programming Model-II Thumb Instruction Set: Register Usage, Other Branch Instructions, Data Processing Instructions, Single-Register and Multi Register Load-Store Instructions, Stack, Software Interrupt Instructions

Unit 4:

ARM Programming Simple C Programs using Function Calls, Pointers, Structures, Integer and Floating Point Arithmetic, Assembly Code using Instruction Scheduling, Register Allocation, Conditional Execution and Loops.

Unit 5:

Memory Management Cache Architecture, Polices, Flushing and Caches, MMU, Page Tables, Translation, Access Permissions, Content Switch.

TEXTBOOKS:

1. ARM Systems Developer's Guides- Designing & Optimizing System Software – Andrew N. Sloss, Dominic Symes, Chris Wright, 2008, Elsevier.

REFERENCES:

1. Embedded Microcomputer Systems, Real Time Interfacing – Jonathan W. Valvano – Brookes / Cole, 1999, Thomas Learning.

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EMBEDDED REAL TIME OPERATING SYSTEM

Unit 1:

Introduction OS Services, Process Management, Timer Functions, Event Functions, Memory Management, Device, File and IO Systems Management, Interrupt Routines in RTOS Environment and Handling of Interrupt Source Calls, Real-Time Operating Systems, Basic Design Using an RTOS, RTOS Task Scheduling Models, Interrupt Latency and Response of the Tasks as Performance Metrics, OS Security.

Unit 2:

RTOS Programming Basic Functions and Types of RTOS for Embedded Systems, RTOS mCOS-II, RTOS Vx Works, Programming concepts of above RTOS with relevant Examples, Programming concepts of RTOS Windows CE, RTOS OSEK, RTOS Linux 2.6.x and RTOS RT Linux.

Unit 3:

Program Modeling – Case Studies Case study of embedded system design and coding for an Automatic Chocolate Vending Machine (ACVM) Using Mucos RTOS, case study of digital camera hardware and software architecture, case study of coding for sending application layer byte streams on a TCP/IP Network Using RTOS Vx Works, Case Study of Embedded System for an Adaptive Cruise Control (ACC) System in Car, Case Study of Embedded System for a Smart Card, Case Study of Embedded System of Mobile Phone Software for Key Inputs.

Unit 4:

Target Image Creation & Programming in Linux Off-The-Shelf Operating Systems, Operating System Software, Target Image Creation for Window XP Embedded, Porting RTOS on a Micro Controller based Development Board.

Overview and programming concepts of Unix/Linux Programming, Shell Programming, System Programming.

Unit 5:

Programming in RT Linux Overview of RT Linux, Core RT Linux API, Program to display a message periodically, semaphore management, Mutex, Management, Case Study of Appliance Control by RT Linux System.

TEXTBOOKS:

1. Dr. K.V.K.K. Prasad: "Embedded/Real-Time Systems" Dream Tech Publications, Black pad book,2003.
2. Rajkamal: "Embedded Systems-Architecture, Programming and Design", Tata McGraw Hill Publications, Second Edition, 2008.

REFERENCES:

1. Labrosse, "Embedding system building blocks ", CMP publishers,1999.
2. Rob Williams," Real time Systems Development", Butterworth Heinemann Publications,2005.

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SIGNAL PROCESSING FOR EMBEDDED SYSTEMS

UNIT I

Overview Of DSP Digital signal processing basics – processing models for dsp – common filters – adaptive digital systems – non-linear systems.

UNIT II

DSP Applications-I : Spectral analysis and modulation inverse. Kalmann filter – data compression methods, coding, Vocoder, LPC, MP3 coding. RLS estimation, pseudo-Hufmann algorithm, LZW

UNIT III

DSP Applications – II : Error correcting codes and channel coding, Hamming distance and error correction, CRC, Reed Solomon codes, convolution codes, Viterbi decoding, interleaving – practical issues in using DSP.

UNIT IV

DSP Programming - Overview of DSP algorithms – DSP architectures – optimizing DSP software – RTOS for DSP, testing and debugging DSP systems – embedded DSP software design using multicore SoC architectures.

UNIT V

DSP PROGRAM OPTIMIZATION AND GUIDELINES: Software performance engineering - code optimization – algorithm development guidelines.

TEXTBOOKS:

1. Dag Stranneby, William Walker, “Digital Signal Processors and applications”, Elsevier, 2003.

2. Embedded Signal Processing with the Micro Signal Architecture, Woon-Seng Gan, Sen M.kuo,Wiley Publisher,2007.

REFERENCES:

1. Robert Oshana, “DSP Software Development Techniques for embedded real time applications", Elsevier, 2006.

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DIGITAL SYSTEM DESIGN
(ELECTIVE-I)

UNIT-I

Minimization Procedures and CAMP Algorithm: Review on minimization of switching functions using tabular methods, k-map, QM algorithm, CAMP-I algorithm, Phase-I: Determination of Adjacencies, DA, CSC, SSMs and EPCs,, CAMP-I algorithm, Phase-II: Passport checking, Determination of SPC, CAMP-II algorithm: Determination of solution cube, Cube based operations, determination of selected cubes are wholly within the given switching function or not, Introduction to cube based algorithms.

UNIT-II

PLA Design, Minimization and Folding Algorithms: Introduction to PLDs, basic configurations and advantages of PLDs, PLA-Introduction, Block diagram of PLA, size of PLA, PLA design aspects, PLA minimization algorithm(IISc algorithm), PLA folding algorithm(COMPACT algorithm)-Illustration of algorithms with suitable examples.

UNIT –III

Design of Large Scale Digital Systems: Algorithmic state machine charts-Introduction, Derivation of SM Charts, Realization of SM Chart, control implementation, control unit design, data processor design, ROM design, PAL design aspects, digital system design approaches using CPLDs, FPGAs and ASICs.

UNIT-IV

Fault Diagnosis in Combinational Circuits: Faults classes and models, fault diagnosis and testing, fault detection test, test generation, testing process, obtaining a minimal complete test set, circuit under test methods- Path sensitization method, Boolean difference method, properties of Boolean differences, Kohavi algorithm, faults in PLAs, DFT schemes, built in self-test.

UNIT-V

Fault Diagnosis in Sequential Circuits: Fault detection and location in sequential circuits, circuit test approach, initial state identification, Haming experiments, synchronizing experiments, machine identification, distinguishing experiment, adaptive distinguishing experiments.

TEXTBOOKS:

1. Logic Design Theory-N. N. Biswas, PHI,1993.
2. Switching and Finite Automata Theory-Z. Kohavi , 2nd Edition, 2001, TMH
3. Digital system Design using PLDd-Lala,2003

REFERENCES:

1. Fundamentals of Logic Design – Charles H. Roth, 5th Ed., Cengage Learning.
2. Digital Systems Testing and Testable Design – Miron Abramovici, Melvin A. Breuer and Arthur D. Friedman- John Wiley & Sons Inc,2003.

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NETWORK SECURITY & CRYPTOGRAPHY
(ELECTIVE I)

UNIT-I

Introduction Attacks, Services and Mechanisms, Security attacks, Security services, A Model for Internetwork security. Classical Techniques: Conventional Encryption model, Steganography, Classical Encryption Techniques.

UNIT-II:

Modern Techniques: Simplified DES, Block Cipher Principles, Data Encryption standard, Strength of DES, Differential and Linear Cryptanalysis, Block Cipher Design Principles and Modes of operations. Algorithms: Triple DES, International Data Encryption algorithm, Blowfish, RC5, CAST-128, RC2, Characteristics of Advanced Symmetric block cifers. Conventional Encryption: Placement of Encryption function, Traffic confidentiality, Key distribution, Random Number Generation. Public Key Cryptography: Principles, RSA Algorithm, Key Management, Diffie-Hellman Key exchange, Elliptic Curve Cryptography. **UNIT-III:**

Number Theory: Prime and Relatively prime numbers, Modular arithmetic, Fermat's and Euler's theorems, Testing for primality, Euclid's Algorithm, the Chinese remainder theorem, Discrete logarithms. Message authentication and Hash Functions: Authentication requirements and functions, Message Authentication, Hash functions,

Security of Hash functions and MACs.

UNIT-IV:

Hash and Mac Algorithms: MD File, Message digest Algorithm, Secure Hash Algorithm, RIPEMD-160, HMAC. Digital signatures and Authentication Protocols: Digital signatures, Authentication Protocols, Digital signature standards. Authentication Applications: Kerberos, X.509 directory Authentication service.Electronic Mail Security: Pretty Good Privacy, S/MIME.

UNIT-V:

IP Security: Overview, Architecture, Authentication, Encapsulating Security Payload, Combining security Associations, Key Management. Web Security: Web Security

requirements, Secure sockets layer and Transport layer security, Secure Electronic Transaction. Intruders, Viruses and Worms: Intruders, Viruses and Related threats. Fire Walls: Fire wall Design Principles, Trusted systems.

TEXTBOOKS:

1. Cryptography and Network Security: Principles and Practice– William Stallings, 2000, PE.

2. "Aplied Cryptography", Bruce Schneier, 2nd edition,Wley Publishers,2008.

REFERENCES:

1. Principles of Network and Systems Administration, Mark Burgess,John Wiey,2007.

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ADVANCED COMPUTER ARCHITECTURE
(ELECTIVE I)

UNIT -I

Fundamentals of Computer Design: Fundamentals of Computer design, Changing faces of computing and task of computer designer, Technology trends, Cost price and their trends, Measuring and reporting performance, Quantitative principles of computer design, Amdahl's law. Instruction set principles and examples- Introduction, Classifying instruction set-MEmory addressing- type and size of operands, Operations in the instruction set.

UNIT –II

Pipelines:Introduction, Basic RISC instruction set, Simple implementation of RISC instruction set, Classic five stage pipe lined RISC processor, Basic performance issues in pipelining, Pipeline hazards, Reducing pipeline branch penalties. Memory Hierarchy Design:Introduction, Review of ABC of cache, Cache performance, Reducing cache miss penalty, Virtual memory.

UNIT -III

Instruction Level Parallelism the Hardware Approach: Instruction Level parallelism, Dynamic scheduling, Dynamic scheduling using Tomasulo's approach, Branch prediction, high performance instruction delivery- hardware based speculation. ILP Software Approach Basic compiler level techniques, Static branch prediction, VLIW approach, Exploiting ILP, Parallelism at compile time, Cross cutting issues -Hardware verses Software.

UNIT –IV

Multi Processors and Thread Level Parallelism: Multi Processors and Thread level Parallelism- Introduction, Characteristics of application domain, Systematic shared memory architecture, Distributed shared – memory architecture, Synchronization.

UNIT –V

Inter Connection and Networks: Introduction, Interconnection network media, Practical issues in interconnecting networks, Examples of inter connection, Cluster, Designing of clusters. Intel Architecture: Intel IA-64 ILP in embedded and mobile markets Fallacies and pit falls.

TEXTBOOKS:

1. John L. Hennessy, David A. Patterson - Computer Architecture: A Quantitative Approach, 3rd Edition, An Imprint of Elsevier,2002.

REFERENCES:

1. John P. Shen and Miikko H. Lipasti - Modern Processor Design : Fundamentals of Super Scalar Processors,2013.
2. Computer Architecture and Parallel Processing - Kai Hwang, Faye A.Brigs., MC Graw Hill,1984.
3. Advanced Computer Architecture - A Design Space Approach - Dezso Sima, Terence Fountain, Peter Kacsuk , Pearson Ed,1997.

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EMBEDDED COMPUTING
(ELECTIVE II)

UNIT-I

Programming on Linux Platform:System Calls, Scheduling, Memory Allocation, Timers, Embedded Linux, Root File System, Busy Box. Operating System Overview: Processes, Tasks, Threads, MultiThreading, Semaphore, Message Queue.

UNIT-II

Introduction to Software Development Tools GNU GCC, make, gdb, static and dynamic linking, C libraries, compiler options, code optimization switches, lint, code profiling tools.

UNIT-III

Interfacing ModulesSensor and actuator interface, data transfer and control, GPS, GSM module interfacing with data processing and display, OpenCV for machine vision, Audio signal processing.

UNIT-IV

Networking BasicsSockets, ports, UDP, TCP/IP, client server model, socket programming, 802.11, Bluetooth, ZigBee, SSH, firewalls, network security.

UNIT-V

Intel Architecture 32-bit (IA32) Instruction Set Application binary interface, exception and interrupt handling, interrupt latency, assemblers, assembler directives, macros, simulation and debugging tools.

TEXTBOOKS:

1. Modern Embedded Computing - Peter Barry and Patrick Crowley, 1st Ed., Elsevier/Morgan Kaufmann, 2012.
2. Linux Application Development - Michael K. Johnson, Erik W. Troan,Adission Wesley, 1998.
3. Assembly Language for x86 Processors by Kip R. Irvine,7th edition Prentice-Hall publishers,2014

REFERENCES:

1. Operating System Concepts by Abraham Silberschatz, Peter B. Galvin and Greg Gagne,wiley publisher, 8th edition,2008.
2. Intel® 64 and IA-32 Architectures Software Developer Manuals

3. The Design of the UNIX Operating System by Maurice J. Bach PrenticeHall 4. UNIX Network Programming by W. Richard Stevens

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EMBEDDED CONTROL SYSTEMS
(ELECTIVE II)

UNIT I - CONTROL SYSTEM BASICS

Z-transforms – performance requirements - block diagrams - analysis and design - sampling theory – difference equations.

UNIT II - CONTROL SYSTEM IMPLEMENTATION

Discretization method – Fixed point mathematics – Nonlinear controller elements – Gain scheduling – Controller implementation and testing in Embedded Systems. - a case study of robotic control system.

UNIT III - CONTROL SYSTEM TESTING

Software implications - Controller implementation and testing in embedded systems - Measuring frequency response.

UNIT IV - INPUT DEVICES

Keyboard basics - Keyboard scanning algorithm - Character LCD modules - LCD module display Configuration - Time-of-day clock - Timer manager - Interrupts - Interrupt service routines - Interrupt-driven pulse width modulation. Triangle waves analog vs. digital values - Auto port detect - Capturing analog information in the timer interrupt service routine - Automatic, multiple channel analog to digital data acquisition.

UNIT V - OUTPUT DEVICES AND SENSORS

H Bridge – relay drives - DC/ Stepper Motor control– optical devices. Linear and angular displacement sensors: resistance sensor – induction displacement sensor – digital optical displacement sensor – pneumatic sensors. Speed and flow rate sensors : electromagnetic sensors – fluid flow sensor – thermal flow sensor. Force sensors: piezoelectric sensors – strain gauge sensor – magnetic flux sensor – inductive pressure sensor – capacitive pressure sensor. Temperature sensors: electrical – thermal expansion – optical Case Study- Examples for sensor, actuator, control circuits with applications.

TEXTBOOKS:

1. Jim Ledin, “Embedded control systems in C/C++”, CMP Books, 2004.

2. TimWiscott, “Applied control for embedded systems”, Elsevier Publications, 2006.

3. Jean J. Labrosse, "Embedded Systems Building Blocks: Complete and Ready-To-Use Modules in C", The publisher, Paul Temme, 2011.

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REFERENCES:

1. Ball S.R., "Embedded microprocessor Systems Real World Design", Prentice Hall, 2002.

2. Lewin A.R.W. Edwards, "Open source robotics and process control cookbook", Elsevier Publications, 2005.

3. Ben Zion Sandler, "Robotics", Elsevier Publications, 1999

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ADVANCED OPERATING SYSTEMS
(ELECTIVE II)

UNIT-I

Introduction to Operating Systems: Overview of computer system hardware, Instruction execution, I/O function, Interrupts, Memory hierarchy, I/O Communication techniques, Operating system objectives and functions, Evaluation of operating System

UNIT-I

Introduction to UNIX and LINUX: Basic Commands & Command Arguments, Standard Input, Output, Input / Output Redirection, Filters and Editors, Shells and Operations

UNIT-III:

System Calls: System calls and related file structures, Input / Output, Process creation & termination. **Inter Process Communication:**Introduction, File and record locking, Client – Server example, Pipes, FIFOs, Streams & Messages, Name Spaces, Systems V IPC, Message queues, Semaphores, Shared Memory, Sockets & TLI.

UNIT-IV:

Introduction to Distributed Systems: Goals of distributed system, Hardware and software concepts, Design issues. **Communication in Distributed Systems:**Layered protocols, ATM networks, Client - Server model, Remote procedure call and Group communication.

UNIT-V:

Synchronization in Distributed Systems: Clock synchronization, Mutual exclusion, E-tech algorithms, Bully algorithm, Ring algorithm, Atomic transactions **Deadlocks:**Dead lock in distributed systems, Distributed dead lock prevention and distributed dead lock detection.

TEXTBOOKS:

1. The Design of the UNIX Operating Systems – Maurice J. Bach, 1986, PHI. 2.
Distributed Operating System - Andrew. S. Tanenbaum, 1994, PHI.
3. The Complete Reference LINUX – Richard Peterson, 4th Ed., McGraw – Hill.

REFERENCES:

1. Operating Systems: Internal and Design Principles -Stallings, 6th Ed., PE. 2.
Modern Operating Systems - Andrew S Tanenbaum, 3rd Ed., PE.
3. Operating System Principles - Abraham Silberchatz, Peter B. Galvin, Greg Gagne, 7th Ed., John Wiley
4. UNIX User Guide – Ritchie & Yates.
5. UNIX Network Programming - W.Richard Stevens, 1998, PHI.

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EMBEDDED C LABORATORY

The Students are required to write the programs using C-Language according to the hardware requirements such as 8051/PIC Micro controllers or any ARM processor developer kits.

- The following experiments are required to develop the algorithms, flow diagrams, source code and perform the compilation, execution and implement the same using necessary hardware kits for verification. The programs developed for the implementation should be at the level of an embedded system design.
- The students are required to perform at least EIGHT experiments.

List of Experiments:

1. LED Blinking.
2. ASCII to Decimal vice versa conversion. 3. Basic Arithmetic operations.
4. PWM (Motor application).
5. Serial Communication (USART). 6. ADC and DAC implementation. 7. JTAG Debugger.
8. Seven segment display interfacing. 9. LCD display interfacing.
10. 3x4 keyboard interfacing.
11. Memory Device interfacing (Reading or Writing a file from external memory). 12. Temperature sensor/4 way Road control /Elevator.

Lab Requirements:

Software:

1. Keil Micro-vision IDE or Eclipse IDE for C and C++ (YAGARTO Eclipse IDE) 2. LINUX Environment for the compilation using Eclipse IDE & Java with latest version.

Hardware:

1. The development kits of 8051/PIC Micro controllers or any ARM processor.

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	4	**0**	**3**

HARDWARE SOFTWARE CO-DESIGN

Unit 1:

Co- Design Issues:Co- Design Models, Architectures, Languages, A Generic Co-design Methodology.
Co- Synthesis Algorithms:Hardware software synthesis algorithms: hardware – software partitioning distributed system co-synthesis.

Unit 2:

Prototyping and Emulation: Prototyping and emulation techniques, prototyping and emulation environments, future developments in emulation and prototyping architecture specialization techniques, system communication infrastructure

Target Architectures:Architecture Specialization techniques, System Communication infrastructure, Target Architecture and Application System classes, Architecture for control dominated systems (8051-Architectures for High performance control), Architecture for Data dominated systems (ADSP21060, TMS320C60), Mixed Systems.

Unit 3:

Compilation Techniques and Tools for Embedded Processor Architectures:Modern embedded architectures, embedded software development needs, compilation technologies, practical consideration in a compiler development environment.

Unit 4:

Design Specification and Verification: Design, co-design, the codesign computational model, concurrency coordinating concurrent computations, interfacing components, design verification, implementation verification, verification tools, interface verification.

Unit 5:

Languages for System – Level Specification and Design-I: Systemlevel specification, design representation for system level synthesis, system level specification languages.

Languages for System – Level Specification and Design-II: Heterogeneous specifications and multi language co-simulation, the cosyma system and lycos system.

TEXTBOOKS:

1. Hardware / Software Co- Design Principles and Practice – JorgenStaunstrup, Wayne Wolf – 2009, Springer.

2. Hardware / Software Co- Design - Giovanni De Micheli, Mariagiovanna Sami, 2002, Kluwer Academic Publishers.

REFERENCES:

1. A Practical Introduction to Hardware/Software Co-design -Patrick R. Schaumont -2010 – Springer Publications.

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I Year – II SEMESTER

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DSP INTEGRATED CIRCUITS

UNIT I

DSP IC'S AND VLSI CIRCUIT TECHNOLOGIES: Standard digital signal processors, Application specific IC's for DSP, DSP systems, DSP system design, Integrated circuit design. MOS transistors, MOS logic, VLSI process technologies, Trends in CMOS technologies.

UNIT II

DIGITAL SIGNAL PROCESSING: Digital signal processing, Sampling of analog signals, Selection of sample frequency, Signal-processing systems, Frequency response, Transfer functions, Signal flow graphs, Filter structures, Adaptive DSP algorithms, DFT-The Discrete Fourier Transform, FFT-The Fast Fourier Transform Algorithm, Image coding, Discrete cosine transforms. EST-2013 SRM(E&T) 31

UNIT III

DIGITAL FILTERS AND FINITE WORD LENGTH : FIR filters, FIR filter structures, FIR chips, IIR filters, Specifications of IIR filters, Mapping of analog transfer functions, Mapping of analog filter structures, Multirate systems, Interpolation with an integer factor L, Sampling rate change with a ratio L/M, Multirate filters. Finite word length effects -Parasitic oscillations, Scaling of signal levels, Round-off noise, Measuring round-off noise, Coefficient sensitivity,Sensitivity and noise.

UNIT IV

DSP ARCHITECTURES AND THEIR SYNTHESIS : DSP system architectures, Standard DSP architecture, Ideal DSP architectures, Multiprocessors and multicomputers, Systolic and Wave front arrays, Shared memory architectures. Mapping of DSP algorithms onto hardware, Implementation based on complex PEs, Shared memory architecture with Bit – serial PEs.

UNIT V

ARITHMETIC UNITS AND IC DESIGN : Conventional number system, redundant Number system, Residue Number System. Bit-parallel and Bit-Serial arithmetic, Basic shift accumulator, Reducing the memory size, Complex multipliers, Improved shiftaccumulator. Layout of VLSI circuits, FFT processor, DCT processor and Interpolator as case studies.

TEXTBOOKS:

1. Lars Wanhammer, "DSP Integrated Circuits", Academic press, New York, 1999.
2. Robert J. Schilling, "Fundamentals of Digital Singal Processing using MATLAB", Perason Education, 2010.

REFERENCES:

1. A.V.Oppenheim et.al, "Discrete-time Signal Processing", Pearson education, 2000.

2. Emmanuel C. Ifeachor, Barrie W. Jervis, "Digital signal processing – A practical approach", 2nd Edition, Pearson edition, Asia, 2011.
3. Keshab K.Parhi, "VLSI digital Signal Processing Systems design and Implementation", Wiley India, 2007.

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EMBEDDED NETWORKING

Unit 1:

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

Unit 2:

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

Unit 3:

Ethernet 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.

Unit 4:

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

Unit 5:

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

TEXTBOOKS:

1. Embedded Systems Design: A Unified Hardware/Software Introduction - Frank Vahid, Tony Givargis, John & Wiley Publications, 2002.
2. Parallel Port Complete: Programming, interfacing and using the PCs parallel printer port - Jan Axelson, Penram Publications, 1996.

REFERENCES:

1. Advanced PIC microcontroller projects in C: from USB to RTOS with the PIC18F series - Dogan Ibrahim, Elsevier 2008.
2. Embedded Ethernet and Internet Complete - Jan Axelson, Penram publications, 2003. 3. Networking Wireless Sensors - Bhaskar KrishnamachariÀÛÜ, Cambridge press 2005.

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CPLD AND FPGA ARCHITECURES AND APPLICATIONS

Unit 1:

Introduction to Programmable Logic Devices Introduction, Simple Programmable Logic Devices – Read Only Memories, Programmable Logic Arrays, Programmable Array Logic, Programmable Logic Devices/ Generic Array Logic; Complex Programmable Logic Devices – Architecture of Xilinx Cool Runner XCR3064XL CPLD, CPLD Implementation of a Parallel Adder with Accumulation.

Unit 2:

Field Programmable Gate Arrays Organization of FPGAs, FPGA Programming Technologies, Programmable Logic Block Architectures, Programmable Interconnects, Programmable I/O blocks in FPGAs, Dedicated Specialized Components of FPGAs, Applications of FPGAs.

Unit 3:

SRAM Programmable FPGAs Introduction, Programming Technology, Device Architecture, The Xilinx XC2000, XC3000 and XC4000 Architectures.

Unit 4:

Anti-Fuse Programmed FPGAs Introduction, Programming Technology, Device Architecture, The Actel ACT1, ACT2 and ACT3 Architectures.

Unit 5:

Design Applications General Design Issues, Counter Examples, A Fast Video Controller, A Position Tracker for a Robot Manipulator, A Fast DMA Controller, Designing Counters with ACT devices, Designing Adders and Accumulators with the ACT Architecture.

TEXTBOOKS:

1. Field Programmable Gate Array Technology - Stephen M. Trimberger, Springer International Edition,1994.

2. Digital Systems Design - Charles H. Roth Jr, Lizy Kurian John,2nd Ed., Cengage Learning,1998.

REFERENCES:

1. Field Programmable Gate Arrays - John V. Oldfield, Richard C. Dorf, Wiley India,1995. 2. Digital Design Using Field Programmable Gate Arrays - Pak K. Chan/ Samiha Mourad, Pearson Low Price Edition,1994.
3. Digital Systems Design with FPGAs and CPLDs - Ian Grout, Elsevier Newnes,2008. 4. FPGA based System Design - Wayne Wolf, Prentice Hall Modern Semiconductor Design Series,2004.

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SENSORS AND ACTUATORS
(ELECTIVE-III)

Unit 1:

Sensors / Transducers: Principles – Classification – Parameters – Characteristics - Environmental Parameters (EP) – Characterization. Mechanical and Electromechanical Sensors: Introduction – Resistive Potentiometer – Strain Gauge – Resistance Strain Gauge – Semiconductor Strain Gauges -Inductive Sensors: Sensitivity and Linearity of the Sensor – Types-Capacitive Sensors:– Electrostatic Transducer– Force/Stress Sensors Using Quartz Resonators – Ultrasonic Sensors.

Unit 2:

Thermal Sensors: Introduction – Gas thermometric Sensors – Thermal Expansion Type Thermometric Sensors – Acoustic Temperature Sensor – Dielectric Constant and Refractive Index thermo sensors – Helium Low Temperature Thermometer – Nuclear Thermometer – Magnetic Thermometer – Resistance Change Type Thermometric Sensors – Thermoemf Sensors– Junction Semiconductor Types– Thermal Radiation Sensors –Quartz Crystal Thermoelectric Sensors – NQR Thermometry – Spectroscopic Thermometry – Noise Thermometry –Heat Flux Sensors

Magnetic sensors: Introduction – Sensors and the Principles Behind – Magneto-resistive Sensors – Anisotropic Magneto resistive Sensing – Semiconductor Magnetoresistors– Hall Effect and Sensors – Inductance and Eddy Current Sensors– Angular/Rotary Movement Transducers – Synchros – Synchro-resolvers - Eddy Current Sensors – Electromagnetic Flowmeter – Switching Magnetic Sensors SQUID Sensors

Unit 3:

Radiation Sensors: Introduction – Basic Characteristics – Types of Photosensistors/Photo detectors– X-ray and Nuclear Radiation Sensors– Fiber Optic Sensors. Electro analytical Sensors: Introduction – The Electrochemical Cell – The Cell Potential - Standard Hydrogen Electrode (SHE) – Liquid Junction and Other Potentials – Polarization – Concentration Polarization-– Reference Electrodes - Sensor Electrodes – Electro ceramics in Gas Media .

Unit 4:

Smart Sensors: Introduction – Primary Sensors – Excitation – Amplification – Filters – Converters – Compensation– Information Coding/Processing - Data Communication – Standards for Smart Sensor Interface – The Automation

Sensors-Applications: Introduction – On-board Automobile Sensors (Automotive Sensors)– Home Appliance Sensors – Aerospace Sensors — Sensors for Manufacturing –Sensors for environmental Monitoring

Unit 5:

Actuators Pneumatic and Hydraulic Actuation Systems- Actuation systems – Pneumatic and hydraulic systems - Directional Control valves – Presure control valves – Cylinders - Servo and proportional control valves – Process control valves – Rotary actuators Mechanical Actuation Systems- Types of motion – Kinematic chains – Cams – Gears – Ratchet and pawl – Belt and chain drives – Bearings – Mechanical aspects of motor selection

Electrical Actuation Systems-Electrical systems -Mechanical switches – Solid-state switches Solenoids – D.C. Motors – A.C. motors – Stepper motors

TEXTBOOKS:

1. D. Patranabis – "Sensors and Transducers" – 2nd Ed.,PHI Learning Private Limited,2003. 2. W. Bolton – "Mechatronics" –4th edition, Pearson Education Limited,2008.

REFERENCES:

1. Sensors And Actruators – D. Patranabis – 2nd Ed., PHI, 2013.

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MICRO ELECTRO MECHANICAL SYSTEM DESIGN
(ELECTIVE III)

UNIT-I

Introduction Basic structures of MEM devices – (Canti-Levers, Fixed Beams diaphragms). Broad Response of Micro electromechanical systems (MEMS) to Mechanical (Force, pressure etc.) Thermal, Electrical, optical and magnetic stimuli, compatibility of MEMS from the point of power dissipation, leakage etc.

UNIT-II

Review of mechanical concepts like stress, strain, bending moment, deflection curve. Differential equations describing the deflection under concentrated force, Distributed force, distributed force, Deflection curves for canti-levers- fixed beam. Electrostatic excitation – columbic force between the fixed and moving electrodes. Deflection with voltage in C.L, Deflection Vs Voltage curve, critical fringe field – field calculations using Laplace equation. Discussion on the approximate solutions – Transient response of the MEMS.

UNIT-III

Types Two terminal MEMS - capacitance Vs voltage Curve – Variable capacitor. Applications of variable capacitors. Two terminal MEM structures. Three terminal MEM structures – Controlled variable capacitors – MEM as a switch and possible applications.

UNIT-IV

MEM Circuits & Structures MEM circuits & structures for simple GATES- AND, OR, NAND, NOR, Exclusive OR, simple MEM configurations for flip-flops triggering applications to counters, converters. Applications for analog circuits like frequency converters, wave shaping. RF Switches for modulation. MEM Transducers for pressure, force temperature. Optical MEMS.

UNIT-V

MEM Technologies Silicon based MEMS- Process flow – Brief account of various processes and layers like fixed layer, moving layers spacers etc., and etching technologies. Metal Based MEMS: Thin and thick film technologies for MEMS.
Process flow and description of the processes, Status of MEMS in the current electronics scenario.

TEXTBOOKS:

1. MEMS Theory, Design and Technology - GABRIEL. M.Review, R.F.,2003, John wiley & Sons. .
2. Strength of Materials –Thimo Shenko, 2000, CBS publishers & Distributors.

3. MEMS and NEMS, Systems Devices; and Structures – Servey E.Lyshevski, 2002, CRC ss.

REFERENCES:

1. Sensor Technology and Devices - Ristic L. (Ed) , 1994, Artech House, London.

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INTERNET PROTOCOLS
(ELECTIVE-III)

UNIT -I

Internetworking Concepts: Principles of Internetworking, Connectionless Internetworking, Application level Interconnections, Network level Interconnection, Properties of thee Internet, Internet Architecture, Wired LANS, Wireless LANs, Point-to-Point WANs, Switched WANs, Connecting Devices, TCP/IP Protocol Suite.

IP Address: Classful Addressing: Introduction, Classful Addressing, Other Issues, Sub-netting and Super-netting

Classless Addressing: Variable length Blocks, Sub-netting, Address Allocation. Delivery, Forwarding, and Routing of IP Packets: Delivery, Forwarding, Routing, Structure of Router.

ARP and RARP:ARP, ARP Package, RARP.

UNIT -II

Internet Protocol (IP): Datagram, Fragmentation, Options, Checksum, IP V.6.

Transmission Control Protocol (TCP):TCP Services, TCP Features, Segment, A TCP Connection, State Transition Diagram, Flow Control, Error Control, Congestion Control, TCP Times.

Stream Control Transmission Protocol (SCTP):SCTP Services, SCTP Features, Packet Format, Flow Control, Error Control, Congestion Control.

Mobile IP: Addressing, Agents, Three Phases, Inefficiency in Mobile IP.

Classical TCP Improvements: Indirect TCP, Snooping TCP, Mobile TCP, Fast Retransmit/ Fast Recovery, Transmission/ Time Out Freezing, Selective Retransmission, Transaction Oriented TCP.

UNIT –III

Unicast Routing Protocols (RIP, OSPF, and BGP): Intra and Interdomain Routing, Distance Vector Routing, RIP, Link State Routing, OSPF, Path Vector Routing, BGP.

Multicasting and Multicast Routing Protocols: Unicast - MulticastBroadcast, Multicast Applications, Multicast Routing, Multicast Link
State Routing: MOSPF, Multicast Distance Vector: DVMRP.

UNIT -IV:

Domain Name System (DNS): Name Space, Domain Name Space, Distribution of Name Space, and DNS in the internet.

Remote Login TELNET: Concept, Network Virtual Terminal (NVT). File Transfer FTP and TFTP: File Transfer Protocol (FTP). Electronic Mail:SMTP and POP.

Network Management-SNMP: Concept, Management Components, World Wide Web-HTTP Architecture.

UNIT –V

Multimedia: Digitizing Audio and Video, Network security, security in the internet firewalls. Audio and Video Compression, Streaming Stored Audio/Video, Streaming Live udio/Video, Real-Time Interactive Audio/ Video, RTP, RTCP, Voice Over IP. Network Security, Security in the Internet, Firewalls.

TEXTBOOKS:

1. TCP/IP Protocol Suite- Behrouz A. Forouzan, Third Edition, TMH,2005.

2. Internetworking with TCP/IP- Comer, 6th edition, PHI,2013.

REFERENCES:

1. High performance TCP/IP Networking- Mahbub Hassan, Raj Jain, PHI, 2005

2. Data Communications & Networking – B.A. Forouzan – 2 nd Edition – TMH,2000.

3. High Speed Networks and Internets- William Stallings, Pearson Education, 2002.

4. Data and Computer Communications, William Stallings, 7th Edition., PEI.

5. The Internet and Its Protocols – Adrin Farrel, Elsevier, 2005.

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SYSTEM ON CHIP DESIGN
(ELECTIVE – IV)

UNIT-I

Introduction to the System Approach: System Architecture, Components of the system, Hardware & Software, Processor Architectures, Memory and Addressing. System level interconnection, An approach for SOC Design, System Architecture and Complexity.

UNIT-II

Processors: Introduction , Processor Selection for SOC, Basic concepts in Processor Architecture, Basic concepts in Processor Micro Architecture, Basic elements in Instruction handling. Buffers: minimizing Pipeline Delays, Branches, More Robust Processors, Vector Processors and Vector Instructions extensions, VLIW Processors, Superscalar Processors.

UNIT-III

Memory Design for SOC: Overview of SOC external memory, Internal Memory, Size, Scratchpads and Cache memory, Cache Organization, Cache data, Write Policies, Strategies for line replacement at miss time, Types of Cache, Split – I, and D – Caches, Multilevel Caches, Virtual to real translation , SOC Memory System, Models of Simple Processor – memory interaction.

UNIT-IV

Interconnect Customization and Configuration: Inter Connect Architectures, Bus: Basic Architectures, SOC Standard Buses , Analytic Bus Models, Using the Bus model, Effects of **Bus transactions and contention time. SOC Customization:** An overview, Customizing Instruction Processor, Reconfiguration Technologies, Mapping design onto Reconfigurable devices, Instance-Specific design, Customizable Soft Processor, Reconfiguration - overhead analysis and trade-off analysis on reconfigurable Parallelism.

UNIT-V

Application Studies / Case Studies:SOC Design approach, AES algorithms, Design and evaluation, Image compression – JPEG compression.

TEXTBOOKS:

1. Computer System Design System-on-Chip - Michael J. Flynn and Wayne Luk, Wiley India Pvt. Ltd,2011.

2. ARM System on Chip Architecture – Steve Furber –2nd Ed., 2000, Addison Wesley Professional.

REFERENCES:

1. Design of System on a Chip: Devices and Components – Ricardo Reis, 1st Ed., 2004, Springer

2. Co-Verification of Hardware and Software for ARM System on Chip Design (Embedded Technology) – Jason Andrews – Newnes, BK and CDROM.

3. System on Chip Verification – Methodologies and Techniques – Prakash Rashinkar, Peter Paterson and Leena Singh L, 2001, Kluwer Academic Publishers.

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EMBEDDED LINUX
(ELECTIVE IV)

UNIT I - LINUX FUNDAMENTALS

Introduction - host-target development setup - hardware support - development languages and tools – RT linux.

UNIT II - INITIALIZATION

Linux kernel and kernel initialization - system initialization – hardware support -bootloaders.

UNIT III - DEVICE HANDLING

Device driver basics - module utilities - file systems - MTD subsystems – busybox.

UNIT IV - DEVELOPMENT TOOLS

Embedded development environment - GNU debugger - tracing & profiling tools - binary utilities - kernel debugging - debugging embedded Linux applications - porting Linux -Linux and real time - SDRAM interface.

UNIT V - DEVICE APPLICATIONS

Asynchronous serial communication interface - parallel port interfacing - USB interfacing - memory I/O interfacing - using interrupts for timing.

TEXT BOOKS:

1. Karim Yaghmour, Jon Masters, Gillad Ben Yossef, Philippe Gerum, “Building embedded linux systems”,2nd Ed., O'Reilly, 2008.

2. Christopher Hallinan, “Embedded Linux Primer: A practical real world approach”, Prentice Hall,2nd Ed., 2007.

REFERENCES:

1. Craig Hollabaugh, “Embedded Linux:Hardware,software and Interfacing”, 2nd Ed.,Pearson Education, 2002.

2. Doug Abbott,“Linux for embedded and real time applications”, Elsevier Science, 1st Ed.,2003

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MULTIMEDIA AND SIGNAL CODING
(ELECTIVE IV)

UNIT-I

Introduction to Multimedia: Multimedia, World Wide Web, Overview of Multimedia Tools, Multimedia Authoring, Graphics/ Image Data Types, and File Formats.

Color in Image and Video: Color Science – Image Formation, Camera Systems, Gamma Correction, Color Matching Functions, CIE Chromaticity Diagram, Color Monitor Specifications, Outof- Gamut Colors, White Point Correction, XYZ to RGB Transform, Transform with Gamma Correction, L*A*B* Color Model. Color Models in Images – RGB Color Model for CRT Displays, Subtractive Color: CMY Color Model, Transformation from RGB to CMY, Under Color Removal: CMYK System, Printer Gamuts, Color Models in Video – Video Color Transforms, YUV Color Model, YIQ Color Model, Ycbcr Color Model.

UNIT-II

Video Concepts: Types of Video Signals, Analog Video, Digital Video.

Audio Concepts: Digitization of Sound, Quantization and Transmission of Audio.

UNIT-III

Compression Algorithms: Lossless Compression Algorithms: Run Length Coding, Variable Length Coding, Arithmetic Coding, Lossless JPEG, Image Compression.

Lossy Image Compression Algorithms: Transform Coding: KLT And DCT Coding, Wavelet Based Coding.

Image Compression Standards: JPEG and JPEG2000.

UNIT-IV

Video Compression Techniques: Introduction to Video Compression, Video Compression Based on Motion Compensation, Search for Motion Vectors, H.261- Intra-Frame and Inter-Frame Coding, Quantization, Encoder and Decoder, Overview of MPEG1 and MPEG2.

UNIT-V

Audio Compression Techniques: ADPCM in Speech Coding, G.726 ADPCM, Vocoders – Phase Insensitivity, Channel Vocoder, Formant Vocoder, Linear Predictive Coding, CELP, Hybrid Excitation, Vocoders, MPEG Audio – MPEG Layers, MPEG Audio Strategy, MPEG Audio Compression Algorithms, MPEG-2 AAC, MPEG-4 Audio.

TEXTBOOKS:

1. Fundamentals of Multimedia – Ze- Nian Li, Mark S. Drew, PHI, 2010.
2. Multimedia Signals & Systems – Mrinal Kr. Mandal Springer International Edition 1st Edition, 2009

REFERENCES:

1. Multimedia Communication Systems – Techniques, Stds& Netwroks K.R. Rao, Zorans. Bojkoric, Dragorad A.Milovanovic, 1st Edition, 2002.
2. Fundamentals of Multimedia Ze- Nian Li, Mark S.Drew, Pearson Education (LPE), 1st Edition, 2009.
3. Multimedia Systems John F. Koegel Bufond Pearson Education (LPE), 1st Edition, 2003. 4. Digital Video Processing – A. Murat Tekalp, PHI, 1996.
5. Video Processing and Communications – Yaowang, Jorn Ostermann, Ya-QinZhang, Pearson, 2002.

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EMBEDDED SYSTEMS LABORATORY

The Students are required to write the programs using C-Language according to the Experiment requirements using RTOS Library Functions and macros ARM-926 developer kits and ARM-Cortex.

The following experiments are required to develop the algorithms, flow diagrams, source code and perform the compilation, execution and implement the same using necessary hardware kits for verification. The programs developed for the implementation should be at the level of an embedded system design.

The students are required to perform at least SIX experiments from Part-I and TWO experiments from

Part-II.

List of Experiments:

Part-I: Experiments using ARM-926 with PERFECT RTOS

1. Register a new command in CLI. 2. Create a new Task.
3. Interrupt handling.

4. Allocate resource using semaphores. 5. Share resource using MUTEX.
6. Avoid deadlock using BANKER'S algorithm.

7. Synchronize two identical threads using MONITOR. 8. Reader's Writer's Problem for concurrent Tasks.