EASWARI ENGINEERING COLLEGE
(Autonomous Institution)
BHARATHI SALAI, RAMAPURAM, CHENNAI-600 089

[A Unit of SRM Group of Educational Institutions,
Approved by AICTE |Affiliated to Anna University, Chennai |
NAAC Accredited 'A' Grade ,2(f) & 12(B) Status (UGC)|
ISO 9001:2015 Certified|NBA Accredited Programmes |
FIST Funded (DST)|SIRO Certified (DSIR)]

R-2019
CURRICULUM AND SYLLABUS

M.E- EMBEDDED SYSTEM TECHNOLOGIES
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

ACADEMIC CURRICULUM (2019 – 2020)

M.E. (EMBEDDED SYSTEM TECHNOLOGIES)

I M.E, I SEMESTER

SEMESTER I								
Sl. NO.	**Course Code**	**Course Title**	**Category**	**Hours / Week**				**Credits**
				L	**T**	**P**	**R**	
Theory								
1	192MAB104T	Applied Mathematics for Electrical Engineers	B	3	2	-	-	4
2	192EEC101T	ARM Processors and Controllers	C	3	-	-	-	3
3	192EEC102T	Advanced Digital System Design	C	3	-	-	-	3
4	192EEC103T	Embedded Sensor Networks	C	3	-	-	-	3
5		Professional Elective - I	E	3	-	-	-	3
Practical								
6	192EEC111L	Embedded Systems Laboratory	C	-	-	3	1	2
Employability Enhancement / Career Advancement Course								
7	192EEA111L	Term Paper Writing and Seminar	A	-	-	4	-	2
8	192EEA112I	Industry Supported Employability Enhancement Course (Optional)	A	-	-	-	-	ONE/TWO
9	192EEA113T	Online course (Optional) *****	A	-	-	-	-	THREE
Total				**15**	**2**	**7**	**1**	**20**

SEMESTER II								
Sl. NO.	**Course Code**	**Course Title**	**Category**	**Hours / Week**				**Credits**
				L	**T**	**P**	**R**	
Theory								
1	192EEC202T	Real Time Operating Systems	C	3	-	-	-	3
2	192EEC203T	Digital Controllers in Power Electronics Application	C	3	-	-	-	3
3	192EEC204T	Embedded Linux	C	3	-	-	-	3
4		Professional Elective – II	E	3	-	-	-	3
5		Open Elective	O	3	-	-	-	3
Practical								
6	192EEC211L	Real Time Operating Systems Laboratory	C	-	-	3	1	2
Mandatory Course (Choice)								
7		Research Methodology and IPR/ Foreign Language (Opt for any one)	M	2	-	-	-	TWO
Employability Enhancement / Career Advancement Course								
8	192EEP211L	Minor Project	A	-	-	-	4	2

9	192EEA211I	Internship / Industrial Training	A	-	-	-	-	1
10	192EEP212I	Industry Supported Employability Enhancement Course (optional) *	A	-	-	2	-	ONE/TWO
11	192EEA213T	Online course (Optional) *	A	-	-	-	-	THREE
Total				**17**	**0**	**5**	**5**	**20**

SEMESTER III								
Sl. NO.	**Course Code**	**Course Title**	**Category**	**Hours / Week**				**Credits**
				L	**T**	**P**	**R**	
Theory								
1		Professional Elective – III	E	3	-	-	-	3
2		Professional Elective – IV	E	3	-	-	-	3
Practical								
3	192EEP311L	Project Work/ Start-Up Phase-I	P	-	-	-	16	8
Employability Enhancement / Career Advancement Course								
4	192EEA311I	Internship / Industrial Training	A	-	-	-	-	1
Total				**6**	**0**	**0**	**16**	**15**

SEMESTER IV								
Sl. NO.	**Course Code**	**Course Title**	**Category**	**Hours / Week**				**Credits**
				L	**T**	**P**	**R**	
Practical								
1	192EEP411L	Project Work/ Start-Up Phase-II	P	-	-	-	28	14
Total				**0**	**0**	**0**	**28**	**14**
Total Credit								**69**

Subject Area / **Semester**	**I**	**II**	**III**	**IV**	**Credit**
Foundation Course (B)	4	-			**4**
Professional Core (C)	11	11	-	-	**22**
Professional Electives (E)	3	3	6	-	**12**
Open Electives (O)	-	3	-	-	**3**
Employability Enhancement Courses (A)	2	3	9	14	**28**
Credit	**20**	**20**	**15**	**14**	**69**

NOTE:* REFER R-19 FOR EARNING CREDITS

PROFESSIONAL ELECTIVE								
Sl. No.	**Course Code**	**Course Title**	**Category**	**Hours / Week**				**Credits**
				L	**T**	**P**	**R**	**C**
1	192EEE001T	Digital Image Processing	E	3	-	-	-	3
2	192EEE002T	Real Time Embedded Systems	C	3	-	-	-	3
3	192EEE003T	Low Power VLSI Design	E	3	-	-	-	3
4	192EEE004T	Digital Instrumentation	E	3	-	-	-	3
5	192EEE005T	Software for Embedded Systems	E	3	-	-	-	3
6	192EEE006T	Wireless and Mobile Communication	E	3	-	-	-	3
7	192EEE007T	Machine Learning and Applications	E	3	-	-	-	3
8	192EEE008T	Embedded System Network	E	3	-	-	-	3
9	192EEE009T	Information Theory and Coding	E	3	-	-	-	3
10	192EEE010T	Internet of Things	E	3	-	-	-	3
11	192EEE011T	Robotics and Control	E	3	-	-	-	3
12	192EEE012T	Electric Vehicles and Power Management	E	3	-	-	-	3

192MAB104T APPLIED MATHEMATICS FOR ELECTRICAL ENGINEERS

L	T	P	R	C
3	2	-	-	4

COURSE OBJECTIVES:

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

UNIT I MATRIX THEORY 12

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

UNIT II CALCULUS OF VARIATIONS 12

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

UNIT III PROBABILITY AND RANDOM VARIABLES 12

Probability – Axioms of probability – Conditional probability – Baye's theorem - Random variables - Probability function – Moments – Moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Function of a random variable.

UNIT IV LINEAR PROGRAMMING 12

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

UNIT V FOURIER SERIES 12

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

Total: 60 Hours

COURSE OUTCOMES:

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

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

REFERENCE(S)

1. Andrews L.C. and Phillips R.L., "Mathematical Techniques for Engineers and Scientists", Prentice Hall of India Pvt. Ltd., New Delhi, 2005.
2. Bronson, R. "Matrix Operation", Schaum's outline series, 2nd Edition, McGraw Hill, 2011.Elsgolc, L. D. "Calculus of Variations", Dover Publications, New York, 2007.

3. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.
4. O'Neil, P.V., "Advanced Engineering Mathematics", Thomson Asia Pvt. Ltd., Singapore, 2003.
5. Taha, H.A., "Operations Research, An Introduction", 9th Edition, Pearson education, New Delhi, 2016.

192EEC101T ARM PROCESSORS AND CONTROLLERS

L	T	P	R	C
3	-	-	-	3

COURSE OBJECTIVES:

- To study the concepts of Architecture and Assembly language programming of ARM Processor.
- To study the concepts of Architectural Support for High level language and memory hierarchy.
- To study the concepts of Architectural support for system Development and Operating system.

UNIT I ARM ARCHITECTURE 9

Abstraction in hardware design – MUO -Acorn RISC Machine – Architecture Inheritance – ARM programming model – ARM Development Tools – 3 and 5 Stage Pipeline ARM Organization –ARM Instruction Execution and Implementation – ARM Co-Processor Interface.

UNIT II ARM ASSEMBLY LANGUAGE PROGRAMMING 9

ARM Instruction Types – data Transfer, Data Processing and Control Flow Instructions – ARM Instruction set – Co-Processor Instruction.

UNIT III ARCHITECTURAL SUPPORT FOR HIGH LEVEL LANGUAGE AND MEMORY HIERARCHY 9

Data Types – Abstraction in software design – expressions – Loops – Functions and Procedures – Conditional Statements – use of memory- Memory size and speed – On Chip Memory – Caches Design – an example –Memory management.

UNIT IV ARCHITECTURAL SUPPORT FOR SYSTEM DEVELOPMENT 9

Advantaged Microcontroller Bus Architecture – ARM memory Interface – ARM Reference Peripheral Specification – Hardware System Prototyping Tools – Emulator – Debug Architecture

UNIT V ARCHITECTURAL SUPPORT FOR OPERATING SYSTEM 9

An introduction to Operating systems – ARM system Control Coprocessor – CP15 Protection unit Registers – ARM Protection unit – CP15 MMU Registers – ARM MMU Architecture –Synchronization context Switching input and output.

Total: 45 Hours

COURSE OUTCOMES:

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

- Analyze various types of coprocessors and design suitable co-processor interface to ARM processor.
- Analyze floating point processor architecture and its architectural support for higher level language.
- Identify the architectural support of ARM for operating system and analyze the function of memory Management unit of ARM.

REFERENCE(S)

1. Steve Furber, ARM System on Chip Architecture, Addison –Wesley Professional, 2000.
2. Ricardo Reis, Design of System on a Chip: Devices and Components, Springer, 2004.
3. Jason Andrews, o-Verification of Hardware and Software for ARM System on Chip
4. Design (Embedded Technology), ewnes, BK and CD-ROM, Aug 2004.
5. P.Rashinkar, L.Paterson and Singh, System on a Chip Verification- Methodologies and Techniques, Kluwer Academic Publishers, 2000.

192EEC102T ADVANCED DIGITAL SYSTEMS DESIGN

L	T	P	R	C
3	-	-	-	3

COURSE OBJECTIVES:

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

UNIT I SEQUENTIAL CIRCUIT DESIGN 9

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

UNIT II ASYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN 9

Analysis of Asynchronous Sequential Circuit (ASC) – Flow Table Reduction – Races in ASC – State Assignment – Problem and the Transition Table – Design of ASC – Static and Dynamic Hazards – Essential Hazards – Data Synchronizers – Designing Vending Machine Controller – Mixed Operating Mode Asynchronous Circuits.

UNIT III FAULT DIAGNOSIS AND TESTABILITY ALGORITHMS 9

Fault Table Method – Path Sensitization Method – Boolean Difference Method – Kohavi Algorithm – Tolerance Techniques – The Compact Algorithm – Practical PLA's –Fault in PLA – Test Generation – Masking Cycle – DFT Schemes – Built-in Self-Test.

UNIT IV ARCHITECTURES &DESIGN USING PROGRAMMABLE DEVICES 9

Realize combinational, Arithmetic, Sequential Circuit with Programmable Array Logic; Architecture and application of Field Programmable Logic Sequence. Architecture of EPLD, Programmable Electrically Erasable Logic – Designing a Synchronous Sequential Circuit using a GAL – EPROM – Realization State machine using PLD-Programming Techniques -Re-Programmable Devices Architecture- Function blocks, I/O blocks, Interconnects- Xilinx FPGA – Xilinx 2000 --Xilinx3000- Xilinx 4000 family.

UNIT V HDL PROGRAMMING 9

VHDL Description of Combinational Circuits – Arrays – VHDL Operators – Compilation and Simulation of VHDL Code–Modeling using VHDL – Flip Flops – Registers – Counters–Sequential Machine – Combinational Logic Circuits –VHDL Code for–Serial Adder, Binary Multiplier – Binary Divider–complete Sequential Systems– Test Bench-Design of a Simple Microprocessor

Total: 45 Hours

COURSE OUTCOMES:

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

- Analyze and design sequential digital circuits
- Design and use programming tools for implementing digital circuits of industry standards
- Identify the requirements and specifications of the system required for a given application

- Learners can acquire knowledge about HDL programming.
- Improved Employability and entrepreneurship capacity due to knowledge upgradation on
- recent trends in digital design for embedded systems.

REFERENCE(S)

1. M. Morris Mano, Michael D.Ciletti, “Digital System Design” Pearson Education, 2008.
2. Charles H. Roth Jr., “Digital System Design using VHDL” Thomson Learning, 1998.
3. Charles H. Roth Jr., Fundamentals of Logic design Thomson Learning, 2004.
4. Donald G.Givone, Digital principles and Design, Tata Mc GrawHill, 2002.
5. John M.Yarbrough, Digital Logic appns .and Design,Thomson Learning, 2001.
6. Stephen Brown and ZvonkVranesic, Fundamentals of Digital Logic with VHDL Design, TataMcGrawHill, 2002.
7. Mark Zwolinski, Digital System Design with VHDLPearson Education, 2004.

192EEC103T EMBEDDED SENSOR NETWORKS

L	T	P	R	C
3	-	-	-	3

COURSE OJECTIVES

- To focus on the various components of sensor network and formulate the various performance metrics.
- To Illustrate the various types of sensor networking protocol.
- To Interpret the various infrastructure establishment in sensor networks
- To Describe the various networking database environment.
- To Study the software concepts in python programming.

UNIT I SENSOR NETWORKS 9

Overview of sensor networks - Constraints and Challenges – Advantages of sensor networks– Applications – Collaborative Processing – Key definitions in sensor networks – Tracking scenario – Problem formulation –Distributed representation and interference of states – Tracking multiple objects – Sensor models – performance comparison and metrics.

UNIT II SENSOR NETWORKING PROTOCOL 9

Key assumptions – Medium access control – S-MAC Protocol, -TCP/IP – IEEE 802.15.4 standard and ZigBee – General Issues – Geographic, Energy-Aware Routing – Attribute based routing –Classification and Applications of Nano sensor.

UNIT III INFRASTRUCTURE ESTABLISHMENT 9

Topology control – Clustering-Time synchronization – Localization – Task driven sensing-
Role of sensor nodes – Information based tasking – Routing and aggregation.

UNIT IV SENSOR NETWORK DATABASE 9

Sensor Database Challenges – Querying the physical environment – Interfaces – In-network aggregation – Data centric storage – Data indices and range queries – Distributed Hierarchical
aggregation – Temporal data.

UNIT V SENSOR NETWORK PLATFORMS AND TOOLS 9

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

Total: 45 Hours

COURSE OUTCOMES:

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

- learn the basics of embedded sensor networks and its applications in enabling technologies
- understand the architecture and elements of wireless sensor networks
- study the tools and platforms needed to establish sensor networks

REFERENCE(S)

1. Feng Zhao, Leonidas Guibas, "Wireless Sensor Networks An information processing approach", Mogan Kanufmann Publishers, 2004
2. Richard Zurawski, "Embedded System Hand Book", CRC Press, 2009.
3. Iran Stojmenovic, "Hand book of sensor networks", John Wiley & Sons, 2005.
4. Michel Banatre, Pedre Jose Marron, Anibal Ollero and Adam Wilisz, "Cooperating Embedded System and Wireless sensor Network", John Willy, 2008.
5. Embedded System Handbook, "Networked Embedded Systems", 2nd Edition, CRC press, 2009.

192EEC111L EMBEDDED SYSTEMS LABORATORY

L	T	P	R	C
-	-	3	1	2

COURSE OBJECTIVES:

- To design with experiments, in programming suites/ simulators.
- To learn design, modeling& simulation of Combinational, Sequential, Synchronous, Asynchronous circuits with simulators/experiments, in programming processor boards, processor interfacing/designing reprogrammable system

Experiments

1) Experiments based on 8-bit processors and its interfacing techniques (PIC,8051)
2) Experiments based on 16-bit processors and its interfacing techniques (MSP430)
3) Experiments based on 32-bit processors and its interfacing techniques (ARM Cortex – M0/M4/M7)
4) Experiments on Open source H/W and S/W (Arduino / Raspberry PI)
5) Experiments based on VHDL
6) Experiments based on DSP Processors (C2000, TMS320C6XX)
7) Experiments based on Embedded Networking (CAN, I2C, NS2)

REFERENCE(S)

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

Total: 60 Hours

192EEA111L **TERM PAPER WRITING AND SEMINAR**

L	T	P	R	C
-	-	4	-	2

In this course, students will develop their scientific and technical reading and writing skills that they need to understand and construct research articles. A term paper requires a student to obtain information from a variety of sources (i.e., Journals, dictionaries, reference books) and then place it in logically developed ideas. The work involves the following steps:

1. Selecting a subject, narrowing the subject into a topic
2. Stating an objective.
3. Collecting the relevant bibliography (at least 15 journal papers)
4. Preparing a working outline.
5. Studying the papers and understanding the authors contributions and critically analyzing each paper.
6. Preparing a working outline
7. Linking the papers and preparing a draft of the paper.
8. Preparing conclusions based on the reading of all the papers.
9. Writing the Final Paper and giving final Presentation

Please keep a file where the work carried out by you is maintained. Activities to be carried out

Activity	Instructions	Submission week	Evaluation
Selection of area of interest and Topic Stating an Objective	You are requested to select an area of interest, topic and state an objective	2nd week	**3 %** Based on clarity of thought, current relevance and clarity in writing
Collecting Information about your area & topic	➢ List 1 Special Interest Groups or professional society ➢ List 2 journals ➢ List 2 conferences, symposia or workshops ➢ List 1 thesis title ➢ List 3 web presences (mailing lists, forums, ➢ news sites) ➢ List 3 authors who publish regularly in your area ➢ Attach a call for papers (CFP) from your area.	3rd week	**3%** (the selected information must be area specific and of international and national standard)
Collection of Journal papers in the topic in the context of the objective – collect 20 & then filter	➢ You have to provide a complete list of references you will be using- Based on your objective - Search various digital libraries and Google Scholar ➢ When picking papers to read - try to Pick papers that are related to each other in some ways and/or that are in the same field so that you can write a meaningful survey out of them ➢ Favour papers from well-known journals and conferences ➢ Favour —firstll or —foundationalll papers in the field (as indicated in other people 's survey paper) ➢ Favour more recent papers ➢ Pick a recent survey of the field so you can quickly gain an overview, ➢ Find relationships with respect to each other and to your topic area (classification scheme/ categorization) ➢ Mark in the hard copy of papers whether complete work or section/sections of the paper are being considered	4th week	**6%** (the list of standards papers and reason for selection)

Reading and notes for first 5 papers	Reading Paper Process: ➢ For each paper form a Table answering the following questions: ➢ What is the main topic of the article? ➢ What was/were the main issue(s) the author said they want to discuss? ➢ Why did the author claim it was important? ➢ How does the work build on other 's work, in the author 's opinion? ➢ What simplifying assumptions does the author claim to be making? ➢ What did the author do? ➢ How did the author claim they were going to evaluate their work and compare it to others? ➢ What did the author say were the limitations of their research? ➢ What did the author say were the important directions for future research? Conclude with limitations/issues not addressed by the paper (from the perspective of your survey)	5th week	**8%** (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)
Reading and notes for next5 papers	Repeat Reading Paper Process	6th week	**8%** (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)
Reading and notes for final 5 papers	Repeat Reading Paper Process	7th week	**8%** (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)
Draft outline 1 and Linking papers	Prepare a draft Outline, your survey goals, along with a classification / categorization diagram	8th week	**8%** (this component will be evaluated based on the linking and classification among the papers)
Abstract	Prepare a draft abstract and give a presentation	9th week	**6%** (Clarity, purpose and conclusion) **6%** Presentation & Viva Voce

Introduction Background	Write an introduction and background sections	10th week	**5%** (clarity)
Sections of the paper	Write the sections of your paper based on the classification / categorization diagram in keeping with the goals of your survey	11thweek	**10%** (this component will be evaluated based on the linking and classification among the papers)
Your conclusions	Write your conclusions and future work	12th week	**5%** (conclusions – clarity and your ideas)
Final Draft	Complete the final draft of your paper	13th week	**10%** (formatting, English, Clarity and linking) **4%** Plagiarism Check Report
Seminar	A brief 15 slides on your paper	14th & 15th week	**10%** (based on presentation and Viva-voce)

TOTAL: 60 PERIODS

192EEC202T REAL TIME OPERATING SYSTEMS

L	T	P	R	C
3	-	-	-	3

COURSE OBJECTIVES:

- To acquire knowledge about different types of scheduling algorithms
- To study about microC/OSII RTOS
- To understand the various functions of RTOS

UNIT I BASIC PRINCIPLES & TASKS 9

Basic Principles - Operating System structures - System Calls - Files-Processes - Design and Implementation of processes - Communication between processes - Introduction to Distributed operating system - Distributed scheduling - Real time computation - structure of a real system - task classes - performance measures for real time systems - estimating program run times - task assignment and scheduling – classical uni-processor scheduling algorithms - task assignment.

UNIT II REAL TIME MODELS 9

Event-based, process-based and graph-based models, pertinent models - real time languages - system performance analysis - optimization of time loading and memory loading models of multi-processor system and distributed systems - task assignment - end to end tasks in heterogeneous systems - temporal distance constraints - resource contention - resource access control - priority ceiling - multiple unit resource access – access to data objects - concurrency.

UNIT III RTOS CONCEPT 9

Fore ground and back ground process - resources - tasks - multi tasking – priorities - schedulers - kernel - exclusion - inter-task communication - interrupts - clock tick – micro C/OS II kernel structure – micro

C/OS II initialization - starting /OS II

UNIT IV RTOS FUNCTIONS 9

Task Management - Time management - Semaphore Management - Mutual Exclusion - Semaphore - Event Management - Memory Management - Porting micro C/OS II.

UNIT V REAL TIME KERNEL AND RTOS APPLICATIONS 9

Principles - design issues - polled loop systems - RTOS porting to a target - comparison between multitasking OS, embedded OS and RTOS- RTOS for image processing - embedded RTOS for VOIPRTOS for fault-tolerant application - RTOS for control systems.

Total: 45 Hours

COURSE OUTCOMES:

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

- describe the general architecture of computers.
- describe, contrast and compare differing structures for operating systems.
- understand and analyze theory and implementation of processes, resource control (concurrency etc.), physical and virtual memory, scheduling, I/O and files.

REFERENCE(S)

1. Philip Laplante, Real Time Design and Analysis-an Engineer's hand book, Wiley IEEE Press, 2004
2. C.M. Krishna and Kang Shin, Real Time Systems, McGraw Hill, 2001
3. Jean Labrosse, Micro C/OS II-Real Time Kernel, CMP Books, 2002
4. Silberschatz, P. B. Galvin, and G. Greg, Operating System Concepts, Wiley Publications, 2002
5. P. C. P. Bhatt, Operating Systems, NPTEL Courseware.

192EEC203T DIGITAL CONTROLLERS IN POWER ELECTRONIC APPLICATIONS

L	T	P	R	C
3	-	-	-	3

COURSE OBJECTIVES:

- To acquire knowledge about the various components and working of C2000 DSP processor
- To study about FPGA based systems
- To acquire knowledge about the various possible digital controllers in Power electronics applications

UNIT I INTRODUCTION TO DSP PROCESSOR: 8

Introduction to the C2xx DSP core and code generation. The components of the C2xx DSP core, mapping external devices to the C2xx core, peripherals and Peripheral Interface, System configuration registers, Memory, Types of Physical Memory, memory Addressing Modes, Code Composer Studio for C2xx DSP.

UNIT II I/O AND INTERRUPTS: 8

Pin Multiplexing (MUX) and General Purpose I/O Overview, Multiplexing and General Purpose I/O Control Registers, Programming I/O. Introduction to Interrupts, Interrupt Hierarchy, Interrupt Control Registers, Initializing and Servicing Interrupts in Software, Programming Interrupts

UNIT III ADC AND EVENT MANAGERS: 9

ADC Overview, Operation of the ADC in the DSP, Overview of the Event manager (EV), Event Manager Interrupts, General Purpose (GP) Timers, Compare Units, Capture Units and Quadrature Enclosed Pulse (QEP) Circuitry, General Event Manager Information, Programming of ADC and Event Managers

UNIT IV FPGA: 7

Introduction to Field Programmable Gate Arrays – CPLD Vs FPGA – Types of FPGA, Xilinx XC3000 series - case study.

UNIT V DESIGN OF CONTROLLER IN POWER ELECTRONICS: 13

Typical applications: DSP-based implementation of DC-DC buck-boost converter- DSP-based control of permanent magnet brushless DC machines- DSP-based Implementation of clarkes's and park's transformations- DSP-Based implementation of SPWM, SVPWM inverter pulse generation.

Total: 45 Hours

COURSE OUTCOMES:

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

- understand the concepts of DSP core with peripheral devices
- provide knowledge about various types of Field Programmable Gate Array
- design DSC based controller for industrial drives

REFERENCES:

1. 2833x Digital Signal Controller (DSC) Data Manual.
   a. TMS320C28x CPU and Instruction Set Reference Guide - SPRU430.
   b. TMS320x28xx, 28xxx Peripheral Reference Guide - SPRU566.
   c. TMS320x2833x System Control and Interrupts Reference Guide - SPRUFB0.
   d. TMS320x2833x Analog-to-Digital Converter (ADC) Reference Guide - SPRU812.
   e. TMS320x28xx, 28xxx Enhanced Pulse Width Modulator (ePWM) & High-Resolution Pulse Width Modulator (HRPWM) Module Reference Guide - SPRU791 & - SPRU924.
2. Hamid.A.Toliyat and Steven G.Campbell —DSP Based Electro Mechanical Motion Control— CRC Press New York, 2004.
3. Wayne Wolf,‖ FPGA based System Design—, Prentice hall, 2004.

192EEC204T EMBEDDED LINUX

L	T	P	R	C
3	-	-	-	3

COURSE OBJECTIVES:

- To study the fundamentals of operating systems.
- To understand Linux operating measurement systems.
- To obtain basic knowledge on board support packages and device drivers.

UNIT I FUNDAMENTALS OF OPERATING SYSTEMS 9

Overview of operating systems, Process and threads, Processes and Programs, Programmer view of processes, OS View of processes, Threads, Scheduling, Non preemptive and preemptive scheduling, Real Time Scheduling, Process Synchronization, Semaphores, Message Passing, Mailboxes, Deadlocks, Synchronization and scheduling in multiprocessor Operating Systems.

UNIT II LINUX FUNDAMENTALS 9

Introduction to Linux, Basic Linux commands and concepts, logging in, Shells, Basic text editing, advanced shells and shell scripting, Linux File System, Linux programming, Processes and threads in Linux, Inter process communication, Devices, Linux System calls.

UNIT III EMBEDDED LINUX 9

Embedded Linux-Introduction, Advantage, Embedded Linux Distributions, Architecture, Linux kernel architecture, User space, Linux startup sequence, GNU cross platform Toolchain.

UNIT IV BOARD SUPPORT PACKAGE AND EMBEDDED STORAGE 9

Inclusion of BSP in kernel build procedure, Boot loader Interface, Memory Map, Interrupt Management, PCI Subsystem, Timers, UART, Power Management, Embedded Storage, Flash Map, Memory Technology Device (MTD) –MTD Architecture, MTD Driver for NOR Flash.

UNIT V EMBEDDED DRIVERS AND APPLICATION PORTING 9

Linux serial driver, Ethernet driver, I2C subsystem, USB gadgets, Watchdog timer, Kernel Modules, Application porting roadmap, Programming with threads, Operating System Porting Layer, Kernel API Driver, Case studies - RT Linux – uC linux.

Total: 45 Hours

COURSE OUTCOMES:

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

- Apply and integrate theory and practical which has been studied to solve the engineering problems.
- Develop the suitable research methodology for the project.
- Present and justify/defend the project proposal.

REFERENCE(S):

1. Paul Cobbaut, Fundamental Linuxt ,Netsec BVBA, 2015.
2. P.Raghavan , Embedded Linux System Design and Development, Taylor & Francis, 2012.
3. Craig Hollabaugh , Embedded Linux, Hardware, Software and Interfacing , 2003.
4. Philippe Gerum, Karim Yaghmour , Building Embedded Linux Systems, 2009.
5. Christopher Hallinan , Embedded Linux Primer: A Practical Real-World Approach, 2nd ed,Prentice Hall, 2007.
6. www.linuxjournal.com.

192EEC211L REAL TIME OPERATING SYTEMS LABORATORY

L	T	P	R	C
-	-	3	1	2

COURSE OBJECTIVES

- Knows the various task assignment and scheduling methods.
- Emphasizes hard and soft real time computer system design for uniprocessor embedded system applications and distributed real time systems.

LIST OF EXPERIMENTS

1. Task creation, deletion and priority assignment
2. Task Pre-emption and context switching
3. Deadlock and Priority inversion
4. Shared Memory between tasks
5. Scheduling Policies like
    a. First Come First Served
    b. Round Robin (time quantum can be defined)

c. Shortest Job First
d. Priority First
e. SJF with Priority Elevation rule (threshold can be defined)

6. Intertask communication like Message Queues, Pipes and Semaphore

Equipment / Support Required

Any RTOS tools like (free RTOS, UCOS II, Cheddar RTS tool)

Total: 30 Hours

REFERENCE(S)

1) Phillip A. Laplante, “Real time systems design and analysis”, 4th edition, Wiley InerScience, ISBN 978-0470-76864-8
2) Jane W. Liu “Real Time Systems” Prentice Hall, 2000, ISBN: 0-13-099651-3.
3) C.M. Krishna and R.G. Shin, “Real time system” McGraw Hill 1997.
4) Micro C/OS-II, The real time kernel, A complete portable, ROMable, scalable preemptive RTOS by Jean J. Labrosse, R&D books, Miller Freeman Inc., ISBN: 0-87930-543-6; Phone: 785 841 1631.
5) Embedded Systems Building Blocks, 2nd edition, Complete and ready to use modules in C, by Jean J. Labrosse, R&D books, Miller Freeman Inc., ISBN: 0-87930-604-1; Phone: 1-800-788-3123.
6) Jeffrey Tsai and Steve Yang, “Monitoring and Debugging of Distributed real time system” IEEE computer Society press, ISBN 0-8186-6537-8
7) Subra Ganesan, “Teaching Real time system schedulability using low cost microprocessor board” Proceeding of ASEE NCS conference 2016.
8) Valvano, “Embedded microcontroller system- real time interfacing” Brooks/Cole publisher

192EEE001T **DIGITAL IMAGE PROCESSING**

L	T	P	R	C
3	-	-	-	3

COURSE OBJECTIVES

- To understand the image processing concepts and analysis
- To understand the image processing techniques
- To familiarize the image processing environment and their applications,
- To appreciate the use of image processing in various applications

UNIT I IMAGE FORMATION AND ENHANCEMENT 9

Human visual system – Sampling and Quantization – Color fundamentals – Spatial domain processing – Simple image operations – Point wise intensity transformations - Histogram processing - Linear and non-linear noise smoothening - Sharpening - Derivatives – Laplacian – Combing spatial enhancement methods.

UNIT II FREQUENCY TRANSFORMS AND APPLICATIONS 9

Frequency domain processing – 2-D transforms: DFT, DCT and DWT –Properties – Frequency domain filtering techniques – Sub band coding of image compression – Coding techniques: Huffman, Run length and Block transform – JPEG – Performance metrics.

UNIT III IMAGE RESTORATION AND RECONSTRUCTION 9

Image degradation – Noise models – Image observation models - Spatial filtering: mean filters, order statistics filters, adaptive filters - Inverse filtering - Wiener filtering – Constrained least squares filtering. Image Reconstruction from projections – Radon transform and it’s Application.

UNIT IV SEGMENTATION AND FEATURE EXTRACTION 9

Edge detection: Gradient operators - edge linking and boundary detection: Global processing via Hough transforms, Graph theoretic techniques – Thresholding techniques – K-means Clustering – Feature extraction: Boundary feature descriptors – Region feature descriptors – Principal components – SIFT. Object Recognition applications.

UNIT V COLOR AND MULTISPECTRAL IMAGE PROCESSING 9

Color Image-Processing Fundamentals, RGB Models, HSI Models, Relationship Between Different Models. Multispectral Image Analysis - Color Image Processing Three-Dimensional Image Processing-Computerized Axial Tomography-Stereometry-Stereoscopic Image Display-Shaded Surface Display.

Total: 45 Hours

COURSE OUTCOMES:

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

- Design and implement algorithms for image processing applications that incorporates different concepts of medical Image Processing
- Familiar with the use of MATLAB and its equivalent open source tools
- Critically analyze different approaches to image processing applications
- Explore the possibility of applying Image processing concepts in various applications

REFERENCE(S)

1. Gonzalez R.C. Woods R.E., "Digital Image Processing", Fourth Edition, Pearson, 2017.
2. Jayaraman S., Esakkirajan S., Veerakumar T., "Digital Image Processing", Tata McGraw Hill,2011.
3. Jain A.K., "Fundamentals of Digital Image Processing", Prentice Hall of India, 2010.
4. Digital Image Processing, Gonzalez.R.C& Woods. R.E., 3/e, Pearson Education, 2008.
5 Digital Image Processing, Kenneth R Castleman, Pearson Education,1995.
6. Image Processing, Sid Ahmed, McGraw Hill, New York, 1995.

192EEE002T REAL TIME EMBEDDED SYSTEMS

L	T	P	R	C
3	-	-	-	3

COURSE OBJECTIVES

:

- Learn the architecture and programming of ARM processor.
- Be familiar with the embedded computing platform design and analysis.
- Be exposed to the basic concepts of real time Operating system.
- Learn the system design techniques and networks for embedded systems

UNIT I INTRODUCTION TO EMBEDDED COMPUTING AND ARM PROCESSORS 9

Complex systems and microprocessors– Embedded system design process –Design example: Model train controller- Instruction sets preliminaries - ARM Processor – CPU: programming input and output supervisor mode, exceptions and traps – Co-processors- Memory system mechanisms – CPU performance- CPU power consumption.

UNIT II EMBEDDED COMPUTING PLATFORM DESIGN 9

The CPU Bus-Memory devices and systems–Designing with computing platforms – consumer electronics architecture – platform-level performance analysis - Components for embedded programs Models of programs- Assembly, linking and loading – compilation techniques- Program level performance analysis – Software performance optimization – Program level energy and power analysis and optimization – Analysis and optimization of program size- Program validation and testing.

UNIT III PROCESSES AND OPERATING SYSTEMS 9

Introduction – Multiple tasks and multiple processes – Multi rate systems- Preemptive real-time operating systems- Priority based scheduling- Inter process communication mechanisms – Evaluating operating system performance- power optimization strategies for processes – Example Real time operating systems-POSIX-Windows CE.

UNIT IV SYSTEM DESIGN TECHNIQUES AND NETWORKS 9

Design methodologies- Design flows - Requirement Analysis – Specifications-System analysis and architecture design – Quality Assurance techniques- Distributed embedded systems – MPSoCs and shared memory multiprocessors.

UNIT V CASE STUDY **9**

Data compressor - Alarm Clock - Audio player - Software Modem-Digital still camera - Telephone answering machine-Engine control unit – Video accelerator.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Describe the architecture and programming of ARM processor.
- Outline the concepts of embedded systems
- Explain the basic concepts of real time Operating system design.
- Use the system design techniques to develop software for embedded systems
- Differentiate between the general-purpose operating system and the real time operating system
- Model real-time applications using embedded-system concepts

TEXT BOOK:

1. Marilyn Wolf, "Computers as Components - Principles of Embedded Computing System Design", Third Edition "Morgan Kaufmann Publisher (An imprint from Elsevier), 2012.

REFERENCE(S)

1. Jonathan W.Valvano, "Embedded Microcomputer Systems Real Time Interfacing", Third Edition Cengage Learning, 2012.
2. David. E. Simon, "An Embedded Software Primer", 1st Edition, Fifth Impression, Addison-Wesley Professional, 2007.
3. Raymond J.A. Buhr, Donald L.Bailey, "An Introduction to Real-Time Systems- From Design to Networking with C/C++", Prentice Hall, 1999.
4. C.M. Krishna, Kang G. Shin, "Real-Time Systems", International Editions, Mc Graw Hill 1997
5. K.V.K.K.Prasad, "Embedded Real-Time Systems: Concepts, Design & Programming", Dream Tech Press, 2005.
6. Sriram V Iyer, Pankaj Gupta, "Embedded Real Time Systems Programming", Tata Mc Graw Hill, 2004.

192EEE003T LOW POWER VLSI DESIGN

L	T	P	R	C
3	-	-	-	3

COURSE OBJECTIVES

- To understand the different types of low power adders and multipliers
- To focus on synthesis of different level low power transforms.
- To gain knowledge on low power static RAM architecture & the source of power dissipation in SRAM

UNIT I POWER DISSIPATION IN CMOS **9**

Sources of power Dissipation–Physics of power dissipation in MOSFET devices, Power dissipation in CMOS, Power dissipation in Domino CMOS-Low power VLSI design limits.

UNIT II POWER ESTIMATION **9**

Modeling of signals- Signal probability calculation-probabilistic techniques for signal activity estimation-statistical techniques for power estimation-estimation of glitch power-sensitivity analysis-power estimation at the circuit level-estimation of maximum power.

UNIT III SYNTHESIS FOR LOW POWER **9**

Behavioral level transforms-Algorithm using First –Order, second, Mth Order Differences-Parallel Implementation Pipelined Implementation- Logic level optimization– Technology dependent and Independent– -Circuit level-Static, Dynamic, PTL, DCVSL, PPL.

UNIT IV LOW POWER STATIC RAM ARCHITECTURES 9

Organization of a static RAM, MOS static RAM memory cell, Banked organization of SRAMs, reducing voltage swings on bit lines, reducing power in the write diver circuits, Reducing power in sense amplifier circuits

UNIT V LOW ENERGY COMPUTING USING ENERGY RECOVERY TECHNIQUES 9

Energy dissipation in transistor channel using an RC model, Energy recovery circuit design, Designs with partially reversible logic, Supply clock generation.

Total: 45 Hours

COURSE OUTCOMES:

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

- Able to understand the different techniques involved in low power adders and multipliers
- Understandings of the impact of various low power transform
- Identify and analyze the different techniques involved in low power SRAM.

REFERENCE(S)

1. K.Roy and S.C. Prasad, Low Power CMOS VLSI Circuit Design, Wiley, 2000.
2. K.S. Yeo and K.Roy, Low-Voltage, Low-Power VLSI Subsystems, Tata McGraw-Hill, 2004.
3. DimitriosSoudris, ChirstianPignet and Costas Goutis, Designing CMOS Circuits for Low Power, Kluwer, 2009.
4. James B. Kuo and Shin – Chia Lin, Low voltage SOI CMOS VLSI Devices and Circuits, John Wiley and Sons, 2001.
5. J.B Kuo and J.H Lou, Low voltage CMOS VLSI Circuits, Wiley, 1999.
6. Gary Yeap, Practical Low Power Digital VLSI Design, Kluwer, 1997.

192EEE004T DIGITAL INSTRUMENTATION

L	T	P	R	C
3	-	-	-	3

COURSE OBJECTIVES

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

UNIT I DATA ACQUISITION SYSTEMS 10

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

UNIT II INSTRUMENT COMMUNICATION 10

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

UNIT III VIRTUAL INSTRUMENTATION BASICS 12

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

UNIT IV CONFIGURING PROGRAMMABLE INSTRUMENTATION 7

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

UNIT V CASE STUDIES 6

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

Total: 45 Hours

COURSE OUTCOMES:

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

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

REFERENCE(S)

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

192EEE005T SOFTWARE FOR EMBEDDED SYSTEMS

L	T	P	R	C
3	-	-	-	3

COURSE OBJECTIVES

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

UNIT I EMBEDDED PROGRAMMING 9

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

UNIT II C PROGRAMMING TOOLCHAIN IN LINUX 9

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

UNIT III EMBEDDED C 9

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

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

Multi-State systems and function sequences: Implementing multi-state (Timed) system -Implementing a Multi-state (Input/Timed) system. Using the Serial Interface: RS232 – The Basic RS-232 Protocol - Asynchronous data transmission and baud rates - Flow control - Includes Self Study topics of all 5 units and considered for Continuous Assessment only Software architecture - Using on-chip UART for RS-232 communication – Memory requirements - The serial menu architecture - Examples. Case study: Intruder alarm system.

UNIT V EMBEDDED JAVA 9

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

Total: 45 Hours

COURSE OUTCOMES:

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

- Outline the concepts of Embedded Programming.
- Point out the function of Tool chain in LINUX.
- Differentiate time driven multi stage architecture and hardware.
- Gain knowledge about Embedded C and Embedded JAVA.
- Describe the overview of JAVA Card Technology

REFERENCE(S)

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

192EEE006T WIRELESS AND MOBILE COMMUNICATION

L	T	P	R	C
3	-	-	-	3

COURSE OBJECTIVES

- To educate the students to understand the fundamentals of wireless communication technologies and operation of cellular technology
- To explain the architecture, functioning, protocols, capabilities and application of various wireless mobile networks.
- To introduce network routing protocols and to evaluate design challenges, constraints and security issues associated with Ad-hoc wireless networks.
- To study the basis for classification of commercial family of wireless communication technologies

UNIT I INTRODUCTION 9

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

UNIT II MOBILE NETWORKS **9**

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

UNIT III WIRELESS NETWORKS **9**

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

UNIT IV ROUTING **9**

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

UNIT V TRANSPORT AND APPLICATION LAYERS **9**

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

Total: 45 Hours

COURSE OUTCOMES:

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

- design a cellular system in a specific radio and geographic environment with specific frequency range and design mobile communication considering various propagation path loss models under different operating conditions.
- demonstrate their understanding on functioning of wireless and mobile communication system
- recognize the various frequency and bandwidth allocations, design concepts of emerging communication systems compare different technologies and protocols used for wireless and mobile communication systems.

REFERENCE(S)

1. Kaveh Pahlavan, Prasanth Krishnamoorthy, “Principles of Wireless Networks’ PHI/Pearson Education, 2003
2. C. Siva Ram Murthy and B.S. Manoj, AdHoc Wireless Networks: Architectures and protocols, Prentice Hall PTR, 2004
3. Uwe Hansmann, Lothar Merk, Martin S. Nicklons and Thomas Stober, “Principles of Mobile computing”, Springer, New york, 2003.
4. C.K.Toh, “ AdHoc mobile wireless networks”, Prentice Hall, Inc, 2002.
5. Charles E. Perkins, “Adhoc Networking”, Addison-Wesley, 2001.
6. Jochen Schiller, “Mobile communications”, PHI/Pearson Education, Second Edition, 2003.
7. William Stallings, “Wireless communications and Networks”, PHI/Pearson Education, 2002.

192EEE007T MACHINE LEARNING AND APPLICATIONS

L	T	P	R	C
3	-	-	-	3

COURSE OBJECTIVES

- To introduce students to the basic concepts and techniques of Machine Learning.
- To have a thorough understanding of the Supervised and Unsupervised learning techniques.
- To study the various probability-based learning techniques
- To understand graphical models of machine learning algorithms

UNIT I PROBABILITY DISTRIBUTIONS 9

Basic Definitions, Types of learning, Probability Theory, Probability Reasoning, Model Selection, Curse of Dimensionality, Decision Theory, Information Theory, Binary Variables, Multinomial Variables, Gaussian Distribution, Exponential Family, Nonparametric Methods, Belief Networks.

UNIT II LINEAR MODELS FOR REGRESSION AND CLASSIFICATION 9

Linear Basis Function Models, Bias-Variance Decomposition, Bayesian Linear Regression, Bayesian Model Comparison, Evidence Approximation, Limitations of Fixed Basis Functions, Discriminant Functions, Probabilistic Generative and Discriminative Models, Laplace Approximation, Bayesian Logistic Regression.

UNIT III GRAPHICAL MODELS 9

Markov Chain Monte Carlo Methods – Sampling – Proposal Distribution – Markov Chain Monte Carlo – Graphical Models – Bayesian Networks – Markov Random Fields – Hidden Markov Models – Tracking Methods

UNIT IV NEURAL NETWORKS 9

Introduction, Enforcement Learning, Feed-forward Network functions, Error Backpropagation, Hessian Matrix, Mixture Density Networks, Bayesian Neural Networks, Convolution Neural Network, Dual Representations, Constructing Kernels, Gaussian Processes, Maximum Margin Classifiers, Relevance Vector Machines.

UNIT V APPLICATIONS OF MACHINE LEARNING ALGORITHMS 9

Content Based Image Retrieval, Machine Learning Approach for face Recognition, Computer Aided Diagnosis, Computer Vision, Speech Recognition, Text Mining, Thinking Machines, Smart Machines, Business Applications of Deep Learning, Software Reliability Prediction, Medical Imaging.

Total: 45 Hours

COURSE OUTCOMES:

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

- Distinguish between, supervised, unsupervised and semi-supervised learning
- Apply the appropriate machine learning strategy for any given problem
- Suggest supervised, unsupervised or semi-supervised learning algorithms for any given problem
- Design systems that uses the appropriate graph models of machine learning
- Modify existing machine learning algorithms to improve classification efficiency

REFERENCE(S)

1. Pradeep Kumar and Arvind Tiwari, “Ubiquitous Machine Learning and Its Applications”, IGI Global, 2017.
2. Ethem Alpaydin, “Introduction to Machine Learning”, Prentice Hall of India, New Delhi, 2014.
3. David Barber, “Bayesian Reasoning and Machine Learning”, Cambridge University Press, New Delhi, 2014.

192EEE008T EMBEDDED SYSTEM NETWORKS

L	T	P	R	C
3	-	-	-	3

COURSE OBJECTIVES:

- To expose the students to the fundamentals of wired embedded networking techniques.
- To expose the students to the fundamentals of wireless embedded networking
- To study on design of automation in instrumentation
- To introduce design of Programmable measurement & control of electrical Devices & grid

UNIT I THE CAN BUS: 5

Introduction – Concepts of Bus Access and Arbitration – Error Processing and Management – Definition of the CAN Protocol ISO 11898-1 – Error Properties, Detection and Processing – Framing.

UNIT II THE CAN PHYSICAL LAYER: 10

Introduction – Signal Propagation – Bit Synchronization – Network Speed and Range – High Speed CAN – Low Speed CAN – CAN Components – Event-Triggered and Time-Triggered Protocols - CAN Applications**:** Application Layers and Development Tools for CAN - Introduction of Communication Protocols used in Automobiles: LIN, MOST Flex ray

UNIT III USB: 10

Introduction **–** Types of USB Transfers: Control Transfer – Bulk Transfer – Interrupt Transfer – Isochronous Transfer – Introduction to the Enumeration Process – Introduction to USB Development Tools.

UNIT IV NETWORK SECURITY: 11

Introduction – Confidentiality – Message Integrity - Message Authentication - Digital Signature - Entry Authentication - Key management – Internet Security – Firewalls.

UNIT V TCP/IP FOR EMBEDDED SYSTEMS: 9

Introduction – Embedded SMTP Client –Embedded SMTP Server – Case Studies: IP Security Camera – Vending Machine – Internet Radio – Ethernet Gateway.

Total: 45 Hours

COURSE OUTCOMES:

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

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

REFERENCE(S)

1. Dominique Paret, —Multiplexed Networks for Embedded Systems‖, Wiley, 2007
2. John Hyde, —USB Design by Example‖, Intel University Press, 2001
3. Jan, Axelson, —USB Complete‖, Lake View Research, 2005
4. Behrouz A Forouzan and FirouzMosharraf, ‖Computer Network – a Top Down Approach‖, Tata McGraw Hill Education Pvt.
5. Ltd., New Delhi, 2012.
6. Edward Insam, —TCP/IP Embedded Internet Applications‖, Elsevier, 2003
7. Tim Jones, —TCP/IP Application Layer Protocols for Embedded Systems‖, Charles River Media, 2002

192EEE009T INFORMATION THEORY AND CODING

L	T	P	R	C
3	-	-	-	3

COURSE OBJECTIVES

- This course introduces how various coding takes place in communication and what type of different codes are used in communication system.
- It also introduces different entropies, channel capacity and purpose of encoding.

UNIT I FUNDAMENTAL LIMITS IN INFORMATION THEORY 9

Measure of Information, Data Compaction, Discrete Memory less Channels, Relationship among different Entropies, Mutual information, Channel Capacity, Capacity of channel with symmetric noise structure

BSC and BEC, Channel Coding Theorem, Differential Entropy and Mutual Information for Continuous Ensembles, Information Capacity Theorem, Rate Distortion Theory.

UNIT II ELEMENTS OF ENCODING 9

Source Coding: Instantaneous Codes, Source Coding Theorem, The Kraft Inequality and McMillan's Theorem, Average Length and Compact Codes, Shannon's Noiseless Coding Theorem, Fano Coding, Huffman Coding, Arithmetic Coding, Higher-order Modelling. Fundamentals of Channel Coding: Code Rate, Decoding Rules, Hamming Distance, Bounds on M, Maximal Codes and Perfect Codes, Error Probabilities, Shannon's Fundamental Coding Theorem.

UNIT III INTRODUCTION TO ALGEBRA 9

Groups, Ring, Vector space and Fields, Linear Spaces, Linear Spaces over Binary Fields, Construction of Galois field GF (2m), Basic Properties of Galois Field GF (2m), Codes Derived from Hadamard Matrices.

UNIT IV ERROR CORRECTING CODES 9

Linear Block Codes: Introduction to Linear Block codes, Syndrome and Error detection, Minimum distance of block code, error detecting and Error correcting capability a block code. Cyclic Codes: Rings of Polynomials, Description of Cyclic codes, Encoding and Decoding of Cyclic Codes and its Circuits, Goley Codes, Hamming Codes, Cyclic Redundancy Check Codes, Reed-Muller Codes.

UNIT V BURST CORRECTING CODES 9

Finite Fields, Irreducible Polynomials, Construction of Finite Fields, Bursts of Errors, Fire Codes, Minimum Polynomials, Bose Chaudhuri- Hocquenghem Codes, Other Fields, Reed-Solomon Codes. Convolution Codes: Binary Convolution Codes, Decoding Convolution Codes, the Viterbi Algorithm, Sequential Decoding, Trellis Modulation, Turbo Codes

Total: 45 Hours

COURSE OUTCOMES:

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

- Calculate the information content of a random variable from its probability distribution;
- Relate the joint, conditional, and marginal entropies of variables in terms of their coupled probabilities;
- Define channel capacities and properties using Shannon's Theorems;
- construct efficient codes for data on imperfect communication channels;
- Generalize the discrete concepts to continuous signals on continuous channels;
- To obtain an understanding of the theoretical principles of source coding.
- Describe the information resolution, compression, and efficient coding properties.

REFERENCE(S)

1. F.M. Reza: Information Theory, McGraw Hill
2. ShuLin& J Costeib: Error Control Coding, (PHI)
3. Dass, Mullick&Chatterjee : Digital Communication, John Wiley, Ed. 1992

192EEE010T INTERNET OF THINGS

L	T	P	R	C
3	-	-	-	3

COURSE OBJECTIVES

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

UNIT I INTRODUCTION TO INTERNET OF THINGS 6

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

UNIT II IOT ARCHITECTURE: 12

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

UNIT III PROTOCOLS AND WIRELESS TECHNOLOGY FOR IOT 9

Protocols: NFC, RFID, Zigbee MIPI, M-PHY, UniPro, SPMI, SPI, M-PCIe Wired vs. Wireless communication, GSM, CDMA, LTE, GPRS, small cell. Wireless technologies for IoT: WiFi (IEEE 802.11), Bluetooth/Bluetooth Smart, ZigBee/ZigBee Smart, UWB (IEEE 802.15.4), 6LoWPAN, Proprietary systems.

UNIT IV DATA ANALYSTICS FOR IOT 9

Services/Attributes: Big-Data Analytics and Visualization, Dependability, Security, Maintainability. Data analytics for IoT: A framework for data-driven decision making, Descriptive, Predictive and Prescriptive Analytics, Business Intelligence and Artificial Intelligence Importance of impact and open innovation in data-driven decision making.

UNIT V CASE STUDIES 9

Home Automation, smart cities, Smart Grid, Electric vehicle charging, Environment, Agriculture, Productivity Applications

Total: 45 Hours

COURSE OUTCOMES:

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

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

REFERENCE(S)

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

192EEE011T ROBOTICS AND CONTROL

L	T	P	R	C
3	-	-	-	3

COURSE OBJECTIVES

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

UNIT I INTRODUCTION AND TERMINOLOGIES 9

Definition-Classification-History- Robots Components-Degrees of freedom-Robot joints-coordinates-Reference frames-workspace-Robot languages-actuators-sensors-Position, velocity and acceleration sensors-Torque sensors-tactile and touch sensors-proximity and range sensors- vision system-social issues.

UNIT II KINEMATICS 9

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

UNIT III DIFFERENTIAL MOTION AND PATH PLANNING 9

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

UNIT IV DYNAMIC MODELLING 9

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

UNIT V ROBOT CONTROL SYSTEM 9

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

Total: 45 Hours

COURSE OUTCOMES:

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

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

REFERENCES

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

192EEE012T ELECTRIC VEHICLES AND POWER MANAGEMENT

L	T	P	R	C
3	**-**	**-**	**-**	**3**

COURSE OBJECTIVES

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

UNIT I ELECTRIC VEHICLES AND VEHICLE MECHANICS 9

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

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

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

UNIT III CONTROL OF DC AND AC DRIVES 9

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

UNIT IV BATTERY ENERGY STORAGE SYSTEM 9

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

UNIT V ALTERNATIVE ENERGY STORAGE SYSTEMS 9

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

Total: 45 Hours

COURSE OUTCOMES:

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

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

REFERENCES

1 Iqbal Hussain, "Electric and Hybrid Vehicles: Design Fundamentals, Second Edition" CRC Press, Taylor & Francis Group, Second Edition (2011).

2 Ali Emadi, Mehrdad Ehsani, John M.Miller, "Vehicular Electric Power Systems", Special Indian Edition, Marcel dekker, Inc 2010.

RESEARCH METHODOLOGY AND IPR

L	T	P	R	C
2	-	-	-	TWO

COURSE OBJECTIVES:

- To focus on research related activities and recognizing the ensuing knowledge as property.
- To create consciousness for Intellectual Property Rights and its constituents.
- To perform documentation and administrative procedures relating to IPR in India as well as abroad.

UNIT I INTRODUCTION TO RESEARCH METHODOLOGY 9

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

UNIT II LITERATURE STUDIES-I 4

Effective literature studies approach, analysis Plagiarism, Research ethics.

UNIT III LITERATURE STUDIES-II 5

Effective technical writing, how to write report, Developing a Research Proposal, Format of research proposal, presentation and assessment by a review committee.

UNIT IV NATURE OF INTELLECTUAL PROPERTY 9

Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT V PATENT RIGHTS 9

Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT VI NEW DEVELOPMENTS IN IPR 9

Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge, Case Studies.

Total: 45 Hours

COURSE OUTCOMES:

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

- Analyze research related information
- Follow research ethics
- Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
- Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

REFERENCE(S)

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
5. Mayall , "Industrial Design", McGraw Hill, 1992.
6. Niebel , "Product Design", McGraw Hill, 1974.
7. Asimov , "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
9. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008.