S.A. ENGINEERING COLLEGE, CHENNAI – 77
(An Autonomous Institution Affiliated to Anna University)
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
REGULATION-2020
CHOICE BASED CREDIT SYSTEM
M.E. EMBEDDED SYSTEMS AND TECHNOLOGIES

Programme Educational Objective

1) To prepare students for successful careers in industry that meets the needs of Indian and global industries as employable professionals.
2) To develop the ability among students to synthesize data and technical concepts for application to product design, system development of societal importance.
3) To provide opportunity for students to work as part of teams on multidisciplinary projects to solve engineering, technical issues of societal demands.
4) To provide the P.G students with a sound foundation in the mathematical, scientific and engineering fundamentals necessary to formulate, solve and analyze engineering problems and to prepare them for employability and higher studies.
5) To promote student awareness of the lifelong learning and to introduce them to professional ethics and codes of professional practice.

Program Outcomes

a) To Offer the P.G Program in Embedded System Technology with imparting domain knowledge in Electrical circuits, electronic devices, information technology and communication engineering to develop inter-process communication techniques based on hardware– software approaches for real time process automations.

b) To enhance teaching & research contributions in Embedded System Technology with an ability to design and construct hardware and software systems, component or process keeping in tune with the latest developments and Industry requirements particularly for electrical and allied consumer electronics industries.

c) An ability to design and conduct experiments as well as to organize, analyze and interpret data on multidisciplinary domains onto role of electronics, computer science, communication engineering for electrical applications.

d) Be able to identify problems in major issues of Electrical Systems, analyse problems, coordinate through all options in design & developments and solve them using the knowledge base of Embedded Technology.

e) To extend advanced teaching & training sessions with promoting industry based internships, leading to development of self-employable entrepreneurs and globally employable professionals.

f) To provide guidance and supervision in identified domains of Embedded Application Development for Electrical & related Industries with realistic concerns such as economic, environmental, ethical, health and safety, manufacturability and technology sustainability.

g) An ability to effectively communicate technical information in speech, presentation, and in writing.

h) An understanding of professional, legal and ethical issues and responsibilities as it pertains to engineering profession with engaging in life-long learning with knowledge of contemporary issues.

Programme Educational Objectives	Programme Outcomes							
	a	b	c	d	e	f	g	h
1	✓	✓			✓	✓		
2				✓	✓	✓	✓	
3					✓		✓	✓
4	✓	✓	✓			✓		✓
5					✓	✓		✓

MAPPING – PG- EMBEDDED SYSTEM TECHNOLOGIES

			POa	POb	POc	POd	POe	POf	POg	POh
YEAR 1	SEM 1	Applied Mathematics for Electrical Engineers	✓				✓			
		Advanced Digital Principles and Design	✓	✓	✓	✓				
		Advanced Microprocessor and Microcontroller Design	✓	✓	✓	✓				
		Embedded Systems Design		✓	✓	✓	✓	✓		
		Software for Embedded Systems		✓	✓	✓	✓	✓		
		Professional Elective I								
		Embedded systems Laboratory								
	SEM2	Real Time Operating System								
		Pervasive Devices and Technology		✓	✓	✓	✓	✓		
		RISC Processor Architecture and Programming								
		Internet of Things								
		Professional Elective II								
		Professional Elective III								
		Real Time Embedded Operating Systems Laboratory		✓	✓	✓	✓	✓		✓
YEAR 2	SEM 3	Professional Elective IV	✓	✓	✓	✓				
		Professional Elective V Professional Elective VI								
		Project Work Phase I		✓	✓	✓	✓	✓		✓
	SEM4	Project Work Phase II		✓	✓	✓	✓	✓		✓

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CURRICULUM AND SYLLABUS I TO IV SEMESTERS

Sl. No.	SUBJECT CODE	SUBJECT	CATEGORY	CONTACT PERIODS	L	T	P	C
SEMESTER –I								
Theory:								
1.	MA2102	Applied Mathematics for Electrical Engineers	FC	4	4	0	0	4
2.	EE2101	Advanced Digital Principles and Design	PC	5	3	2	0	4
3.	EE2102	Advanced Microprocessor and Microcontroller Design	PC	3	3	0	0	3
4.	EE2103	Embedded Systems Design	PC	3	3	0	0	3
5.	EE2104	Software for Embedded Systems	PC	3	3	0	0	3
6.		Professional Elective I	PE	3	3	0	0	3
Practical / Sessional:								
7.	EE2108	Embedded systems Laboratory	PC	4	0	0	4	2
			TOTAL	**25**	**19**	**2**	**4**	**22**
SEMESTER –II								
Theory:								
1.	EE2201	Real Time Operating Systems	PC	3	3	0	0	3
2.	EE2202	Pervasive Devices And Technology	PC	3	3	0	0	3
3.	EE2203	RISC Processor architecture and programming	PC	3	3	0	0	3
4.	EE2204	Internet of Things	PC	3	3	0	0	3
5.		Professional Elective II	PE	3	3	0	0	3
6.		Professional Elective III	PE	3	3	0	0	3
Practical / Sessional:								
7.	EE2211	Real Time Embedded Operating Systems Laboratory	PC	4	0	0	4	2
			TOTAL	**22**	**18**	**0**	**4**	**20**
SEMESTER –III								
Theory:								
1.		Professional Elective IV	PE	3	3	0	0	3
2.		Professional Elective V	PE	3	3	0	0	3
3.		Professional Elective VI	PE	3	3	0	0	3
Practical / Sessional:								

4.	EE2313	Project Work Phase I	EEC	12	0	0	12	6
			TOTAL	**21**	**9**	**0**	**12**	**15**
SEMESTER –IV								
Practical / Sessional:								
1.	EE2411	Project Work Phase II	EEC	24	0	0	24	12
			TOTAL	**24**	**0**	**0**	**24**	**12**

PROFESSIONAL ELECTIVES

Sl.No.	Subject code	SUBJECT	Category	L	T	P	C
PROFESSIONAL ELECTIVE –I							
1.	EE2105	MEMS Technology	PE	3	0	0	3
2.	EE2106	Advanced Computer Architecture And Parallel Processing	PE	3	0	0	3
3.	EE2107	Digital Instrumentation	PE	3	0	0	3
PROFESSIONAL ELECTIVE – II & III							
1.	EE2205	Embedded Linux	PE	3	0	0	3
2.	EE2206	Advanced Digital Signal Processing	PE	3	0	0	3
3.	EE2207	Python Programming	PE	3	0	0	3
4.	EE2208	Embedded Product Development	PE	3	0	0	3
5.	EE2209	Automotive Embedded System	PE	3	0	0	3
6.	EE2210	Reconfigurable Processor and SoC Design	PE	3	0	0	3
PROFESSIONAL ELECTIVE – IV, V & VI							
1.	EE2301	Digital Image Processing	PE	3	0	0	3
2.	EE2302	Embedded Networking and Automation of Electrical System	PE	3	0	0	3
3.	EE2303	Smart System Design	PE	3	0	0	3
4.	EE2304	Entrepreneurship Development	PE	3	0	0	3
5.	EE2305	Nano Electronics	PE	3	0	0	3
6.	EE2306	Distributed Embedded Computing	PE	3	0	0	3
7	EE2307	Smart Grid	PE	3	0	0	3
8	EE2308	Electric Vehicles and Power Management	PE	3	0	0	3
9	EE2309	Soft Computing and Optimization Techniques	PE	3	0	0	3
10	EE2310	Wireless And Mobile Communication	PE	3	0	0	3
11	EE2311	Cryptography And Network Security	PE	3	0	0	3
12	EE2312	Robotics and Control	PE	3	0	0	3

Curriculum –credits Summary

	I	II	III	IV	Total
HS	0	0	0	0	**0**
BS	0	0	0	0	**0**
ES	0	0	0	0	**0**
PC	5	5	0	0	**10**
PE	1	2	3	0	**06**
OE	0	0	0	0	**0**
EEC	2	3	2	1	**08**
FC	1	0	0	0	**01**
TOTAL	**09**	**10**	**05**	**01**	**25**

MA2102 APPLIED MATHEMATICS FOR ELECTRICAL ENGINEERS

L	T	P	C
4	0	0	4

COURSE OBJECTIVES:

- The main objective of this course is to demonstrate various analytical skills in applied mathematics sand 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 dependent on first and higher order derivatives – Functional dependent on functions of several independent variables – Variation 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 - Probabilityfunction–Moments–Momentgeneratingfunctionsandtheirproperties–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 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: 60PERIODS

OUTCOMES:

After completing this course, students should demonstrate competency in the following skills:

- Apply various methods in matrix theory to solve system of linear equations.
- Maximizing and minimizing the functional that occurring electrical engineering discipline.
- Computation of probability and moments, standard distributions of discrete and continuous random variables and function so far 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 use sine representing the power signals.

REFERENCES:

1. AndrewsL.C.andPhillipsR.L."MathematicalTechniquesforEngineersandScientists",Prentice Hall of India Pvt.Ltd.,new Delhi, 2005.
2. Bronson,R."Matrix Operation", Schaum'soutlineseries,2nd Edition, McGrawHill, 2011.
3. Elsgolc,L.D."Calculus of Variations",Dover Publications, NewYork,2007.
4. Johnson,R.A.,Miller,IandFreundJ.,"MillerandFreund'sProbabilityandStatisticsforEngineers",Pearson Education,Asia,8th Edition,2015.
5. O'Neil,P.V.,"AdvancedEngineeringMathematics",ThomsonAsiaPvt.Ltd.,Singapore,2003.
6. Taha,H.A.,"OperationsResearch,AnIntroduction",9thEdition,Pearsoneducation,NewDelhi,2016.

EE2101 ADVANCED DIGITAL PRINCIPLES AND DESIGN

L	T	P	C
3	2	0	4

COURSE OBJECTIVES:

- To expose the students to the fundamentals of sequential system design, Asynchronouscircuits, switching errors.
- To teach the fundamentals of modeling through comparative study on the classification ofcommercial 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 conceptsacquired over the 5 Units of the subject for improved employability skills

UNIT I SEQUENTIAL CIRCUIT DESIGN 12

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

UNIT II ASYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN 12

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 – Designing Hazard free circuits

UNIT III FAULT DIAGNOSIS AND TESTABILITY ALGORITHMS 12

Fault Table Method – Path Sensitization Method – Boolean Difference Method – Kohavi Algorithm – Tolerance Techniques –Built-in Self-Test.

UNIT IV ARCHITECTURES & DESIGN USING PROGRAMMABLE DEVICES 12

Realize combinational, Arithmetic, Sequential Circuit with Programmable Array Logic; Architecture and application of Field Programmable Logic Sequence**.** Architecture of EPLD, Programmable Electrically Erasable Logic – Programming Techniques -Re-Programmable Devices Architecture-Function blocks, I/O blocks, Interconnects- Xilinx FPGA – Xilinx 2000 - Xilinx 4000 family.

UNIT V HDL PROGRAMMING 12

Overview of digital design with VHDL, hierarchical modelling concepts, gate level modelling, data flow modelling, behavioural modelling, task & functions, logic synthesis-simulation-Designexamples, Ripple

carry Adders, Carry Look ahead adders, Multiplier, ALU, Shift Registers, Multiplexer,Comparator, Test Bench

Note: Class room discussions and tutorials can include the following guidelines for improved teaching /learning process: Discussions / Practice on Workbench : Logic Synthesis and Simulation fordigital designs

TOTAL: 45+30=75PERIODS

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 onrecent trends in digital design for embedded systems

REFERENCES:

1. Donald G. Givone, "Digital principles and Design", Tata McGraw Hill 2002.
2. Stephen Brown and Zvonk Vranesic, "Fundamentals of Digital Logic with VHDL Deisgn", Tata McGraw Hill, 2002
3. William J. Dally / Curtis Harting / Tor M. Aamodt," Digital Design Using VHDL:A SystemsApproach, Cambridge Univerity Press,2015.
4. Charles H. Roth Jr., "Digital Systems design using VHDL", Cengage Learning, 2010.
5. Mark Zwolinski, "Digital System Design with VHDL", Pearson Education, 2004
6. Parag K Lala, "Digital System design using PLD", BS Publications, 2003
7. Stephen M.Trimberger,FPGA Technology,Springer,1994
8. Nripendra N Biswas, "Logic Design Theory", Prentice Hall of India, 2001
9. Charles H. Roth Jr., "Fundamentals of Logic design", Thomson Learning, 2004.
10. John V.Oldfeild ,Richard C.Dorf,"Field Programmable Gate Arrays",Wiley India Edition,2008

EE2102	**ADVANCED MICROPROCESSOR AND MICROCONTROLLER DESIGN**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To introduce the fundamentals of microcontroller based system design.
- To teach I/O and RTOS role on microcontroller.
- To know Microcontroller based system design, applications.
- To teach I/O interface in system Design
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

UNIT I 8051 ARCHITECTURE **9**

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

UNIT II 8051 PROGRAMMING 9

Assembly language programming – Arithmetic Instructions – Logical Instructions –Single bit Instructions – Timer Counter Programming – Serial Communication Programming, Interrupt Programming, LCD digital clock, thermometer – Significance of RTOS for 8051

UNIT III PIC MICROCONTROLLER 9

Architecture – memory organization – addressing modes – instruction set – PIC progrmming in Assembly & C –I/O port, Data Conversion, RAM & ROM Allocation, Timer programming, practice in MP-LAB.

UNIT IV PERIPHERAL OF PIC MICROCONTROLLER 9

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

UNIT V SYSTEM DESIGN –CASE STUDY 9

Interfacing LCD Display – Keypad Interfacing - Generation of Gate signals for converters and Inverters - Motor Control – Controlling DC/ AC appliances – Measurement of frequency - Stand alone Data Acquisition System.

Note: Class room discussions and tutorials can include the following guidelines for improved teaching /learning process:

Discussions/Practice on Workbench : 8051/PIC/ATMEL/other Microcontroller based Assembly/C language programming – Arithmetic Programming– Timer Counter Programming – Serial Communication-Programming Interrupt –RTOS basis in Task creation and run – LCD digital clock/thermometer- Motor Control

TOTAL : 45 PERIODS

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

- 8-bit microcontrollers, learn assembly and C-programming of PIC.
- Learn Interfacing of Microcontroller.
- Learners will study about PIC microcontroller and system design.
- The course would enable students to enrich their knowledge with hands on experiments and project based learning
- Effectively utilize microcontroller software development tools such as a compiler, make files, or compile scripts

REFERENCES:

1. Muhammad Ali Mazidi, Rolin D. Mckinlay, Danny Causey ‘ PIC Microcontroller and Embedded Systems using Assembly and C for PIC18’, Pearson Education2008
2. Rajkamal,”Microcontrollers Architecture, Programming Interfacing,& System Design, Pearson,2012.
3. Muhammad Ali Mazidi, Sarmad Naimi ,Sepehr Naimi‘ AVR Microcontroller and Embedded Systems using Assembly and C”, Pearson Education2014.
4. Muhammad Ali Mazidi, Janice G. Mazidi and Rolin D. McKinlay, ‘The 8051 Microcontroller and Embedded Systems’ Prentice Hall,2005.
5. John Iovine, ‘PIC Microcontroller Project Book ’, McGraw Hill2000
6. Senthil Kumar,Saravanan,Jeevanathan,”microprocessor &microcontrollers,Oxford,2013.

EE2103 EMBEDDED SYSTEMS DESIGN

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To introduce the Embedded concepts
- To introduce the Overview of Cortex – M3
- To know about the cortex – M3/M4 Programming
- To know about the cortex – M3/M4 Microcontroller
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired
- over the 5 Units of the subject for improved employability skills

UNIT I Embedded Concepts 9

Introduction to embedded systems, Application Areas, Categories of embedded systems, Overview of embedded system architecture, Specialties of embedded systems, recent trends in embedded systems, Architecture of embedded systems, Hardware architecture, Software architecture, Application Software, Communication Software, Development and debugging Tools. **ARM Architecture: Background** of ARM Architecture, Architecture Versions, Processor Naming, Instruction Set Development, Thumb-2 and Instruction Set Architecture.

UNIT II Overview of Cortex-M3 9

Cortex-M3 Basics: Registers, General Purpose Registers, Stack Pointer, Link Register, Program Counter, Special Registers, Operation Mode, Exceptions and Interrupts, Vector Tables, Stack Memory Operations, Reset Sequence - **Instruction Sets:** Assembly Basics, Instruction List, Instruction Descriptions - **Cortex-M3 Implementation Overview:** Pipeline, Block Diagram, Bus Interfaces on Cortex-M3, I-Code Bus, D-Code Bus, System Bus, External PPB and DAP Bus.

UNIT III Cortex-M3/M4 Programming 9

Cortex-M3/M4 Programming: Overview, Typical Development Flow, Using C, CMSIS (Cortex Microcontroller Software Interface Standard), Using Assembly - **Exception Programming:** Using Interrupts, Exception/Interrupt Handlers, Software Interrupts, Vector Table Relocation - **Memory Protection Unit and other Cortex-M3 features:** MPU Registers, Setting Up the MPU, Power Management**,** Multiprocessor Communication.

UNIT IV Cortex-M3/M4 Microcontroller 9

STM32L15xxx ARM Cortex M3/M4 Microcontroller: Memory and Bus Architecture, Power Control, Reset and Clock Control - **STM32L15xxx Peripherals:** GPIOs, System Configuration Controller, NVIC, ADC, Comparators, GP Timers, USART - **Development & Debugging Tools:** Software and Hardwar3e tools like Cross Assembler, Compiler, Debugger, Simulator, In-Circuit Emulator (ICE), Logic Analyzer etc.

UNIT V Embedded System Design-Case Studies 9

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.

TOTAL : 45 PERIODS

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

- To understand about the Embedded concepts
- To understand about the Overview of Cortex – M3
- To understand about the about the cortex – M3/M4 Programming
- To understand about the about the cortex – M3/M4 Microcontroller
- To understand about the Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

REFERENCE BOOKS:

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.
3. The Definitive Guide to the ARM Cortex-M3, Joseph Yiu, Second Edition, Elsevier Inc. 2010.
4. Andrew N Sloss, Dominic Symes, Chris Wright, "ARM System Developer's Guide - Designing and Optimizing System Software", 2006, Elsevier.
5. Peter Marwedel, "Embedded System Design", Science Publishers, 2007.
6. Arnold S Burger, "Embedded System Design", CMP.
7. Rajkamal, "Embedded Systems: Architecture, Programming and Design", TMH Publications, Second Edition, 2008.
8. Steve Furber, "ARM System-on-Chip Architecture", 2nd Edition, Pearson Education
9. Cortex-M series-ARM Reference Manual
10. Embedded/RealTime Systems Concepts, Design and Programming Black Book, Prasad, KVK.
11. DavidSeal"ARMArchitectureReferenceManual",2001AddisonWesley,England;MorganKaufmannPublishers
12. STM32L152xxARMCortex M3 Microcontroller Reference Manual

EE2104 SOFTWARE FOR EMBEDDED SYSTEMS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To expose the students to the fundamentals of embedded Programming.
- To Introduce the GNU C Programming Tool Chain in Linux.
- To study basic concepts of embedded C , Embedded OS& Python Programming
- To introduce time driven architecture, Serial Interface with a case study.
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills.

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 TOOL CHAININ LINUX 9

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

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 EMBEDDED OS 9

Creating embedded operating system: Basis of a simple embedded OS, Introduction to sEOS, Using Timer 0 and Timer 1, Portability issue, Alternative system architecture, Important design considerations when using sEOS- Memory requirements - embedding serial communication & scheduling data transmission - Case study: Intruder alarm system.

UNIT V PYTHON PROGRAMMING 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.

Note: Class room discussions and tutorials can include the following guidelines for improved teaching /learning process:

Discussions/Practice on Workbench: Program Development and practice in exercises with C, C++ Linux and Python Programming Environments.

TOTAL: 45 PERIODS

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

- Ability to use GNU C to develop embedded software.
- knowledge and understanding of fundamental embedded systems design paradigms, architectures, possibilities and challenges, both with respect to software and hardware
- Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design.

REFERENCES

1. Steve Oualline, 'Practical C Programming 3rd Edition', O'Reilly Media, Inc,2006.
2. Michael J Pont, "Embedded C", Pearson Education,2007.
3. Christian Hill, Learning Scientific Programming with Python , CAMBRIDGE UNIVERSITY PRESS,2016.
4. Wesley J.Chun, "Core python application Programming 3rd Edition", Pearson Educat,2016.
5. Mark J.Guzdial," introduction to computing and programming in python – a Multimedia approach ,4th edition, Pearson Education,2015.
6. Stephen Kochan, "Programming in C", 3rd Edition, Sams Publishing,2009.
7. Mark Lutz,"Learning Python,PowerfulOOPs,O'reilly,2011.
8. Peter Prinzs, Tony Crawford, "C in aNutshell",O'Reilly,2016.
9. Dr.Bandu Meshram, "Object Oriented Paradigm C++ BeginnersGuide C&C++",SPD,2016.
10. David Griffiths, Dawn Griffiths, "Head First C",O'reilly,2015.

EE2108 EMBEDDED SYSTEMS LABORATORY				**L 0**	**T 0**	**P 4**	**C 2**
Sl.No	Experiment Detail	Equipment/ Supports Required	Training outcomes	Related Programme outcomes			
1.	Programming in Higher Level Languages/ Platforms	C/C++/Java/Embedded C/ Embedded Java/ Compilers & Platforms	The students will learn design with simulators/ programming environments	a,b,c.d			
2.	Programming with 8 bit Microcontrollers: ✓ Assembly programming Study on in circuit Emulators, cross compilers, debuggers	8051Microcpontrollers with peripherals;;IDE,Board Support Software Tools / C Compiler/others	The students will learn design with simulators/ experiments in programming processor boards, processor interfacing/designing digital controllers	2,3,4,a,c,d			
3.	I/O Programming with 8 bit Microcontrollers I/O Interfacing : Timers/ Interrupts/ Serial port programming/PW M Generation/ Motor Control/ADC/DAC / LCD/ RTC Interfacing/ Sensor Interfacing	8051Microcpontrollers with peripherals; Board Support Software Tools, peripherals with interface		a,f			
4.	.Programming with AVR/ PIC Microcontrollers: ✓ Assembly ✓ C programming ✓ programming ✓ Interfacing peripherals Study on in circuit Emulators, Cross compilers, debuggers	AVR/PIC Microcontrollers with peripherals; ;IDE, Board Support Software Tools /C Compiler/others	The students will learn design with simulators /experiments, in programming processor boards, processor interfacing/ designing digital controllers	a,b,c.d			
5..	I/O Programming with AVR/ PIC Microcontrollers I/O Interfacing : Timers/ Interrupts/ Serial port	AVR/ PIC Microcontrollers with peripherals; Board Support Software Tools, peripherals with interface		2,3,4,a,c,d			

	programming/PW M Generation/ Motor Control/ADC/DAC / LCD/ RTC Interfacing/ Sensor Interfacing			
6.	Programming with Arduino Microcontroller Board : Study on in circuit Emulators, cross compilers, debuggers	Arduino Boards with peripherals ;IDE, Board Support Software Tools /Compiler/others		a,f
7..	VHDL Programming in FPGA processors	Processor Boards with Board Support Tools &Interfaces	The students will learn design ,modeling &simulation of Combinational, Sequential, Synchronous, synchronous circuits with simulators/experiments ,in programming processor boards, processor interfacing/designing reprogrammable system	a,f
8.	Verilog HDL Programming in FPGA processors	Processor Boards with Board Support Tools &Interfaces	The students will learn design, modeling &simulation of Combinational, Sequential, Synchronous, Asynchronous circuits with simulators/ experiments ,in programming processor boards, processor interfacing/designing reprogrammable system	a,f
9..	Programming & Simulation in Simulators /Tools/others	Simulation Tools as Proteus/ ORCAD	The students will learn design with experiments ,in programming suites/simulators/Tool Bench.	a,b,c.d
10	Programming & Simulation in Simulators /Tools/others	Simulation Tools as Matlab /others		2,3,4,a,c,d

Note: Laboratory training, discussions can include the given guidelines for improved teaching /learning process :Hands on experiences can be with Case specific experiments in domains on range of processors,programmes,simulators,circuits that support theory subjects

TOTAL : 60PERIODS

REFERENCE:

1. Mohamammad Ali Mazidi & Mazidi ' 8051 Microcontroller and Embedded Systems', Pearson Education
2. Mohammad Ali Mazidi, Rolind Mckinley and Danny Causey, 'PIC Microcontroller and Embedded Systems' PearsonEducation
3. Simon Monk," Make Action-with Arduino and Raspberry Pi,SPD,2016.
4. Wesley J.Chun,"Core Python Applications Programming,3rded,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",CengageLearning,2010
7. Taan S.Elali,"Discrete Systems and Digital Signal Processing with Matlab",CRCPress2009.
8. Jovitha Jerome,"Virtual Instrumentation usingLabview"PHI,2010.
9. Woon-Seng Gan, Sen M. Kuo, 'Embedded Signal Processing with the Micro Signal Architecture',
10. John Wiley & Sons, Inc., Hoboken, New Jersey2007

Dogan Ibrahim, 'Advanced PIC microcontroller projects in C', Elsevier2008

EE2201 REAL TIME OPERATING SYSTEMS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To expose the students to the fundamentals of interaction of OS with a computer and User computation.
- To teach the fundamental concepts of how process are created and controlled with OS.
- To study on programming logic of modeling Process based on range of OS features
- To compare types and Functionalities in commercial OS, application development using RTOS
- To involve Discussions/ Practice/Exercise onto revising &familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

UNIT I REVIEW OF OPERATING SYSTEMS 9

Basic Principles - Operating System structures – System Calls – Files – Processes – Design and Implementation of processes – Communication between processes – Introduction to Distributed operating system – issues in distributed system: states, events, clocks- Distributed scheduling-Fault &recovery.

UNIT II OVERVIEW OF RTOS 9

RTOS Task and Task state –Multithreaded Preemptive scheduler- Process Synchronization- Message queues– Mail boxes -pipes – Critical section – Semaphores – Classical synchronization problem – Deadlocks

UNIT III REAL TIME MODELS AND LANGUAGES 9

Event Based – Process Based and Graph based Models – Real Time Languages – RTOS Tasks – RT scheduling - Interrupt processing – Synchronization – Control Blocks – Memory Requirements.

UNIT IV REAL TIME KERNEL 6

Principles – Design issues – RTOS Porting to a Target – Comparison and Basic study of various RTOS like – VX works – Linux supportive RTOS – C Executive.

UNIT V INTRODUCTION TO EMBEDDED OS 12

Discussions on Basics of Linux supportive RTOS – uCOS-C Executive for development of RTOS Application –introduction to Android Environment -The Stack – Android User Interface – Preferences, the File System, the Options Menu and Intents, with one Case study

Note: Class room discussions and tutorials can include the following guidelines for improved teaching /learning process: Discussions/Practice on Workbench :on understanding the scheduling techniques, timing circuitry, memory allotment scheme , overview of commercial Embedded OS.

TOTAL: 45 PERIODS

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

- Real-time scheduling and schedule ability analysis, including clock-driven and priority-driven scheduling
- Theoretical background (specification/verification) and practical knowledge of real-time operating systems.
- After completing the course students will appreciate the use of multitasking techniques in real- time systems, understand the fundamental concepts of real-time operating systems
- Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design.

REFERENCES:

1. Silberschatz,Galvin,Gagne" Operating System Concepts,6th ed,JohnWiley,2003
2. Charles Crowley, "Operating Systems-A Design Oriented approach" McGrawHill,1997
3. Raj Kamal, "Embedded Systems- Architecture, Programming and Design" Tata McGraw Hill,2006.
4. Karim Yaghmour,Building Embedded Linux System",O'reillyPub,2003
5. C.M. Krishna, Kang, G.Shin, "Real Time Systems", McGraw Hill,1997.
6. Marko Gargenta,"Learning Android ",O'reilly2011.
7. Herma K., "Real Time Systems – Design for distributed Embedded Applications", Kluwer Academic,1997.
8. Corbet Rubini, Kroah-Hartman, "Linux Device Drivers", O'reilly,2016.
9. Mukesh Sighal and N G Shi "Advanced Concepts in Operating System", McGrawHill,2000
10. D.M.Dhamdhere," Operating Systems,A Concept-BasedApproch,TMH,2008

EE2202 PERVASIVE DEVICES AND TECHNOLOGY

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To expose the fundamentals of wireless sensor technology, classification
- To teach the infrastructure of WSN processor and its functions in networking
- To study on challenges in on interconnectivity of networks & Network communication
- To discuss on commercial wireless technology
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

UNIT I WIRELESS SENSOR DEVICES & NETWORKING 12

Challenges for Wireless Sensor Networks- Characteristic requirements for WSN ,WSN vs Adhoc Networks - introduction to Sensor node networking with any Commercially available sensor nodes – Physical layer and transceiver design considerations in WSNs, -Applications of sensor networks

UNIT II BUILDING PERVASIVE SENSOR NETWORK 12

Single-Node Architecture - Hardware Components, constraints & challenges in resources- Energy Consumption of Sensor Nodes, Operating Systems for Wireless Sensor Networks – Introduction - Operating System Design Issues - Network Architecture -Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts. Data Dissemination-Flooding and Gossiping-Data gathering Sensor Network Scenarios –Optimization, Goals and Figures of Merit – Design Principles for WSNs- Gateway Concepts – Need for gateway

UNIT III WIRELESS TECHNOLOGY 6

Wireless LAN – IEEE 802.11 System Architecture , protocol Architecture – Services , AdHoc Networks, Hiper LAN , Bluetooth , Wireless PAN, Wireless MAN, Wireless Backbone Networks , Wireless Access Technology

UNIT IV OVERVIEW OF SENSOR NETWORK PROTOCOLS 9

Introduction to fundamentals of Wireless sensor network MAC Protocols - Low duty cycle protocols and wakeup concepts - Contention-based protocols - Schedule-based protocols - IEEE 802.15.4 MAC protocol- Energy usage profile, Choice of modulation scheme-basic principle for data transfer and energy management for SMAC , Leach & Zigbee communication

UNIT V WIRELESS NETWORKING OFDEVICES 6

Classification of Wireless Networking of Devices, introduction to RF WPAN 802.15.1 & Blutooth - protocol stack, frame, link manager layer –Bluetooth piconet–application.

Note: Class room discussions and tutorials can include the following guidelines for improved teaching /learning process : Discussions/Exercise/Practice on Workbench : on the basics of Zigbee protocols, sensor motes, role of special microcontrollers for Zigbee communication etc

TOTAL : 45 PERIODS

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

- Relate to current trends in pervasive computing and develop a sense of their practicality
- Identify distinguishing features of the different mobile device categories, namely, Pocket PCs, Personal Digital Assistants (PDAs), and wireless phones.
- Recognize the difference between writing code for workstations and servers on one hand and for resource-constrained devices on the other hand.
- The learning process delivers insight onto building of sensor networks, communication in zigbee network and sensor netwoks protocols are studied.
- Design and develop a pervasive computing device for a specific need.
- Develop a framework for pervasive computing.

REFERENCES:

1. Holger Karl,Andreas Willig,"Protocols & Architectures for WSN",JohnWiley,2012
2. Mark Ciampa,Jorge Olenewa,"Wireless Communications,CengageLearning,2009.
3. Frank Adelstein,SandeepK.S Guptaetal,"Fundamentals of Mobile &Pervasive Computing, TMcHill,

2010.
4. Jaganathan Sarangapani,Wireless AdHoc & SensorN/Ws-Protocols&Control,CRC2007.
5. Kaveh Pahlavan, Prasanth Krishnamoorthy, " Principles of Wireless Networks' PHI/Pearson Education,2003
6. Natalia Olifer and Victor Olifer,"Computer Networks principles.technologies and protocols for network design", Wiley,2015
7. Feng Zhao,Leonidas Guibas"Wireless SensorNetworks",Elsevier,2005.
8. William Stallings, "Wireless communications and Networks", PHI/Pearson Education,2002.
9. Mullet,"Introduction to wireless telecommunications systems and networks", cengage learning, 2010
10. Feng Zhao & Leonidas J. Guibas, "Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007.

EE2203 RISC PROCESSOR ARCHITECTURE AND PROGRAMMING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To teach the architecture of general AVR processor
- To teach the architecture and programming of 8/16 bit RISC processor
- To teach the implementation of DSP in ARM processor
- To discuss on memory management, application development in RISC processor
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

UNIT I AVR MICROCONTROLLER ARCHITECTURE 9

Architecture – memory organization – addressing modes – I/O Memory – EEPROM – I/O Ports – SRAM – Timer –UART – Interrupt Structure- Serial Communication with PC – ADC/DAC Interfacing.

UNIT II ARM ARCHITECTURE AND PROGRAMMING` 9

Arcon RISC Machine – Architectural Inheritance – Core & Architectures -- The ARM Programmer's model -Registers – Pipeline - Interrupts – ARM organization - ARM processor family – Co-processors. Instruction set – Thumb instruction set – Instruction cycle timings.

UNIT III ARM APPLICATION DEVELOPMENT 9

Introduction to RT implementation with ARM – –Exception Handling – Interrupts – Interrupt handling schemes- Firmware and bootloader – Free RTOS Embedded Operating Systems concepts –example on ARM core like ARM9 processor.

UNIT IV MEMORY PROTECTION AND MANAGEMENT 9

Protected Regions-Initializing MPU, Cache and Write Buffer-MPU to MMU-Virtual Memory-Page Tables-TLB-Domain and Memory Access Permission-Fast Context Switch Extension.

UNIT V DESIGN WITH ARM MICROCONTROLLERS 9

Assembler Rules and Directives- Simple ASM/C programs- Hamming Code- Division-Negation- Simple Loops –Look up table- Block copy-subroutines-application.

Note: Class room discussions and tutorials can include the following guidelines for improved teaching /learning process: Discussions/Exercise/Practice on Workbench : *on* Programming practices on the KEIL

Work Bench for Simple ASM/C / Input & output interfacing programs with ARM 7/ARM 9/Nuvoton Processors

TOTAL : 45 PERIODS

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

- Describe the programmer's model of ARM processor and create and test assembly level programming.
- Analyze various types of coprocessors and design suitable co-processor interface to ARM processor.
- Identify the architectural support of ARM for operating system and analyze the function of memory Management unit of ARM.
- Students will develop more understanding on the concepts ARM Architecture, programming and application development.
- The learning process delivers insight into various embedded processors of RISC architecture / computational processors with improved design strategies

REFERENCES

1. Steve Furber, 'ARM system on chip architecture', Addision Wesley
2. Andrew N. Sloss, Dominic Symes, Chris Wright, John Rayfield 'ARM System
3. Developer's Guide Designing and Optimizing System Software', Elsevier2007.
4. Muhammad Ali Mazidi, Sarmad Naimi ,Sepehr Naimi' AVR Microcontroller and Embedded Systems using Assembly and C", Pearson Education2014.
5. ARM Architecture Reference Manual, LPC213x UserManual
6. www.Nuvoton .com/websites on Advanced ARM CortexProcessors
7. Trevor Martin, 'The Insider's Guide To The Philips ARM7-BasedMicrocontrollers,
8. An Engineer's Introduction To The LPC2100 Series' Hitex (UK)Ltd.,

EE2204 INTERNET OF THINGS **L T P C**
3 0 0 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 INTERNETOF 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, smallcell.

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

Note: Class Room Discussions and Tutorials can include the following Guidelines for improved Teaching /Learning Process: Practice through any of Case studies through Exercise/Discussions on Design , Development of embedded solutions using wireless communication by processor support

TOTAL : 45 PERIODS

OUTCOMES

- 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.

REFERENCES*:*

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
6. Internet" Morgan Kuffmann Publishers,2010.
7. Adrian McEwen and Hakim Cassimally, "Designing the Internet of Things", John Wiley and sons,2014
8. Lingyang Song/Dusit Niyato/ Zhu Han/ Ekram Hossain," Wireless Device-to-Device Communications and Networks, CAMBRIDGE UNIVERSITYPRESS,2015
9. OvidiuVermesan and Peter Friess (Editors), "Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems", River Publishers Series in Communication, 2013
10. Vijay Madisetti , ArshdeepBahga, "Internet of Things (A Hands on-Approach)",2014
    Zach Shelby, Carsten Bormann, "6LoWPAN: The Wireless Embedded Internet", John Wiley and sons, 2009
11. Lars T.Berger and Krzyszt of Iniewski, "Smart Grid applications, communications and security", Wiley,2015
12. Janaka Ekanayake, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama and Nick Jenkins, " Smart Grid Technology and Applications", Wiley,2015.
13. Upena Dalal,"Wireless Communications & Networks,Oxford,2015

EE2211 REAL TIME EMBEDDED OPERATING SYSTEMS LAB				L 0	T 0	P 4	C 2
Sl. No	Experiment Detail	Equipment/ Supports Required	Training outcomes	Related programme outcomes			
1.	Programming ARM processor : ARM7 / ARM9/ARM Cortex Study on in circuit Emulators, cross compilers,debuggers	Microcontrollers with peripherals; ;IDE, Board Support Software Tools /Keil/uCOS Compiler/others	The students will learn design with simulators/experiments,in programming processor boards, processor interfacing/ designing digital controllers	a,b,c.d			
	I/O Programming with ARM processor : ARM7 / ARM9/ARM Cortex Microcontrollers I/O Interfacing : Timers/ Interrupts/ Serial port programming/PWM Generation/ Motor Control/ADC/DAC/ LCD/ RTC Interfacing/ Sensor Interfacing	ARM processor : ARM7 / ARM9/ARM Cortex Microcontrollers with peripherals; Board Support Software Tools, peripherals with interface		2,3,4,a,c,d			
2.	Programming with Rasberry Pi Microcontroller Board : Study on in circuit Emulators, cross compilers, debuggers	Rasberry Pi Boards with peripherals ;IDE, Board Support Software Tools /Compiler/others		a,f			
3.	I/O Programming with Arduino ,Rasberry Pi Microcontroller Boards I/O Interfacing : Timers/ Interrupts/ Serial port programming/PWM Generation/ Motor Control/ADC/DAC/ LCD/ RTC Interfacing/ Sensor Interfacing	Arduino,Rasberry Pi Microcontroller Boards with peripherals; Board Support Software Tools, peripherals with interface		a,f			
4.	Programming with DSP	Processor Boards with Board	The students	a,b,c.d			

	processors	Support Tools & Interfaces	will learn design & simulation of Arithmetic ,Logic programs, Filters, Signal anaysis with simulators/ex periments ,in programming processor boards, processorint erfacing/ Tools	
5.	Programming in Freeware softwares/Platforms	Programming Compilers&Platfor ms on freeware	The students will learn programming , compiling in various tools & software domains	2,3,4,a,c,d
6.	<u>Software & Modelling tools</u> ✓ Study on MEMSTools ✓ Study on process Controllermodeling ✓ PLC/SCADA/PCB ✓ one type CADTool	Personal Computers, Licenced software &program ming/modellingtools		a,f
7.	Programming & Simulation in GUI Simulators /Tools/others ✓ Graphical User interface simulations & modeling of instrumentation& controllers	Simulation Tools as Labview /others	The students will learn programming , compiling in various tools & software domains	a,f
8.	Study of one type of Real Time Operating Systems (RTOS)	Compilers & Platforms with VXWorks/ Keil/ Android/ Tiny OS/ Linux Support/any RTOS		a,b,c.d
9.	Programming & Simulation in Python Simulators/Tools/others	Programming in Python Platform		2,3,4,a,c,d
10	Programming with wired/wireless communication protocol/Network Simulators	Learning Communication Protocols & Support Software Tools for BUS & network communication	Learning Communication Protocols & Experimenting with Support Software Tools for Communication interfaces	a,f

TOTAL : 60 PERIODS

Note: Laboratory training, discussions can include the given guidelines for improved teaching /learning process: Hands on experiences with Case specific experiments in domains on range of work Benches, programmable Test suites, simulators, circuit boards that support the practical skill training supportive to theory subjects.

REFERENCES:

1. Mohamammad Ali Mazidi & Mazidi ' 8051 Microcontroller and Embedded Systems', Pearson Education
2. Mohammad Ali Mazidi, Rolind McKinley and Danny Causey, 'PIC Microcontroller and Embedded Systems' PearsonEducation
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",CengageLearning,2010
7. Taan S.Elali,"Discrete Systems and Digital Signal Processing with Matlab", CRCPress2009.
8. Jovitha Jerome,"Virtual Instrumentation usingLabview"PHI,2010.
9. Woon-Seng Gan, Sen M. Kuo, 'Embedded Signal Processing with the Micro Signal Architecture', John Wiley & Sons, Inc., Hoboken, New Jersey2007
10. Dogan Ibrahim, 'Advanced PIC microcontroller projects in C', Elsevier2008

EE2105 MEMS TECHNOLOGY

L	T	P	C
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COURSE OBJECTIVES

- To teach the students properties of materials, microstructure and fabrication methods.
- To teach the design and modeling of Electrostatic sensors and actuators.
- To teach the characterizing thermal sensors and actuators through design and modeling
- To teach the fundamentals of piezoelectric sensors and actuators through exposure to different MEMS and NEMS 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 MICRO-FABRICATION, MATERIALS AND ELECTRO-MECHANICAL CONCEPTS 9

Overview of micro fabrication – Silicon and other material based fabrication processes – Concepts: Conductivity of semiconductors-Crystal planes and orientation-stress and strain-flexural beam bending analysis-torsional deflections-Intrinsic stress- resonant frequency and quality factor.

UNIT II ELECTROSTATIC SENSORS AND ACTUATION 9

Principle, material, design and fabrication of parallel plate capacitors as electrostatic sensors and actuators-Applications.

UNIT III THERMAL SENSING AND ACTUATION 9

Principle, material, design and fabrication of thermal couples, thermal bimorph sensors, thermal resistor sensors-Applications.

UNIT IV PIEZOELECTRIC SENSING AND ACTUATION 9

Piezoelectric effect-cantilever piezoelectric actuator model-properties of piezoelectric materials-Applications.

UNIT V CASE STUDIES 9

Piezo resistive sensors, Magnetic actuation, Micro fluidics applications, Medical applications, Optical MEMS.-NEMS Devices

Note: Class room discussions and tutorials can include the following guidelines for improved teaching /learning process: Discussions/Exercise/Practice on Workbench: on the basics /device model design aspects of thermal/peizo/resistive sensors etc.

TOTAL : 45 PERIODS

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

- Understand basics of microfabrication, develop models and simulate electrostatic and electromagnetic sensors and actuators
- Understand material properties important for MEMS system performance, analyze dynamics of resonant micro mechanical structures
- The learning process delivers insight onto design of micro sensors, embedded sensors & actuators in power aware systems like grid.
- Understand the design process and validation for MEMS devices and systems, and learn the state of the art in optical microsytems
- Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design.

REFERENCES:

1. Chang Liu, "Foundations of MEMS", Pearson International Edition, 2006.
2. Marc Madou , "Fundamentals of micro fabrication",CRC Press,1997.
3. Boston , "Micromachined Transducers Sourcebook",WCB McGraw Hill,1998.
4. M.H.Bao "Micromechanical transducers :Pressure sensors, accelerometers and gyroscopes", Elsevier, Newyork, 2000.

EE2106	ADVANCED COMPUTER ARCHITECTURE AND PARALLEL PROCESSING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To educate the students to the fundamentals of parallel processing
- To teach the fundamentals of network topologies for multiprocessors
- To introduce different pipeline designs
- To introduce features of parallel processors , memory technologies, OS for multiprogrammed computer
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

UNIT I THEORY OF PARALLELISM 9

Parallel Computer models – the state of computing-introduction to parallel processing- parallelism in uniprocessors& Multiprocessors,-parallel architectural classification schemes-speedup performance laws- - Program and Network Properties-H/W-S/W Parallelism

UNIT II SYSTEM INTERCONNECT ARCHITECTURES 9

System interconnect Architectures-Network Properties and routing-Static Interconnection Networks-Dynamic Interconnection Networks-Multiprocessor System Interconnects-interprocessor communication network-Structure of Parallel Computers; Hierarchical bus systems-Crossbar switch and multiport memory-multistage and combining network

UNIT III PIPELINING AND SUPERSCALAR TECHNOLOGIES 6

Pipeline principle and implementation-classification of pipeline processor-introduction of arithmetic, instruction, processor pipelining-pipeline mechanisms-hazards

UNIT IV HARDWARE TECHNOLOGIES 15

Introduction to features of advanced embedded processors through Basic Comparative study : of Architectures -addressing modes -instruction types-performance of- Parallel and scalable architectures, Multiprocessor and SIMD ,MIMD computers, RISC, CISC, Superscalar, VLIW , Vector, Systolic processors of their unique features -Scalable, Multithreaded and data flow Architectures-inter PE communication-interconnection networks- Array & vector processors, vector instruction types- performance modeling-design of vectorising compiler- case Architecture of Itanium processor, Pentium Processor, SPARC Processor.

UNIT V OS ISSUES FOR MULTIPROCESSOR 6

Introduction-Need for Pre -emptive OS – Synchronizing and Scheduling in Multiprocessor OS-, Usual Os scheduling Techniques, threads – Classification of multi-processor OS – Software requirements of multiprocessor OS, Distributed scheduler – PVM – PT Threads in shared memory systems.

Note: Class room discussions and tutorials can include the following guidelines for improved teaching /learning process: :Discussions/Practice on Workbench : modelling of Computing Algorithms /ALU Functional Blocks

TOTAL: 45 PERIODS

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

- An ability to understand the operations of multiprocessor and multicomputer systems.
- To understand the various advanced processor technology, pipelining and scalable architectures.
- To know the working of superscalar pipeline, cache memory organization.
- To understand the principles of multithreading, multithread architecture, static and dynamic data flow.
- Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design

REFERENCES:

1. Kai Hwang “Advanced Computer Architecture”.Tata McGraw Hill2000
2. Advanced Computer architecture , By Rajiv Chopra, S Chand ,2010
3. JohnL.Hennessy,DavidA.Petterson,“Computer Architecture: A Quantitative Approach”, 4th Edition, Elsevier,2007
4. Dezso Sima, Terence Fountain, Peter Kacsuk, “Advanced computer Architecture – A design Space Approach”. Pearson Education,2003.
5. Sajjan G. Shiva “Advanced Computer Architecture”, Taylor & Francis,2008
6. Rajaraman, C.Siva Ram Murthy, “Parallel Computers- Architecture and Programming”, Prentice Hall India,2008
7. Carl Homacher, Zvonko Vranesic, Sefwat Zaky, “Computer Organisation”, 5th Edition, TMH,2002.
8. David E. Culler, Jaswinder Pal Singh with Anoop Gupta “Parallel Computer Architecture” ,Elsevier, 2004.
9. John P. Shen. “Modern processor design Fundamentals of super scalar processors”, Tata McGraw Hill2003.

EE2107 DIGITAL INSTRUMENTATION

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To discuss to the students on the fundamentals building blocks of a digital instrument
- To teach the digital data communication techniques
- To study on bus communication standards and working principles
- To teach Graphical programming using GUI for instrument building
- To 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, Prescaler, 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 progmming 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.

Note: Class room discussions and tutorials can include the following guidelines for improved teaching /learning process :Discussions/Exercise/Practice on Workbench for Digital Control of Relays/Solenoids, Digital I/O – Counter , Timer-servo motor control-PID c control / LCD graphics Interface/storage interface,

TOTAL: 45PERIODS

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.

REFERENCES:

1. Mathivanan, "PC based Instrumentation Concepts and practice", Prentice-Hall India,2009
2. Jovitha Jerome,"Virtual Instrumentation usingLabview"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 & DigitalCommunication,TMcH,2005
6. Lisa K. wells & Jeffrey Travis, Lab VIEW for everyone, Prentice Hall, NewJersey,1997.
7. H S Kalsi, "Electronic Instrumentation" Second Edition, TataMcGraw-Hill,2006.
8. K.Padmanabhan, S.Ananthi A Treatise on Instrumentation Engineering ,I KPublish,2011

EE2205 EMBEDDED LINUX

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To expose the students to the fundamentals of Linux Operating system, its basic commands and shell programming
- To teach the history of embedded Linux, various distributions and basics of GNU Cross Platform Tool Chain.
- To study on different Host-Target setup, debug and various memory device, file systems and performance tuning.
- To introduce the concept of configuring kernel using the cross-platform toolchain.
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

UNIT I FUNDAMENTALS OF LINUX 9

Basic Linux System Concepts: Working with Files and Directories - Introduction to Linux File system - Working with Partitions and File systems - Understanding Linux Permissions; Using Command Line Tools: Executing Commands from the Command Line - Getting to a Shell - Popular Command-Line Commands - Working with the Bash Shell

UNIT II VARIOUS DISTRIBUTIONS AND CROSS PLAT FORM TOOL CHAIN 9

Introduction - History of Embedded Linux - Embedded Linux versus Desktop Linux - Commercial Embedded Linux Distribution - Choosing a distribution - Embedded Linux Distributions - Architecture of Embedded Linux - Linux Kernel Architecture - Porting Roadmap - GNU Cross Plat form Tool chain

UNIT III HOST-TARGET SETUP AND OVER ALL ARCHITECTURE 9

Real Life Embedded Linux Systems - Design and Implementation Methodology - Types of Host/Target

Development Setups - Types of Host/Target Debug Setups - Generic Architecture of an Embedded Linux System - System Startup - Types of Boot Configurations - System Memory Layout - Processor Architectures - Buses and Interfaces - I/O – Storage

UNIT IV KERNEL CONFIGURATION 9

A Practical Project Workspace - GNU Cross-Platform Development Toolchain - C Library Alternatives - Other Programming Languages - Eclipse: An Integrated Development Environment - Terminal Emulators - Selecting a Kernel - Configuring the Kernel - Compiling the Kernel - Installing the Kernel - Basic Root Filesystem Structure - Libraries - Kernel Modules and Kernel Images - Device Files - Main System Applications - System Initialization

UNIT V LINUX DRIVERS 9

Introduction in to basics on Linux drivers, introduction to GNU cross platform Toolchain- Case study on programming one serial driver for developing application using Linux Driver

Note: Class room discussions and tutorials can include the following guidelines for improved teaching /learning process: Discussions/Practice on Workbench : on design of Algorithms for Practicing Shell Programming in Linux / Developing programs in GCC and Eclipse / Learning Debugging and Profiling/Linux Driver interface

TOTAL : 45 PERIODS

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

- To use Linux desktop and GNU tool chain with Eclipse IDE
- Cross compile Linux kernel and port it to target board.
- Add applications and write customized application for the Linux kernel in the target board.
- Students will study about distributions and cross platform toolchain.
- Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design.

REFERENCES:

1. Karim Yaghmour, Jon Masters, Gilad Ben-Yossef, and Philippe Gerum, 'Building Embedded Linux Systems 2nd Edition', SPD -O'Reilly Publications,2008
2. P.Raghavan,Amol Lad,Sriram Neelakandan,"EmbeddedLinux System Design &Development,Auer-bach Publications,2012
3. William von Hagen, 'Ubuntu Linux Bible 3rd Edition', Wiley Publishing Inc.,2010
4. Jonathan Corbet, Alessandro Rubini & Greg Kroah-Hartman, 'Linux Device Drivers 3rd Edition', SPD -O'Reilly Publications,2011
5. Robert Love,"Linux System Programming, SPD -O'Reilly Publications,2010

EE2206 ADVANCED DIGITAL SIGNAL PROCESSING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To expose the students to the fundamentals of digital signal processing in frequency domain& its application
- To teach the fundamentals of digital signal processing in time-frequency domain& its application
- To compare Architectures &features of Programmable DSP Processors & develop logical functions of DSP Processors
- To discuss on Application development with commercial family of DSP Processors
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

UNIT I FUNDAMENTALS OF DSP 12

Frequency interpretation, sampling theorem, aliasing, discrete-time systems, constant-coefficient difference equation. Digital filters: FIR filter design – rectangular, Hamming, Hanning windowing technique. IIR filter design – Butterworth filter, bilinear transformation method, frequency transformation. Fundamentals of multirate processing – decimation and interpolation.

UNIT II TRANSFORMS AND PROPERTIES 9

Discrete Fourier transform (DFT): - properties, Fast Fourier transform (FFT), DIT-FFT, and DIF-FFT. Wavelet transforms: Introduction, wavelet coefficients – orthonormal wavelets and their relationship to filter banks, multi-resolution analysis, and Haar and Daubechies wavelet.

UNIT III ADAPTIVE FILTERS 9

Wiener filters – an introduction. Adaptive filters: Fundamentals of adaptive filters, FIR adaptive filter – steepest descent algorithm, LMS algorithm, NLMS, applications – channel equalization. Adaptive recursive filters – exponentially weighted RLS algorithm.

UNIT IV ARCHITECTURE OF COMMERCIAL DIGITAL SIGNAL PROCESSORS 9

Introduction to commercial digital signal processors, Categorization of DSP processor – Fixed point and floating point, Architecture and instruction set of the TI TMS 320 C54xx and TMS 320 C6xxx DSP processors, On-chip and On-board peripherals – memory (Cache, Flash, SDRAM), codec, multichannel buffered I/O serial ports (McBSPs), interrupts, direct memory access (DMA), timers and general purpose I/Os.

UNITV INTERFACING I/O PERIPHERALS FOR DSP BASED APPLICATIONS 6

Introduction, External Bus Interfacing Signals, Memory Interface, I/O Interface, Programmed I/O, Interrupts, Design of Filter, FFT Algorithm, ,Application for Serial Interfacing, DSP based Power Meter, Position control , CODEC Interface.

TOTAL : 45 PERIODS

Note: Discussions / Exercise / practice on signal analysis, transforms, filter design concepts with simulation tools such as Matlab / Labview / CC studio will help the student understand signal processing concepts and DSP processors.

Overview of TMS320C54xx and TMS320C67xx /other DSP Starter Kits, Introduction to code composer

studio (CCS), Board support library, Chip support library and Runtime support library, Generating basic signals, Digital filter design, Spectrum analysis, Adaptive filters, Speech and Audio processing applications.

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

- Students will learn the essential advanced topics in DSP that are necessary for successful Postgraduate level research.
- Students will have the ability to solve various types of practical problems in DSP
- Comprehend the DFTs and FFTs, design and Analyze the digital filters, comprehend the Finite word length effects in Fixed point DSP Systems.
- The conceptual aspects of Signal processing Transforms are introduced.
- The comparison on commercial available DSP Processors helps to understand system design through processor interface.
- Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design.

REFERENCES:

1. John. G. Proakis, Dimitris G. Manolakis, "Digital signal processing", Pearson Edu,2002
2. Sen M.Kuo,Woon-Seng S.Gan, "Digital Signal Processors- Pearson Edu,2012
3. Ifeachor E. C., Jervis B. W ,"Digital Signal Processing: A practical approach, Pearson- Education, PHI/2002
4. Shaila D. Apte, " Digital Signal Processing", Second Edition, Wiley,2016.
5. Robert J.Schilling,Sandra L.Harris,"Introd. To Digital Signal Processing with Matlab",Cengage,2014.
6. Steven A. Tretter, "Communication System Design Using DSP Algorithms with Laboratory Experiments for the TMS320C6713™ DSK", Springer,2008.
7. RulphChassaing and Donald Reay, "Digital Signal Processing and Applications with the TMS320C6713 and TMS320C6416 DSK", John Wiley & Sons, Inc., Hoboken, New Jersey, 2008.
8. K.P. Soman and K.L. Ramchandran,Insight into WAVELETS from theory to practice, Eastern Economy Edition,2008
9. B Venkataramani and M Bhaskar **"**Digital Signal Processors**"**, TMH, 2nd,2010
10. Vinay K.Ingle,John G.Proakis,"DSP-A Matlab Based Approach",CengageLearning,2010
11. Taan S.Elali,"Discrete Systems and Digital Signal Processing with Matlab",CRC Press2009.
12. Monson H. Hayes, "Statistical Digital signal processing and modelling", John Wiley & Sons, 2008.
13. Avatar Sing, S. Srinivasan, "Digital Signal Processing- Implementation using DSP Microprocessors with Examples from TMS320C54xx", ThomsonIndia,2004.

EE2207 PYTHON PROGRAMMING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- Students will learn the grammar of Python programming language.
- Students will understand and be able to use the basic programming principles such as data types, variable, conditionals, loops, recursion and function calls.
- Students will learn how to use basic data structures such as List, Dictionary and be able to manipulate text files and images.
- Students will understand the process and will acquire skills necessary to effectively attempt a programming problem and implement it with a specific programming language -Python.

- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

UNIT I INTRODUCTION TO PYTHON 9

Introduction to Python language – Using the interpreter – Python data types and functions – Working with Data – List, Dictionary and Set – Processing Primitives – List comprehensions – File Handling – Object model including Variables, Reference counting, Copying, and Type checking – Error handling.

UNIT II PROGRAM ORGANIZATION AND FUNCTIONS 9

Organize Large programs into functions – Python functions including scoping rules and documentation strings – Modules and Libraries – Organize programs into modules – System administration, Text processing, Sub processes, Binary data handling, XML parsing and Database Access – Installing third-party libraries.

UNIT III CLASSES AND OBJECTS 9

Introduction to Object-oriented programming – Basic principles of Object-oriented programming in Python – Class definition, Inheritance, Composition, Operator overloading and Object creation – Python special modules – Python Object System – Object representation, Attribute binding, Memory management, and Special properties of classes including properties, slots and private attributes.

UNIT IV TESTING, DEBUGGING, AND SOFTWARE DEVELOPMENT PRACTICE 9

Python Software development – Use of documentation string – Program testing using doctest and unit test modules – Effective use of assertions – Python debugger and profiler – Iterators and Generators to set up data processing pipelines – An effective technique for addressing common system programming problems (e.g. processing large datafiles, handling infinite data streams, etc.)

UNIT V TEXT I/O HANDLING 9

Text generation, Template strings and Unicode-packages – Python Integration Primer – Network programming – Accessing C code – Survey on how Python interacts with other language programs.

TOTAL: 45 PERIODS

Note: Class Room Discussions and Tutorials can include the following Guidelines for improved Teaching /Learning Process: Practice through any of Case studies through Exercise/Discussions on Design , Development of embedded solutions with improved programming skill learnt through python that can be adopted while programming on other domains.

COURSE OUTCOMES:

- Students will be able to develop skill in system administration and network programming by learning Python.
- Students will also learn how to effectively use Python's very powerful processing primitives, modeling etc.
- Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design.

REFERENCES:

1. Mark Lutz," Learning Python,PowerfulOOPs,O'reilly,2011
2. Robert Sedgewick,Kevin Wayne ,Robert Dondero,Intr Programming in Python,Pearson,2016.
3. Mark J.Guzdial,Barbara Ericson,"Introduction to Computing & Programming in Python,4th Edition Pearson,2015.
4. Budd, Timothy. Exploring Python. McGraw-Hill science,2009.
5. Guttag, John. Introduction to Computation and Programming Using Python. MIT Press,2013.
   Zelle, John M. Python Programming: An Introduction to Computer Science. 1st ed.Franklin Beedle& Associates,2003

EE2208 EMBEDDED PRODUCT DEVELOPMENT

L	T	P	C
3	0	0	3

OBJECTIVE:

- The course aims at providing the basic concepts of product design, product features and its architecture so that student can have a basic knowledge in the common features a product has and how to incorporate them suitably in product.

UNIT I CONCEPTS OF PRODUCT DEVELOPMENT 12

Need for PD- Generic product Development Process Phases- Product Development Process Flows- Product Development organization structures-Strategic importance of Product Planning process – Product Specifications-Target Specifications-Plan and establish product specifications - integration of customer, designer, material supplier and process planner, Competitor and customer - Understanding customer and behavior analysis. Concept Generation, Five Step Method-Basics of Concept selection- Creative thinking – creativity and problem solving- creative thinking methods- generating design concepts-systematic methods for designing –functional decomposition – physical decomposition

UNIT II INTRODUCTION TO APPROACHES IN PRODUCT DEVELOPMENT 12

Product development management - establishing the architecture - creation - Product Architecture changes - variety – component standardization , clustering -geometric layout development - Fundamental and incidental interactions - related system level design issues - secondary systems - architecture of the chunks - creating detailed interface specifications-Portfolio Architecture- competitive benchmarking- Approach for the benchmarking process-Design for manufacturing - Industrial Design-Robust Design – Prototype basics - Principles of prototyping - Planning for prototypes- Economic & Cost Analysis -Testing Methodologies- Product Branding

UNIT III INDUSTRIAL DESIGN STRATEGIES 6

Role of Integrating CAE, CAD, CAM tools for Simulating product performance and manufacturing processes electronically- Basics on reverse engineering – Reverse engineering strategies – Finding reusable software components – Recycling real-time embedded software based approach and its logical basics- Incorporating reverse engineering for consumer product development –case study on DeskJet Printer

UNIT IV ELECTRONIC PRODUCT DEVELOPMENT STAGES 6

Product Development Stages-Embedded product modeling- Linear, Iterative, Prototyping, Spiral - Selection of Sensor, Voltage Supply, Power supply protection, Grounding and noise elimination methods, Thermal protection with heat management – PCB design steps – Software design and testing method – documentation.

UNIT V EMBEDDED PRODUCTS DESIGN 9

Creating general Embedded System Architecture(with Case study example: Mobile Phone / Desk Jet Printer./ Robonoid as a product) -Architectural Structures- Criteria in selection of Hardware & Software Components, processors, input/output interfaces & connectors, ADC System, Memory, choosing Bus Communication Standards, Criteria in selection of Embedded OS/Device Drivers, Need for Developing with IDE, Translation & Debugging Tools & Application Software, Performance Testing, Costing, Benchmarking, Documentation Note: Class room discussions and tutorials can include the following guidelines for improved teaching /learning process: Term Project/Presentation on specific product design can be given for Assessment

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course the student will be able to

- understand the integration of customer requirements in product design
- Apply structural approach to concept generation, creativity, selection and testing
- Understand various aspects of design such as industrial design, design of Consumer specific product , its Reverse Engineering manufacture ,economic analysis and product architecture
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

REFERENCES

1."Product Design and Development", Anita Goyal, Karl T Ulrich, Steven D Eppinger, McGraw –Hill International Edns.1999/ Tata McGrawEducation,ISBN-10-007-14679-9

2.R.G. Kaduskar and V.B. Baru, " Electronic Product Design", Wiley,2014

3.George E.Dieter, Linda C.Schmidt, "Engineering Design", McGraw-Hill International Edition,4th Edition, 2009, ISBN 978-007-127189-9

4.Stephen Armstrong, Engineering and Product Development Management ; The Holistic Approach, CAMBRIDGE UNIVERSITY PRESS (CUP),2014

5.*Rajkamal, 'Embedded system-Architecture, Programming, Design', TMH,2011.*

6.KEVIN OTTO & KRISTIN WOOD, "Product Design and Development", 4th Edition,2009, Product Design Techniques in Reverse Engineering and New Product Development, , Pearson Education (LPE),2001./ISBN9788177588217

7.Yousef Haik, T. M. M. Shahin, "Engineering Design Process", 2nd Edition Reprint, Cengage Learning, 2010, ISBN 0495668141

8.Clive L.Dym, Patrick Little, "Engineering Design: A Project-based Introduction", 3rd Edition, John Wiley & Sons, 2009, ISBN978-0-470-22596-7

EE2209 AUTOMOTIVE EMBEDDED SYSTEM

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To expose the students to the fundamentals and building of Electronic Engine Control systems.
- To teach on functional components and circuits for vehicles
- To discuss on programmable controllers for vehicles
- To teach logics of automation & commercial techniques for vehicle communication
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

UNIT I BASICS OF ELECTRONIC ENGINE CONTROL SYSTEMS 9

Motivation ,concept for electronic engine controls and management-Standards; introduction to fuel economy- automobile sensors-volumetric, thermal, air-fuel ratio, solenoid ,hall effect- exhaust gas oxygen sensors, Oxidizing catalytic efficiency, emission limits and vehicle performance; advantages of using Electronic engine controls – open and closed loop fuel control; Block diagram of Electronic ignition system and Architecture of a EMS with multi point fuel injection system, Direct injection; programmed ignition-actuators interface to the ECU; starter motors and circuits - sensors interface to the ECU; Actuators and their characteristics – exhaust gas recirculation.

UNIT II FUEL CELL FOR AUTOMOTIVE POWER 9

Fuel cell-Introduction-Proton exchange membrane FC (PEM), Solid oxide fuel cell (SOFC)-properties of fuel cells for vehicles-power system of an automobile with fuel cell based drive, and their characteristics

UNIT III VEHICLE MANAGEMENT SYSTEMS 9

Electronic Engine Control-engine mapping, air/fuel ratio spark timing control strategy, fuel control, electronic ignition-Vehicle cruise control- speed control-anti-locking braking system-electronic suspension - electronic steering , wiper control ; Vehicle system schematic for interfacing with EMS, ECU. Energy Management system for electric vehicles- for sensors, accelerators, brake-Battery management, Electric Vehicles-Electrical loads, power management system-electrically assisted power steering system.

UNIT IV AUTOMOTIVE TELEMATICS 9

Role of Bluetooth, CAN, LIN and flex ray communication protocols in automotive applications; Multiplexed vehicle system architecture for signal and data / parameter exchange between EMS, ECUs with other vehicle system components and other control systems; Realizing bus interfaces for diagnostics, dashboard display ,multimedia electronics- Introduction to Society of Automotive Engineers(SAE). J1850 message with(IFR) in frame response in protocol-Local Interconnect n/w [LI N], Bluetooth.

UNIT V ELECTRONIC DIAGNOSTICS FOR VEHICLES 9

System diagnostic standards and regulation requirements –On board diagnosis of vehicles electronic units &electric units-Speedometer, oil and temperature gauges, and audio system.

Note: Class room discussions and tutorials can include the following guidelines for improved teaching /learning process : Discussions//Practice on Workbench/Exercise/ AUTOSAR/ Vehicle simulators :on the basics of interfacing sensors, actuators to special automobile-microcontrollers, role of Instrumentation software packages / special automobile-microcontrollers for i/o port communication applicable to vehicles

TOTAL:45 PERIODS

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

- Design and develop automotive embedded systems.
- Analyze various embedded products used in automotive industry.
- Evaluate the opportunities involving technology, a product or a service required for developing a startup idea used for automotive applications
- Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design.

REFERENCES:

1. William B. Ribbens ,"Understanding Automotive Electronics",Elseiver,2012
2. Ali Emedi, Mehrded ehsani, John M Miller , "Vehicular Electric power system- land, Sea, Air and Space Vehicles" Marcel Decker,2004.
3. L.Vlacic,M.Parent,F.Harahima,"Intelligent Vehicl Technologies",SAEInternational,2001.

4. Jack Erjavec,Jeff Arias,"Alternate Fuel Technology-Electric ,Hybrid& Fuel Cell Vehicles",Cengage,2012
5. Electronic Engine Control technology – Ronald K Jurgen Chilton's guide to Fuel Injection – Ford 6. Automotive Electricals / Electronics System and Components, Tom Denton,3Edition, 2004.
7. Uwe Kiencke, Lars Nielsen, "Automotive Control Systems: For Engine, Driveline, and Vehicle", Springer; 1 edition, March 30, 2000.
8. Automotive Electricals Electronics System and Components, Robert Bosch Gmbh,2004.
9. Automotive Hand Book, Robert Bosch, Bently Publishers, 1997.

EE2210 RECONFIGURABLE PROCESSOR AND SOC DESIGN

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To introduce the Reconfigurable Processor technologies
- To familiarize the need and role of Reconfigurable Processor for embedded system applications.
- To impart the knowledge of Reconfigurable embedded Processor for real time applications.

UNIT I INTRODUCTION 9

Introduction to reconfigurable processor- Reconfigurable Computing-Programming elements and Programming Tools for Reconfigurable Processors, ASIC design flow- Hardware/Software Codesign- FPAA Architecture overview- recent trends in Reconfigurable Processor & SoC.

UNIT II PROGRAMMABLE LOGIC DEVICES CPLD 9

Introduction to Programmable logic devices, SPLDs, CPLD building blocks- Architectures and features of Altera: MAX 7000, MAX V- Xilinx XC 9500,Cool Runner-II.

UNIT III PROGRAMMABLE LOGIC DEVICES FPGA 9

FPGA architecture overview- Challenges of FPGA processor design-Opportunities of FPGA processor design- Designing Soft Core Processors – Designing Hardcore Processors –hardware/software co simulation- FPGA to multi core embedded computing- FPGA based on-board computer system.

UNIT IV RECONFIGURABLE SOC PROCESSORS 9

SoC Overview –Architecture and applications of Xilinx Virtex II pro ,Zynq-7000, Altera Excalibur, Cyclone V -Triscend A7, E5- Atmel FPSLIC- Multicore SoCs.

UNIT V RECONFIGURABLE PROCESSOR AND SOC APPLICATIONS 9

Reconfigurable processor based DC motor control- digital filter design- mobile phone development- High Speed Data Acquisition -Image Processing application-controller implementation for mobile robot.

Note: Class Room Discussions and Tutorials can include the following Guidelines for improved Teaching /Learning Process: Practice through any of Case studies through Exercise/Discussions on Design , Development of embedded solutions using reconfigurable processor support

TOTAL:45 PERIODS

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

- Adaptability, in its complete strength, is present in reconfigurable processors, which makes it an important IP in modern System-on-Chips (SoCs).
- Reconfigurable processors have risen to prominence as a dominant computing platform across embedded, general-purpose, and high-performance application domains during the last decade

- Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design.

REFERENCES

1. Nurmi,Jari(Ed.) "Processor Design System-On-Chip Computing for ASICs and FPGAs" Springer,2007.
2. Ian Grout , "Digital system design with FPGAs and CPLDs" Elsevier,2008.
3. Joao Cardoso, Michael Hübner, "Reconfigurable Computing: From FPGAs to Hardware/ Software Codesign" Springer, 2011.
4. Ron Sass and Anderew G.Schmidt, " Embedded System design with platform FPGAs: Principles and Practices", Elsevier,2010.
5. Steve Kilts, "Advanced FPGA Design: Architecture, Implementation, and Optimization" Willey, 2007.

EE2301 DIGITALI MAGEPROCESSING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

The objectives of this course to impart knowledge in

- the fundamentals of image processing
- the techniques involved in image enhancement
- the low and high-level features for image analysis
- the fundamentals and significance of image compression
- the hardware for image processing applications

UNIT I FUNDAMENTALS OF IMAGE PROCESSING 9

Introduction to image processing systems, sampling and quantization, color fundamentals and models, image operations – arithmetic, geometric and morphological. Multi-resolution analysis – image pyramids

UNIT II IMAGE ENHANCEMENT 9

Spatial domain; Gray-level transformations – histogram processing – spatial filtering, smoothing and sharpening. Frequency domain: filtering in frequency domain – DFT, FFT, DCT – smoothing and sharpening filters – Homomorphic filtering. Image enhancement for remote sensing images and medical images.

UNIT III IMAGE SEGMENTATION AND FEATURE ANALYSIS 9

Detection of discontinuities – edge operators – edge linking and boundary detection, thresholding – feature analysis and extraction – region based segmentation – morphological watersheds – shape skeletonization, phase congruency. Number plate detection using segmentation algorithm.

UNIT IV IMAGE COMPRESSION 9

Image compression: fundamentals – models – elements of information theory – error free compression – lossy compression – compression standards. Applications of image compression techniques in video and image transmission.

UNIT V EMBEDDED IMAGE PROCESSING 9

Introduction to embedded image processing. ASIC vs FPGA - memory requirement, power consumption, parallelism. Design issues in VLSI implementation of Image processing algorithms - interfacing. Hardware implementation of image processing algorithms: Segmentation and compression

TOTAL: 45 PERIODS

NOTE: Discussions / Exercise / practice on Image enhancement, segmentation and compression with simulation tools such as Matlab/ Raspberry pi (python programming) will help the student understand image processing concepts and hardware implementation using relevant processors

COURSE OUTCOMES:

At the end of the course students will comprehend

- Fundamentals of image processing and techniques involved in image enhancement, segmentation and compression and their real-time applications
- The implementation of image processing applications using software and hardware.

REFERENCES:

1. Rafael C. Gonzalez and Richard E. Woods, "Digital Image processing", 2nd edition, Pearson education,2003
2. Anil K. Jain, "Fundamentals of digital image processing", Pearson education,2003
3. Milan Sonka, ValclavHalavac and Roger Boyle, "Image processing, analysis and machine vision", 2nd Edition, Thomson learning,2001
4. Mark Nixon and Alberto Aguado,"Feature extraction & Image processing for computer vision",3rd Edition, Academic press,2012
5. Donald G. Bailey, "Design for Embedded Image processing on FPGAs" John Wiley and Sons, 2011.

EE2302	EMBEDDED NETWORKING AND AUTOMATION OF ELECTRICAL SYSTEM	L	T	P	C
		3	0	0	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 an instrumentation
- To introduce design of Programmable measurement & control of electrical Devices &grid
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

UNIT I EMBEDDED PROCESS COMMUNICATION WITH INSTRUMENT BUS 9

Embedded Networking: Introduction – Cluster of Instruments in System: introduction to bus protocols, connectors, Bus Architecture & Interfacing of external instruments to – RS 232C,RS – 422, RS 485 and USB standards – embedded ethernet – MOD bus and CAN bus.

UNIT II WIRELESS EMBEDDED NETWORKING 9

Wireless sensor networks – Introduction – Sensor node architecture – Commercially available sensor nodes - Network Topology –Localization –Time Synchronization - Energy efficient MAC protocols – SMAC – Energy efficient and robust routing – Data Centric routing Applications of sensor networks; Applications - Home Control - Building Automation - Industrial Automation

UNIT III BUILDING SYSTEM AUTOMATION 9

Concept of Uc Based & PC based data acquisition – Concept of Virtual Instrumentation - Programming Environment to build a Virtual Instrumentation, Building system automation with graphical user interface programming-Programmable Logic Controllers-introduction-Ladder& Functional Block programming-Case study on Temperature control, Valve sequencing control

UNIT IV MEASUREMENT AND EMBEDDED CONTROL OF ELECTRICAL APPARATUS 9

Sensor Types & Characteristics: Sensing Voltage, Current, flux, Torque, Position, Proximity, Force, Data acquisition & Display system- Signal conditioning circuit design- computers/ embedded processor interfacing circuit -design automation and protection of electrical appliances –processor based digital controllers for switching Actuators: Servo motors, Stepper motors, Relays

UNIT V COMMUNICATION FOR LARGE ELECTRICAL SYSTEM AUTOMATION 9

Data Acquisition, Monitoring, Communication, Event Processing, and Polling Principles, SCADA system principles – outage management– Decision support application for substation automation, extended control feeder automation, Performance measure and response time, SCADA Data Models, need, sources, interface.

NOTE:

Discussions/Exercise/Practice on Workbench /simulators: on the basics interface of sensors, actuators to microcontrollers, role of virtual Instrumentation software packages/ simulators/ special microcontrollers for i/o port communication with electrical loads.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

REFERENCES:

1. Control and automation of electrical power distribution systems, James Northcote-Green, Robert Wilson, CRC, Taylor and Francis,2006
2. Krzysztof Iniewski,"Smart Grid ,Infrastructure &Networking",TMcGH,2012
3. Robert Faludi,"Building Wireless SensorNetworks,O'Reilly,2011
4. W.Bolton,Programmable Logic Controllers,5thEd,Elseiver,2010.
5. Shih-Lin Wu,Yu-Chee Tseng,{"Wireless Ad Hoc Networking,PAN,LAN,SAN,AurebachPub,2012
6. Jan Axelson 'Embedded Ethernet and Internet Complete', Penram publications
7. Bhaskar Krishnamachari, 'Networking wireless sensors', Cambridge press2005
8. Robert H. Bishop, "Learning with Lab-View" Preticee Hall, 2009
9. Sanjay Gupta, "Virtual Instrumentation, LABVIEW", TMH, New Delhi,2003

10. Ernest O. Doeblin and Dhanesh N Manik, " Measrement Systems – Application and Design", 5th Edn, TMH, 2007.

EE2303 SMART SYSTEM DESIGN

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To understand about the smart system technologies and its role in real time applications
- To expose students to different open source platforms and Attributes.
- To familiarize the design and development of embedded system based system design.

UNIT I INTRODUCTION 9

Overview of smart system design and requirements- Hardware and software selection & co-design-Communications-smart sensors and actuators-Open-source resources for embedded system-android for embedded system - Embedded system for Ecommerce- Embedded system for Smart card design and development –Recent trends.

UNIT II MOBILE EMBEDDED SYSTEM 9

Design requirements-Hardware platform- OS and Software development platform- Mobile Apps development- Applications: heart beat monitoring, blood pressure monitoring, mobile banking and appliances control.

UNIT III HOME AUTOMATION 9

Home Automation System Architecture-Essential Components- Linux and Raspberry Pi – design and real time implementation.

UNIT IV SMART APPLIANCES AND ENERGY MANAGEMENT 9

Overview- functional requirements-Embedded and Integrated Platforms for Energy Management-Energy Measurement Techniques for Smart Metering-Smart Embedded Appliances Networks – Security Considerations.

UNIT V EMBEDDED SYSTEMS AND ROBOTICS 9

Robots and Controllers-components - Aerial Robotics -Mobile Robot Design- Three-Servo Ant Robot-Autonomous Hexacopter System.

TOTAL : 45 PERIODS

Note: Class room discussions and tutorials can include the following guidelines for improved teaching /learning process : Discussions on integration of H/W & S/W technology in automation of system/process.

OUTCOMES

- Students will develop more understanding on the concepts of smart system design and its present developments.
- Students will study about different embedded open source and cost effective techniques for developing solution for real time applications.
- Students will acquire knowledge on different platforms and Infrastructure for Smart system design.
- Students will learn the art of implementing embedded system for smart applications and control.

REFERENCES:

1. Thomas Bräunl, Embedded Robotics ,Springer,2003.
2. Grimm, Christoph, Neumann, Peter, Mahlknech and Stefan, Embedded Systems for Smart Appliances and Energy Management , Springer2013.
3. Raj Kamal, *Embedded Systems* - Architecture,. Programming and Design",McGraw-Hill,2008
4. Nilanjan Dey, Amartya Mukherjee, Embedded Systems and Robotics with Open Source Tools, CRC press,2016.
5. Karim Yaghmour, Embedded Android , O'Reilly,2013.
6. Steven Goodwin ,Smart Home Automation with Linux and Raspberry Pi, Apress,2013
7. C.K.Toh, " AdHoc mobile wireless networks", Prentice Hall, Inc,2002.
8. Kazem Sohraby, Daniel Minoli andTaieb Znati, " Wireless Sensor Networks Technology, Protocols, and Applications", John Wiley & Sons,2007.
9. Anna Ha´c, "Wireless Sensor Network Designs", John Wiley & Sons Ltd,2003.
10. Robert Faludi,"Wireless SensorNetworks",O'Reilly,2011.

EE2304 ENTREPRENEURSHIP DEVELOPMENT

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To develop an understanding on business promotion process.
- To expose students on the skills required for success in business.
- To impart embedded system technology based entrepreneurship.

UNIT I BASICS FOR ENTREPRENEURSHIP 9

The entrepreneurial culture and structure-theories of entrepreneurship-entrepreneurial traits- types -behavioural patterns of entrepreneurs -entrepreneurial motivation -establishing entrepreneurial systems - idea processing, personnel, financial information and intelligence, rewards and motivation - concept bank - Role of industrial Fairs.

UNIT II CHALLENGES FOR ENTREPRENEURSHIP 9

Setting quality standards- recruitment strategies- time schedules- Financial analysis - credit facilities- Marketing channel – advertisement- institutions providing technical, financial and marketing assistance- factory design -design requirements -applicability of the Factories Act.

UNIT III RESPONSIBILITIES IN ENTREPRENEURSHIP 9

Steps for starting a small industry -selection of type of organization -Incentives and subsidies - Central Govt. schemes and State Govt. Schemes -incentives to SSI -registration, Registration and Licensing requirements for sales tax, CST, Excise Duty -Power -Exploring export possibilities- incentives for exports -import of

capital goods and raw materials- Entrepreneurship development programmes in India- Role and Improvement in Indian Economy.

UNIT IV SCOPE IN EMBEDDED SYSTEM FIELD 9

Entrepreneurship opportunities in Embedded system technologies - embedded systems design, modeling, Feasibility study on embedded system products- Entrepreneurial skills for embedded system hardware and software architecture, software and hardware co-design and challenges; problems of entrepreneurship in Embedded system field.

UNIT V SCOPE THROUGH EMBEDDED PRODUCTS 9

Embedded system Product development- feature driven development- release management-market pull product search Entrepreneurial case studies: Mobile phone development- automation components-Washing machine- Food Processing system and devices- High Performance embedded computers- Industrial Controllers.

Note: Class room discussions and tutorials can include the following guidelines for improved teaching /learning process: Discussions with Case studies on establishing entrepreneurial development through Government supported schemes for utilizing technology.

TOTAL: 45 PERIODS

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

- Manage people, processes, and resources within a diverse organization.
- Apply knowledge of leadership concepts in an integrated manner.
- Analyze the internal/external factors affecting a business/organization to evaluate business opportunities.
- demonstrate extemporaneous speaking skills developed through in-class discussion of text materials, case study analyses, and current entrepreneurship-related issues.
- demonstrate basic computer proficiency, including the use of word processing, presentation, and spreadsheet software packages, as well as a basic facility with the internet and other research tools.
- Key concepts underpinning entrepreneurship and its application in the recognition and exploitation of product/ service/ process opportunities
- Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design.

REFERENCES

1.Kuratko, Enmterpreneurship : A Contemporary Approach, Thomson Learning,2001.
2.Thomas Zimmerer et.al., Essentials of Entrepreneurship and small business Management 3rd Ed. Pearson Education,2002.
3.Greene, Entrepreneurship: Ideas in Action, Thomson Learning, Mumbai,2000
4.Jeffry Timmons, New Ventrure creation, McGraw Hill,1999.
5.Gupta and Smivasan, Entrepreneurial Development, New Delhi, Sultan Chand,1992
6.LyLa B. Das "Embedded Systems: An Integrated Approach" Pearson,2013
7.James K.peckol ," Embedded Systems: A contemporary Design Tool",Wiley,2014

EE2305 NANO ELECTRONICS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To introduce the properties of electron and its implication for electronics
- To teach the importance and the issues of Nanoscale CMOS technology.
- To introduce the characteristics and applications of nano electronic devices, nano fabrication methods and techniques.
- To teach the circuits and architectural features of nano memory 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 INTRODUCTION 12

Particles, waves, Wave mechanics, schrodinger equation, free and confined electrons, particle statistics and density of states. Electron transport in semiconductors and nanostructures, Quantum dots, Quantum Well, Quantum wire , materials and its properties, Ballistic electron transport, 1D transport , Spin electronics- Electrical and Electronics Applications of Nanotechnology.

UNIT II NANO SCALE CMOS 9

Survey of modern electronics and trends towards nano electronics CMOS scaling, challenges and limits, static power, device variability, interconnect - CNT-FET, HEMT , pHEMT FinFET, FerroFET- nanoscale CMOS ciruit design and analysis.

UNIT III NANO ELECTRONIC STRUCTURE AND DEVICES. 9

Resonant-tunneling diodes- Resonant Tunneling Transistor-Single-electron transfer devices-Potential effect transistors- Quantum-dot cellular automata, Nano Photonic Devices-Molecular electronic devices -Nano-electromechanical system devices.

UNIT IV NANO ELECTRONIC MEMORIES 6

Nano tube for memories- Nano RAM- Nanoscale DRAM, SRAM, Tunnel magnetoresistance-Giant magnetoresistance- design and applications.

UNIT V FABRICATION TECHNIQUES 9

Clean room standards-Microfabrication –nanofabrication- nanofabrication issues- E-beam lithography- X-ray and ion-beam lithography- nanoimprint lithography- Scanning probe lithography- dip-pen nanolithography- Nano-characterization techniques.

Note: Class room discussions and tutorials can include the following guidelines for improved teaching /learning process: Discussions/Practice on Workbench : on modelling of nano/micro analog &digital devices.

TOTAL : 45 PERIODS

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

- Students will understand the divers electronic device fabrication.
- The students should be able to understand basic and advanced concepts of nano electronic devices, sensors and transducers and their applications in nanotechnology
- The concepts of a quantum well, quantum transport and tunneling effects.
- Understand the impact of nano electronics onto information technology, communication and computer science.

- Design integrated circuits (microchip) using state-of-the-art CMOS technology
- The learning process delivers insight into categorizing various nano configurations of computational processors with improved design strategies.
- Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design.

REFERENCES:

1. Hagelstein, Peter L., Stephen D. Senturia, and Terry P. Orlando, "Introduction to Applied Quantum and Statistical Physics.", New York, NY: Wiley,2004.
2. Rainer Waser, "Nanoelectronics and Information Technology", Wiley2005
3. Michael A. Nielsen and Isaac L. Chuang, "Quantum Computation and Quantum Information", Cambridge University Press,2000.
4. Adrian Ionesu and Kaustav Banerjee eds." Emerging Nano electronics: Life with and after CMOS" , Vol I, II, and III, Kluwer Academic,2005.
5. Kiyoo Itoh Masashi Horiguchi ,Hitoshi Tanaka, Ultra Low voltage nano scale memories. Spl Indian Edition,Springer.
6. George W. Hanson, Fundamental of nanoelectronics, Pearson education.

EE2306 DISTRIBUTED EMBEDDED COMPUTING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To expose the students to the fundamentals of Network communication technologies and distributed computing.
- To teach the fundamentals of Internet
- To study on Java based Networking and distributed computing
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

UNIT I DISTRIBUTED SYSTEM 9

Introduction- Communication in distribution system-Client/Server Model-Synchronization in distributed system

UNIT II EMBEDDED JAVA 9

Overview of JAVA – Programs- Multithreaded programming- APPLET programming- I/O streaming- RMI-Introduction to Embedded JAVA

UNIT III DISTRIBUTED COMPUTING 9

Definition- Model of distributed computation- Distributed shared memory- Authentication in distributed system

UNIT IV SECURITY IN COMPUTING 9

Security meaning- Threads in networks- Network security control- Firewall- Authentication- E-mail security-Security in web services- Case studies

UNIT V WEB BASED HOME AUTOMATION 9

Components of Distributed Embedded - Protocols & Standards - Hardware/Software selection for Distributed Embedded – case study : Web based Home Automation

Note: Class room discussions and tutorials can include the following guidelines for improved teaching /learning process: Class room discussions and tutorials can include the following guidelines for improved teaching /learning process :Discussions/Practice on Workbench : Program Development and practice in exercises with XML/HTML/Java Programming Environments.

TOTAL: 45 PERIODS

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

- Able to apply knowledge from undergraduate engineering and other disciplines to identify, formulate, solve novel advanced electronics engineering along with soft computing problems that require advanced knowledge within the field.
- Able to understand and integrate new knowledge within the field and advanced technical knowledge in multiple contexts.
- Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design.

REFERENCES:

1. Andrew S. Tanenbaum, "Distributed operating systems", Pearson2013
2. E Balagurusamy," Programming with JAVA", Mc Graw Hill2013
3. Ajay D Kshemkalyani,Mukesh Singhal, "Distributed Computing" – Principles, Algorithm and systems, Cambridge university press2008
4. Charles P. Pfleeger, "Security in Computing", Pearson2009.

EE2307 SMART GRID

L	T	P	C
3	0	0	3

OBJECTIVES:

- To Study about Smart Grid technologies, different smart meters and advanced metering infrastructure.
- To familiarize the power quality management issues in Smart Grid.
- To familiarize the high performance computing for Smart Grid applications

UNIT I INTRODUCTION TO SMART GRID 9

Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, functions, opportunities, challenges and benefits, Difference between conventional & Smart Grid, National and International Initiatives in Smart Grid.

UNIT II SMART GRID TECHNOLOGIES 9

Technology Drivers, Smart energy resources, Smart substations, Substation Automation, Feeder Automation ,Transmission systems: EMS, FACTS and HVDC, Wide area monitoring, Protection and control, Distribution systems: DMS, Volt/Var control, Fault Detection, Isolation and service restoration, Outage management, High-Efficiency Distribution Transformers, Phase Shifting Transformers, Plug in Hybrid Electric Vehicles (PHEV).

UNIT III SMART METERS AND ADVANCED METERING INFRASTRUCTURE 9

Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Phasor Measurement Unit(PMU), Intelligent Electronic Devices (IED) & their application for monitoring & protection.

UNIT IV POWER QUALITY MANAGEMENT IN SMART GRID 9

Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.

UNIT V HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS 9

Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broadband over Power line (BPL), IP based Protocols, Basics of Web Service and CLOUD Computing to make Smart Grids smarter, Cyber Security for Smart Grid.

TOTAL: 45 PERIODS

OUTCOMES:

- Learners will develop more understanding on the concepts of Smart Grid and its present developments.
- Learners will study about different Smart Grid technologies.
- Learners will acquire knowledge about different smart meters and advanced metering infrastructure.
- Learners will have knowledge on power quality management in Smart Grids

- Learners will develop more understanding on LAN, WAN and Cloud Computing for Smart Grid applications.

REFERENCES

1. Stuart Borlase "Smart Grid :Infrastructure, Technology and Solutions", CRC Press2012.
2. Janaka Ekanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, "Smart Grid: Technology and Applications", Wiley2012.
3. Vehbi C. Güngör, DilanSahin, TaskinKocak, Salih Ergüt, Concettina Buccella, Carlo Cecati, and Gerhard P. Hancke, "Smart Grid Technologies: Communication Technologies and Standards" IEEE Transactions On Industrial Informatics, Vol. 7, No. 4, November2011.
4. Xi Fang, Satyajayant Misra, Guoliang Xue, and Dejun Yang "Smart Grid – The New and Improved Power Grid: A Survey" , IEEE Transaction on Smart Grids, vol. 14,2012.

EE2308 ELECTRIC VEHICLES AND POWER MANAGEMENT

L	T	P	C
3	0	0	3

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 PERIODS

OUTCOMES:

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, Inc2010

		L	T	P	C
EE2309	**SOFT COMPUTING AND OPTIMIZATION TECHNIQUES**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

- The main objectives of this course is to make the students
- Understand the fundamental concepts of soft computing, artificial neural networks and optimization techniques
- Familiarize with recent advancements in Artificial neural networks and optimization techniques

UNIT I INTRODUCTION TO SOFT COMPUTING AND NEURAL NETWORKS 9

Introduction to soft computing: soft computing vs. hard computing – various types of soft computing techniques, from conventional AI to computational intelligence, applications of soft computing.

Fundamentals of neural network: biological neuron, artificial neuron, activation function, single layer perceptron – limitations. Multi-layer perceptron – back propagation algorithm.

UNIT II ARTIFICIAL NEURAL NETWORKS 9

Radial basis function networks – reinforcement learning. Hopfield / recurrent network – configuration – stability constraints, associative memory and characteristics, limitations and applications. Hopfield vs. Boltzmann machine. Advances in neural networks – convolution neural networks. Familiarization of Neural network toolbox.

UNIT III FUZZY LOGIC AND NEURO FUZZY SYSTEMS 9

Fundamentals of fuzzy set theory: fuzzy sets, operations on fuzzy sets, scalar cardinality, union and intersection, complement, equilibrium points, aggregation, projection, composition. Fuzzy membership functions. Fundamentals of neuro-fuzzy systems – ANFIS. Familiarization of ANFIS Toolbox.

UNIT IV INTRODUCTION TO OPTIMIZATION TECHNIQUES 9

Classification of optimization problems – classical optimization techniques. Linear programming – simplex algorithm. Non-linear programming – steepest descent method, augmented Lagrange multiplier method – equality constrained problems.

UNIT V ADVANCED OPTIMIZATION TECHNIQUES 9

Simple hill climbing algorithm, Steepest ascent hill climbing – algorithm and features. Simulated annealing – algorithm and features. Genetic algorithm: working principle, fitness function. Familiarization with Optimization Toolbox.

Note: Class room discussions and tutorials can include the following guidelines for improved teaching /learning process : Discussions/Practice on Workbench : on role of Fuzzy, Neural ,Genetic algorithms and Concepts in design of intelligent systems.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course students will

- Comprehend the fundamentals of artificial neural network, fuzzy systems and optimization techniques
- Understand the significance of various optimization algorithms applied to engineering problems.
- Be capable of developing ANN-based models
- Be capable of choosing appropriate optimization techniques for engineering applications.

REFERENCES:

1. Laurene V. Fausett, "Fundamentals of neural networks, architecture, algorithms and applications, Pearson Education,2008.
2. Jyh-Shing Roger Jang, Chuen-Tsai Sun, EijiMizutani, "Neuro-Fuzzy and soft computing",Prentice Hall of India,2003.
3. Simon Haykin, "Neural Networks – A comprehensive foundation", Pearson Education,2005.
4. David E. Goldberg, "Genetic algorithms in search, optimization and machine learning", Pearson Education,2009.
5. Singiresu S. Rao, "Engineering Optimization – Theory and Practice", 4th edition, John Wiley & Sons,2009.
6. Thomas Weise, "Global Optimization algorithms – Theory and applications", self-published, 2009

	L	T	P	C
EE2310 WIRELESS AND MOBILE COMMUNICATION	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

- To expose the students to the fundamentals of wireless communication technologies.
- To teach the fundamentals of wireless mobile network protocols
- To study on wireless network topologies
- To introduce network routing protocols
- To study the basis for classification of commercial family of wireless communication technologies

UNIT I INTRODUCTION 9

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

UNIT II MOBILE NETWORKS 9

Cellular Wireless Allocation Networks – GSM – Architecture – Protocols – Connection Establishment – Frequency – 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 – Multicast Routing - WSN routing – LEACH- SPIN- PEGASIS

UNIT V TRANSPORT AND APPLICATION LAYERS 9

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

Note: Class room discussions and tutorials can include the following guidelines for improved teaching /learning process : Discussions on wireless technology ,its integration for multi system by networked communication.

TOTAL : 45 PERIODS

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

- Knowledge of basic and advanced theories on wireless communications systems in physical, link and network layer.
- Ability to understand, model, and design mobile networks.
- Ability to understand and apply mathematically model in wireless communications.
- Wireless communication transceiver algorithm design
- Mobile system design methodology, link level simulation for wireless communications.
- Fundamentals of mobile communication including various propagation path loss models under different operating conditions and their impact on received signal strength
- The learning process delivers insight into categorizing various embedded & communication protocols for networking of distributed static & mobile systems.

REFERENCES:

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.

EE2311 CRYPTOGRAPHY AND NETWORK SECURITY

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To expose the students to the fundamentals of data security.
- To teach the fundamentals of mathematical aspects in creating Encryption keys
- To teach the fundamentals of Security in data& wireless communication.
- To teach the fundamentals of Secured system operation.
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

UNIT I SYMMETRIC CIPHERS 9

Overview – classical Encryption Techniques – Block Ciphers and the Data Encryption standard – Introduction to Finite Fields – Advanced Encryption standard – Contemporary, Symmetric Ciphers – Confidentiality using Symmetric Encryption.

UNIT II PUBLIC-KEY ENCRYPTION AND HASH FUNCTIONS 9

Introduction to Number Theory – Public-Key Cryptography and RSA – Key Management – Diffie-HellmanKeyExchange–EllipticCurveCryptography–MessageAuthenticationandHashFunctions
Hash Algorithms – Digital Signatures and Authentication Protocols

UNIT III NETWORK SECURITY PRACTICE 9

Authentication Applications – Kerberos – X.509 Authentication Service – Electronic mail Security – Pretty Good Privacy – S/MIME – IP Security architecture – Authentication Header – Encapsulating Security Payload – Key Management.

UNIT IV SYSTEMS ECURITY 9

Intruders – Intrusion Detection – Password Management – Malicious Software – Firewalls – Firewall Design Principles – Trusted Systems.

UNIT V WIRELESS SECURITY 9

Introduction to Wireless LAN Security Standards – Wireless LAN Security Factors and Issues.

Note: Class room discussions and tutorials can include the following guidelines for improved teaching /learning process :Discussions/Exercise/Practice on Workbench : on the basics /numerical design aspects of encryption ,decryption keys/password creation etc

TOTAL: 45 PERIODS

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

- Identify the major types of threats to information security and the associated attacks, understand how security policies, standards and practices are developed.
- Describe the major types of cryptographic algorithms and typical applications, write code to encrypt and decrypt information using some of the standard algorithms
- To be exposed to original research in network security and master information security governance, and related legal and regulatory issues
- The learning process delivers insight onto role of security aspects during data transfer and communication in systems like grid.
- Improved Employability and entrepreneurship capacity due to knowledge upgradation on recent trends in embedded systems design.

REFERRENCES:

1. William Stallings, "Cryptography And Network Security – Principles And Practices", Pearson Education, 3rd Edition,2003.
2. Atul Kahate, "Cryptography and Network Security", Tata McGraw Hill,2003.
3. Natalia Olifer and Victor Olifer,"Computer Networks principles.technologies and protocols for network design", Wiley,2015
4. Bruce Schneier, "Applied Cryptography", John Wiley and Sons Inc,2001.
5. Stewart S. Miller, "Wi-Fi Security", McGraw Hill,2003.
6. Charles B. Pfleeger, Shari Lawrence Pfleeger, "Security In Computing", 3rd Edition, Pearson Education,2003.
7. Mai, "Modern Cryptography: Theory and Practice", First Edition, Pearson Education,2003.

EE2312 ROBOTICS AND CONTROL

L	T	P	C
3	0	0	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 PERIODS

OUTCOMES:

- 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
- Abiilty 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 MacGraw 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.