ANNA UNIVERSITY, CHENNAI
UNIVERSITY DEPARTMENTS
REGULATIONS – 2015
CHOICE BASED CREDIT SYSTEM
M.E. EMBEDDED SYSTEM TECHNOLOGIES

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs) :

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 of societal importance.
3) To provide opportunity for students to work as part of teams on multi disciplinary projects.
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 life long learning and to introduce them to professional ethics and codes of professional practice.

PROGRAMME OUTCOMES (POs):

a) To Offer the P.G Program in Embedded System Technology with imparting domain knowledge in Electrical circuits, electronic devices ; computer science 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 as role of electronics, computer science, communication engineering for electrical applications.

d) Be able to identify problems in major issues of Electrical Systems , analyse problems, co-ordinate 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							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
I	✓	✓			✓	✓		
II				✓	✓	✓	✓	
III					✓		✓	✓
IV	✓	✓	✓			✓		✓
V					✓	✓		✓

			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
YEAR 1	SEM 1	Applied Mathematics for Electrical Engineers	✓		✓		✓			
		Design of Embedded Systems		✓	✓	✓	✓	✓		
		Advanced Digital Principles and Design	✓	✓	✓	✓				
		Microcontroller Based System Design	✓	✓	✓	✓				
		Elective I								
	SEM 2	Real Time Operating System	✓	✓	✓	✓				
		Software for Embedded Systems		✓	✓	✓	✓	✓		
		Wireless and Mobile Communication	✓	✓	✓	✓				
		RISC Processor Architecture and Programming		✓	✓	✓	✓	✓		
		Elective II								
		Elective III								
		Embedded System Technology Laboratory		✓	✓	✓	✓	✓		✓
		Technical Seminar		✓	✓	✓	✓	✓		✓
YEAR 2	SEM 3	Distributed Embedded Computing	✓	✓	✓	✓				
		Elective IV								
		Elective V								
		Project Work Phase I		✓	✓	✓	✓	✓		✓
	SEM 4	Project Work Phase II		✓	✓	✓	✓	✓		✓

ANNA UNIVERSITY, CHENNAI
UNIVERSITY DEPARTMENTS
REGULATIONS – 2015
CHOICE BASED CREDIT SYSTEM
M.E. EMBEDDED SYSTEM TECHNOLOGIES

CURRICULA AND SYLLABI I TO IV SEMESTERS

SEMESTER - I

S.No	Course Code	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA7156	Applied Mathematics for Electrical Engineers	FC	4	4	0	0	4
2.	ET7101	Design of Embedded Systems	PC	3	3	0	0	3
3.	ET7151	Advanced Digital Principles and Design	PC	4	4	0	0	4
4.	ET7152	Microcontroller Based System Design	PC	4	4	0	0	4
5.		Elective I	PE	3	3	0	0	3
			TOTAL	**18**	**18**	**0**	**0**	**18**

SEMESTER - II

S.No	Course Code	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	ET7201	RISC Processor Architecture and Programming	PC	4	4	0	0	4
2.	ET7202	Wireless and Mobile Communication	PC	4	4	0	0	4
3.	ET7251	Real Time Operating System	PC	3	3	0	0	3
4.	ET7252	Software for Embedded Systems	PC	4	4	0	0	4
5.		Elective II	PE	3	3	0	0	3
6.		Elective III	PE	3	3	0	0	3
PRACTICALS								
7.	ET7211	Embedded System Technology Laboratory	PC	4	0	0	4	2
8.	ET7212	Technical Seminar	EEC	2	0	0	2	1
			TOTAL	**27**	**21**	**0**	**6**	**24**

SEMESTER III

S.No	Course Code	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	ET7351	Distributed Embedded Computing	PC	3	3	0	0	3
2.		Elective IV	PE	3	3	0	0	3
3.		Elective V	PE	3	3	0	0	3
PRACTICALS								
4.	ET7311	Project Work Phase I	EEC	12	0	0	12	6
			TOTAL	**21**	**9**	**0**	**12**	**15**

SEMESTER IV

Sl. No	Course Code	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
PRACTICALS								
1.	ET7411	Project Work Phase II	EEC	24	0	0	24	12
			TOTAL	**24**	**0**	**0**	**24**	**12**

TOTAL NO. OF CREDITS: 69

ANNA UNIVERSITY, CHENNAI
UNIVERSITY DEPARTMENTS
REGULATIONS – 2015
CHOICE BASED CREDIT SYSTEM
M.E. EMBEDDED SYSTEM TECHNOLOGIES (PART TIME)

CURRICULA AND SYLLABI I TO VI SEMESTERS

SEMESTER - I

S.No	Course Code	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA7156	Applied Mathematics for Electrical Engineers	FC	4	4	0	0	4
2.	ET7151	Advanced Digital Principles and Design	PC	4	4	0	0	4
3.	ET7152	Microcontroller Based System Design	PC	4	4	0	0	4
			TOTAL	**12**	**12**	**0**	**0**	**12**

SEMESTER - II

S.No	Course Code	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	ET7201	RISC Processor Architecture and Programming	PC	4	4	0	0	4
2.	ET7202	Wireless and Mobile Communication	PC	4	4	0	0	4
3.	ET7252	Software for Embedded Systems	PC	4	4	0	0	4
			TOTAL	**12**	**12**	**0**	**0**	**12**

SEMESTER - III

S.No	Course Code	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.								
2.	ET7101	Design of Embedded Systems	PC	3	3	0	0	3
3.		Elective I	PE	3	3	0	0	3
4.		Elective II	PE	3	3	0	0	3
			TOTAL	**9**	**9**	**0**	**0**	**9**

SEMESTER - IV

S.No	Course Code	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	ET7251	Real Time Operating System	PC	3	3	0	0	3
2.		Elective – III	PE	3	3	0	0	3
PRACTICALS								
3.	ET7211	Embedded System Technology Laboratory	PC	4	0	0	4	2
4.	ET7212	Technical Seminar	EEC	2	0	0	2	1
			TOTAL	**12**	**6**	**0**	**6**	**9**

SEMESTER - V

S.No	Course Code	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	ET7351	Distributed Embedded Computing	PC	3	3	0	0	3
2.		Elective IV	PE	3	3	0	0	3
3.		Elective V	PE	3	3	0	0	3
PRACTICALS								
4.	ET7311	Project Work Phase I	EEC	12	0	0	12	6
			TOTAL	**21**	**9**	**0**	**12**	**15**

SEMESTER - VI

Sl. No	Course Code	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
PRACTICALS								
1.	ET7411	Project Work Phase II	EEC	24	0	0	24	12
			TOTAL	**24**	**0**	**0**	**24**	**12**

TOTAL NO. OF CREDITS: 69

FOUNDATION COURSES (FC)

S.No	Course Code	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.		Applied Mathematics for Electrical Engineers	FC	4	4	0	0	4

PROFESSIONAL CORE (PC)

S.No	Course Code	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.		Design of Embedded Systems	PC	3	3	0	0	3
2.		Advanced Digital Principles and Design	PC	4	4	0	0	4
3.		Microcontroller Based System Design	PC	4	4	0	0	4
4.		Real Time Operating System	PC	3	3	0	0	3
5.		Software for Embedded Systems	PC	4	4	0	0	4
6.		Wireless and Mobile Communication	PC	4	4	0	0	4
7.		RISC Processor Architecture and Programming	PC	4	4	0	0	4
8.		Distributed Embedded Computing	PC	3	3	0	0	3
9.		Embedded System Technology Laboratory	PC	4	0	0	4	2

PROFESSIONAL ELECTIVES (PE)

S.No	Course Code	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	ET7001	Ad Hoc Networks	PE	3	3	0	0	3
2.	ET7002	Adv Computer Architecture and Parallel Processing	PE	3	3	0	0	3
3.	ET7005	Embedded Linux	PE	3	3	0	0	3
4.	ET7004	Design of Automobile Embedded System	PE	3	3	0	0	3
5.	CO7152	Soft Computing Techniques	PE	3	3	0	0	3
6.	ET7074	MEMS Technology	PE	3	3	0	0	3
7.	ET7003	Advanced Embedded Systems	PE	3	3	0	0	3
8.	ET7073	Digital Instrumentation	PE	3	3	0	0	3
9.	ET7006	Embedded Networking and Automation of Electrical System	PE	3	3	0	0	3
10.	ET7008	Nano Electronics	PE	3	3	0	0	3
11.	ET7010	Pervasive Devices and Technology	PE	3	3	0	0	3
12.	ET7007	Embedded Product Development	PE	3	3	0	0	3
13.	PW7251	SCADA System and Applications Management	PE	3	3	0	0	3
14.	HV7072	Design of Substations	PE	3	3	0	0	3
15.	PS7071	Distributed Generation and Micro Grid	PE	3	3	0	0	3
16.	PW7351	Energy Management and Auditing	PE	3	3	0	0	3
17.	ET7071	Advanced Digital Signal Processing	PE	3	3	0	0	3
18.	PS7073	Optimisation Techniques	PE	3	3	0	0	3
19.	PS7074	Solar and Energy Storage System	PE	3	3	0	0	3
20.	PS7075	Wind Energy Conversion System	PE	3	3	0	0	3
21.	PS7255	Smart Grids	PE	3	3	0	0	3
22.	PW7072	Electric Vehicles and Power Management	PE	3	3	0	0	3
23.	ET7013	Security in Networks and Cryptography	PE	3	3	0	0	3
24.	ET7072	Digital Image Processing	PE	3	3	0	0	3
25.	CO 7073	Robotics and Control	PE	3	3	0	0	3

26.	ET7012	Real Time Systems	PE	3	3	0	0	3
27.	ET7075	VLSI Based Design Methodologies	PE	3	3	0	0	3
28.	CO7072	Multi Sensor Data Fusion	PE	3	3	0	0	3
29.	ET7009	Open Source Software	PE	3	3	0	0	3
30.	ET7011	Python Programming	PE	3	3	0	0	3
31.	ET7014	Web Technologies And Trends	PE	3	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S.No	Course Code	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.		Technical Seminar	EEC	2	0	0	2	1
2.		Project Work Phase I	EEC	12	0	0	12	6
3.		Project Work Phase II	EEC	24	0	0	24	12

MA7156 APPLIED MATHEMATICS FOR ELECTRICAL ENGINEERS LT P C
4 0 0 4

OBJECTIVES:

- To develop the ability to apply the concepts of Matrix theory and Linear programming in Electrical Engineering problems.
- To achieve an understanding of the basic concepts of one dimensional random variables and apply in electrical engineering problems.
- To familiarize the students in calculus of variations and solve problems using Fourier transforms associated with engineering applications..

UNIT I MATRIX THEORY 12

The Cholesky decomposition - Generalized Eigen vectors, Canonical basis - QR factorization - Least squares method - Singular value decomposition

UNIT II CALCULUS OF VARIATIONS 12

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

UNIT III ONE DIMENSIONAL RANDOM VARIABLES 12

Random variables - Probability function – moments – moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Function of a Random Variable

UNIT IV LINEAR PROGRAMMING 12

Formulation – Graphical solution – Simplex method – 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 – Eigen value problems and orthogonal functions – Regular Sturm-Liouville systems – Generalized Fourier series

TOTAL: 60 PERIODS

BOOKS FOR STUDY:

1. Richard Bronson, "Matrix Operation", Schaum's outline series, 2nd Edition, McGraw Hill, 2011.
2. Gupta, A.S., Calculus of Variations with Applications, Prentice Hall of India Pvt. Ltd., New Delhi, 1997.
3. Oliver C. Ibe, "Fundamentals of Applied Probability and Random Processes, Academic Press, (An imprint of Elsevier), 2010.
4. Taha, H.A., "Operations Research, An introduction", 10th edition, Pearson education, New Delhi, 2010.
5. Andrews L.C. and Phillips R.L., Mathematical Techniques for Engineers and Scientists, Prentice Hall of India Pvt.Ltd., New Delhi, 2005.

REFERENCES
1. Elsgolts, L., Differential Equations and the Calculus of Variations, MIR Publishers, Moscow, 1973.
2. Grewal, B.S., Higher Engineering Mathematics, 42nd edition, Khanna Publishers, 2012.
3. O'Neil, P.V., Advanced Engineering Mathematics, Thomson Asia Pvt. Ltd., Singapore, 2003.
4. Johnson R. A. and Gupta C. B., "Miller & Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 7th Edition, 2007.

ET7101 DESIGN OF EMBEDDED SYSTEMS L T P C
3 0 0 3

COURSE OBJECTIVE
- To teach the fundamentals of Embedded processor Modeling , Bus Communication in processors, Input/output interfacing
- To introduce on processor scheduling algorithms , Basics of Real time operating system
- To discuss on aspects required in developing a new embedded processor, different Phases & Modeling of embedded system
- 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 EMBEDDED SYSTEMS 12

Introduction to Embedded Systems – The build process for embedded systems- Structural units in Embedded processor , selection of processor & memory devices- DMA – Memory management methods- Timer and Counting devices, Watchdog Timer, Real Time Clock- Software Development tools-IDE, assembler, compiler, linker, simulator, debugger, In circuit emulator, Target Hardware Debugging, need for Hardware-Software Partitioning, Co-Design.

UNIT II EMBEDDED NETWORKING AND INTERRUPTS SERVICE MECHANISM 6

Embedded Networking: Introduction, I/O Device Ports & Buses– Serial Bus communication protocols -RS232 standard – RS485 –USB- CAN Bus – Inter Integrated Circuits (I^2C) – interrupt sources ,Programmed-I/O busy-wait approach without interrupt service mechanism-ISR concept-– multiple interrupts – context and periods for context switching, interrupt latency and deadline – Device Driver – Introduction to Basic Concept of Parallel port & Serial port Device Drivers.

UNIT III RTOS BASED EMBEDDED SYSTEM DESIGN 9

Introduction to basic concepts of RTOS- Need, Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Preemptive and non-preemptive scheduling, Task communication-shared memory, message passing-, Interprocess Communication – synchronization between processes-semaphores, Mailbox, pipes, priority inversion, priority inheritance, comparison of Real time Operating systems: VxWorks, чC/OS-II, RT Linux

UNIT IV FUNDAMENTALS OF UML 9

Overview of UML, Scope of UML, Conceptual model of UML, Architectural – Metamodel, Unified Software Development Lifecycle-UML Diagram- Timing ,Task Diagram Modeling techniques - structural, Behavioral, Activity Diagrams-simple patterns

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UNIT V EMBEDDED SYSTEM APPLICATION DEVELOPMENT 9

Objective, Need, different Phases & Modeling of the EDLC-choice of Target Architectures for Embedded Application Development-for Control Dominated-Data Dominated Systems-Case studies on Digital Camera, Adaptive Cruise control in a Car, Mobile Phone software for key inputs.

NOTE
Practice through any of Case studies through Exercise/Discussions on Design, Development & Product Manufacturing Processes' of embedded Products like : Digital Camera /Adaptive Cruise control in a Car /Mobile Phone / Automated Robonoid

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- The learning process delivers insight into design & development of computational processors & automated process with improved design strategies.
- Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design.

REFERENCES

1. Rajkamal, 'Embedded system-Architecture, Programming, Design', TMH,2011.
2. Peckol, "Embedded system Design",JohnWiley&Sons,2010
3. Lyla B Das," Embedded Systems-An Integrated Approach",Pearson2013
4. Elicia White,"Making Embedded Systems",O'Reilly Series,SPD,2011
5. Bruce Powel Douglass,"Real-Time UML Workshop for Embedded Systems,Elsevier,2011
6. MichaelBlaha and James Rambaugh," Oriented Modeling and Design wih UML"
7. Jorgen Staunstrup, Wayne Wolf, "Harware/Software Co-Design:Principles and Practice", Kluwer Academic Pub, 1997.
8. Shibu.K.V, "Introduction to Embedded Systems", TataMcgraw Hill,2009
9. Tammy Noergaard, "Embedded System Architecture, A comprehensive Guide for Engineers and Programmers", Elsevier, 2006
10. Jonathan W.Valvano,"Embedded Microcomputer Systems ,Real Time Interfacing",Cengage Learning,3rd edition,2012

ET7151 ADVANCED DIGITAL PRINCIPLES AND DESIGN L T P C
4 0 0 4

COURSE OBJECTIVES

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

UNIT I SEQUENTIAL CIRCUIT DESIGN 12

Analysis of Clocked Synchronous Sequential Networks (CSSN) Modelling of CSSN – State Stable 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 Vending Machine Controller

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 SYNCHRONOUS DESIGN USING PROGRAMMABLE DEVICES 12

Programming Techniques - Re-Programmable Devices Architecture- Function blocks, I/Oblocks, Interconnects, Realize combinational, Arithmetic, Sequential Circuit with Programmable Array Logic; Architecture and application of Field Programmable Logic Sequence**.**

UNIT V ARCHITECTURES AND PROGRAMMING PROGRAMMABLE LOGIC DEVICES 12

Architecture of EPLD, Programmable Electrically Erasable Logic – Xilinx FPGA – Xilinx 2000 - Xilinx 4000 family.

NOTE

Discussions/Practice on Workbench : Logic Synthesis And Simulation for digital design with VHDL, hierarchical modeling concepts, modules and port definitions, gate level modeling, data flow modeling, behavioral modeling task & functions, logic synthesis-simulation-Design examples, Ripple carry Adders, Carry Look ahead adders, Design of Arithmetic circuits for Fast adder, Array Multiplier, ALU, Shift Registers, Multiplexer, Comparator/other examples on Test Bench.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

- The learning process delivers insight into incorporating switching logics,with improved design strategies. Error free circuitry design of computation logics of processors.
- Improved Employability and entrepreneurship capacity due to knowledge upgradation on recent 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. Charles H. Roth Jr., “Digital Systems design using VHDL”, Cengage Learning, 2010.
4. Mark Zwolinski, “Digital System Design with VHDL”, Pearson Education, 2004
5. Parag K Lala, “Digital System design using PLD”, BS Publications, 2003
6. John M Yarbrough, “Digital Logic applications and Design”, Thomson Learning,2001
7. Nripendra N Biswas, “Logic Design Theory”, Prentice Hall of India, 2001
8. Charles H. Roth Jr., “Fundamentals of Logic design”, Thomson Learning, 2004.
9. John V.Oldfeild,Richard C.Dorf,”Field Programmable Gate Arrays”,Wiley India Edition,2008

ET7152 MICROCONTROLLER BASED SYSTEM DESIGN L T P C
4 0 0 4

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 12

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

UNIT III PIC MICROCONTROLLER 12

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 12

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 15

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

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

TOTAL : 60 PERIODS

COURSE OUTCOMES*:*

- The learning process delivers insight into involving the capacities of a programmable microcontroller for system interface & automation of processes with improved design strategies.
- Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design.

REFERENCES

1. Muhammad Ali Mazidi, Rolin D. Mckinlay, Danny Causey ' PIC Microcontroller and Embedded Systems using Assembly and C for PIC18', Pearson Education 2008
2. Rajkamal,"Microcontrollers Architecture, Programming,Interfacing,&System Design,Pearson,2012
3. Myke Predko, "Programming and customizing the 8051 microcontroller", Tata McGraw Hill 2001.
4. Muhammad Ali Mazidi,Sarmad Naimi,Sepehr Naimi," The AVR Microcontroller and Embedded Systems' Using Assembly & C, Pearson Education,2014
5. Muhammad Ali Mazidi, Janice G. Mazidi and Rolin D. McKinlay, 'The 8051 Microcontroller and Embedded Systems' Prentice Hall, 2005.
6. John Iovine, 'PIC Microcontroller Project Book ', McGraw Hill 2000

ET7201 RISC PROCESSOR ARCHITECTURE AND PROGRAMMING L T P C
4 0 0 4

COURSE OBJECTIVES

- To teach the architecture of RISC processor
- To compare the architecture and programming of 8,16,32 bit (NUVOTON, ARM Cortex M Series) 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 ARM MICROCONTROLLER ARCHITECTURE 12

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 ` 12

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 12

Introduction to DSP on ARM – Filter –Exception Handling – Interrupts – Interrupt handling schemes- Firmware and bootloader – Example: Standalone - Embedded Operating Systems – Fundamental Components – Example- ARM Cortex M0 *NUVOTON* Processor.

UNIT IV MEMORY PROTECTION AND MANAGEMENT 12

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 12

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

NOTE

Discussions/Exercice/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 : 60 PERIODS

COURSE OUTCOMES:

- The learning process delivers insight into various embedded processors of RISC architecture / 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. Steve Furber, 'ARM system on chip architecture', Addision Wesley,2010.
2. Andrew N. Sloss, Dominic Symes, Chris Wright, John Rayfield 'ARM System Developer's Guide Designing and Optimizing System Software', Elsevier 2007.
3. Trevor Martin, 'The Insider's Guide To The Philips ARM7-Based Microcontrollers, An Engineer's Introduction To The LPC2100 Series' Hitex (UK) Ltd.,
4. Dananjay V. Gadre 'Programming and Customizing the AVR microcontroller', McGraw Hill 2001
5.William Hohl, ' ARM Assebly Language' Fundamentals and Techniques,2009.
6. ARM Architecture Reference Manual, LPC213x User Manual
7. www.Nuvoton .com/websites on Advanced ARM Cortex Processors

ET7202 WIRELESS AND MOBILE COMMUNICATION L T P C
4 0 0 4

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, network routing protocols
- To introduce the basis for classification of commercial family of wireless communication technologies
- 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

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

UNIT II MOBILE NETWORKS 12

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

UNIT III WIRELESS NETWORKS 2

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

UNIT IV ROUTING 12

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

UNIT V TRANSPORT AND APPLICATION LAYERS 12

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

NOTE

Discussions/Practice on Workbench : Sessions in NS2 / Glomosim / Open Source packages.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

- The learning process delivers insight into categorizing various embedded & communication protocols for networking of distributed static & mobile systems.
- Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design.

REFERENCES

1. Jochen Schiller, " Mobile communications", PHI/Pearson Education, Second Edition, 2003.
2. Kaveh Pahlavan, Prasanth Krishnamoorthy, " Principles of Wireless Networks' PHI/Pearson Education, 2003
3. C. Siva Ram Murthy and B.S. Manoj, AdHoc Wireless Networks: Architectures and protocols, Prentice Hall PTR, 2004.

4. Uwe Hansmann, Lothar Merk, Martin S. Nicklons and Thomas Stober, " Principles of Mobile computing", Springer, New york, 2003.
5. C.K.Toh, " AdHoc mobile wireless networks", Prentice Hall, Inc, 2002.
6. Charles E. Perkins, " Adhoc Networking", Addison-Wesley, 2001.
7. William Stallings, " Wireless communications and Networks", PHI/Pearson Education, 2002.

ET7251 REAL TIME OPERATING SYSTEM 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 12

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 6

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 – Polled Loop Systems – RTOS Porting to a Target – Comparison and Basic study of various RTOS like – VX works – Linux supportive RTOS – C Executive.

UNIT V APPLICATION DEVELOPMENT USING 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

Discussions/Practice on Workbench :on understanding the scheduling techniques, timing circuitary, memory allotment scheme , overview of commercial Embedded OS.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

- The learning process delivers insight into scheduling, disciplining various embedded & computational processes with improved design strategies.
- 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,John Wiley,2003
2. Charles Crowley, "Operating Systems-A Design Oriented approach" McGraw Hill,1997
3. Raj Kamal, "Embedded Systems- Architecture, Programming and Design" Tata McGraw Hill,2006.
4. Karim Yaghmour,Building Embedded Linux System",O'reilly Pub,2003
5. Marko Gargenta,"Learning Android ",O'reilly 2011.
6. Herma K., "Real Time Systems – Design for distributed Embedded Applications", Kluwer Academic, 1997.
7. C.M. Krishna, Kang, G.Shin, "Real Time Systems", McGraw Hill, 1997.
8. Raymond J.A.Bhur, Donald L.Bailey, "An Introduction to Real Time Systems", PHI,1999
9. Mukesh Sighal and N G Shi "Advanced Concepts in Operating System", McGraw Hill,2000
10. D.M.Dhamdhere," Operating Systems,A Concept-Based Approch,TMH,2008

ET7252 SOFTWARE FOR EMBEDDED SYSTEMS L T P C
4 0 0 4

COURSE OBJECTIVES

- To expose the students to the fundamentals of embedded Programming.
- To Introduce the GNU C Programming Tool Chain in Linux.
- To study the basic concepts of embedded C and Embedded OS
- To introduce time driven architecture, Serial Interface with a case study.
- To 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 12

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

UNIT II C PROGRAMMING TOOLCHAIN IN LINUX 12

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 C Library

UNIT III EMBEDDED C 12

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 12

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 12

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

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

TOTAL : 60 PERIODS

COURSE OUTCOMES:

- The learning process delivers insight into various programming languages/softwares compatible to embedded process development with improved design & programming skills.
- 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. Stephen Kochan, "Programming in C", 3rd Edition, Sams Publishing, 2009.
3. Michael J Pont, "Embedded C", Pearson Education, 2007.
4. Mark Lutz,"Learning Python,Powerful OOPs,O'reilly,2011.

ET7211 EMBEDDED SYSTEM TECHNOLOGY LABORATORY L T P C

0 0 4 2

COURSE OBJECTIVES

- To involve the students to Practice on Workbench /Software Tools/ Hardware Processor Boards with the supporting Peripherals.
- To teach the concepts of algorithm development & programming on software tools and micro Controllers with peripheral interfaces.
- Practicing through atleast one of the subdivisions covered within experiments listed below to expose the students into the revising the concepts acquired from theory subjects.

Sl.No	EXPERIMENT DETAIL
1	Programming with 8 bit Microcontroller /PIC /AVR /other special Microcontrollers : Assembly /C program Study with peripherals; ;IDE, Board Support Software Tools /UcOS-II/C Compiler/others with simulators/practice with incircuit Emulators, crosscompilers, debuggers
2	I/O Programming with 8 bit Microcontrollers/PIC Microcontrollers / other special Microcontrollers I/O Interfacing : Timers/ Interrupts/ Serial port programming/PWM Generation/ Motor Control/ADC/DAC/ LCD/ RTC Interfacing/ Sensor Interfacing
3.	Programming in Higher Level Languages as C/C++/Java/Embedded C/Embedded Java/ Compilers& Platforms /Linux Support Platforms/Special Embedded Design Programming Suites
4.	Programming with 16 bit /ARM family/special Embedded processors on Assembly / C programming Study with peripherals; IDE, Board Support Software Tools /OS/ C Compiler/others
5.	I/O Interfacing with Nuvoton ARM cortex series /ARM series Embedded processors I/O Programming/ Timers/ Interrupts/ Serial port programming/PWM Generation/ Motor Control/ADC/DAC/ LCD/ RTC Interfacing/ Sensor/communication modules Interfacing Study with peripherals; IDE, Board Support Software Tools /OS/C Compiler/Matlab/Labview support/others with in circuit Emulators, crosscompilers, debuggers
6.	Design and Implementation of Combinational and Sequential Circuits on Simulation Tools as VLSI Suite/pspice/MentorGraphics/any CAD Suite/others Experimenting on Xilinx/Altera CPLD/FPGA/Cortex series processors
7.	Study of one type of Real Time Operating Systems (RTOS) with VXWorks/Keil/Android/Tiny OS/ Linux Support RTOS
8.	Simulation & Programming on System Modelling with using programming environments (MATLAB/LabVIEW/Processor Modeling/ MEMS Suites:Intellisuite/Comsol/other Simulation Tools)
9.	Programming with wired/wireless communication protocol/Network Simulators Study with Networking processors & its peripherals; IDE, Board Support Software Tools /OS/C Compiler/others on in circuit Emulators, crosscompilers, debuggers

10.	Programming with Fixed Point & Floating Point DSP Processors With IDE, Board Support Packages & Peripherals on Assembly /C/ Simulation with Matlab/Labview; /other programming suites /CCS Compilers- Simulation for Correlation, Convolution, Arithmetic adder, Multiplier, Design of Filters - FIR based , IIR based; I/O peripheral Interface.

TOTAL : 60 PERIODS

ET7351 DISTRIBUTED EMBEDDED COMPUTING L T P C
3 0 0 3

COURSE OBJECTIVES

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

UNIT I INTERNET INFRASTRUCTURE 9

Broad Band Transmission facilities –OpenInterconnection standards –Local Area Networks – Wide Area Networks –Network management – Network Security – Cluster computers.

UNIT II INTERNET CONCEPTS 9

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

UNIT III EMBEDDED JAVA 9

Introduction to Embedded Java and J2ME - embedded java concepts -IO streaming – Object serialization – Networking – Threading – RMI – multicasting – distributed databases –– Smart Card basics – Java card technology overview – Java card objects – Java card applets – Web Technology for Embedded Systems.

UNIT IV EMBEDDED AGENT 9

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

UNIT V EMBEDDED COMPUTING ARCHITECTURE 9

Synthesis of the information technologies of distributed embedded systems – analog/digital co-design – optimizing functional distribution in complex system design – validation and fast prototyping of

multiprocessor system-on-chip – a new dynamic scheduling algorithm for real-time multiprocessor systems.

NOTE
Discussions/Practice on Workbench : Program Development and practice in exercises with XML/HTML/Java Programming Environments.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

- The learning process delivers insight into involving JAVA concepts& internet based communication to establish decentralized control mechanism of system
- Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design.

REFERENCES:

1. Dietel & Dietel, "JAVA how to program", Prentice Hall 1999.
2. Sape Mullender, "Distributed Systems", Addison-Wesley, 1993.
3. George Coulouris and Jean Dollimore, "Distributed Systems – concepts and design",Addison –Wesley 1988.
4. "Architecture and Design of Distributed Embedded Systems", edited by Bernd Kleinjohann C-lab, Universitat Paderborn, Germany, Kluwer AcademicPub, Boston, April 2001, 248 pp.
5. Wigglesworth,"Java Programming Advanced Topics,Cengage,2010
6. Mclaughlin,"Java & XML,O'reilly,2006.

ET7311 PROJECT WORK PHASE I L T P C
0 0 12 6

PROJECT PHASE I - LAB Assignment (20 % of Marks in Sessional Evaluation)

Pre-requisites: *choice of project title/broad domain of research topic for project*
Course objectives and outcomes

	Course objectives		**Training outcomes**	**Related programme outcomes**
1.0	✓ **Programming in C/ Embedded C / C++ / JAVA** ✓ **Network Simulators** ✓ **Python Programming** ✓ **Programming on Pervasive Computing** ✓ **Java for Wireless Devices**	1.1	Skill development in software programming/working in simulators, emulators, learn using the commercial packages for wired, wireless communications	a,b,c.d
2.0	**Embedded Processors with Programming**	2.1	The students will learn design with	2,3,4,a,c,d

	✓ **uc,ARM processors/NW Processors** ✓ **DSP / Image / Video Processors** ✓ **VHDL Programming in processors**		simulators/experiments,in programming processor boards, processor interfacing/designing reprogrammable system	
3.0	✓ **Android / LINUX OS Internals/VxWorks/Keil Os**	3.1	The students will skill through OS programming through API, libraries	a,f
4.0	✓ **Virtual Instrumentation programming** ✓ **Simulink/Mathlab Tools** ✓ **Study on MEMS Tools** ✓ **Study on process Controller modeling** ✓ **PLC/SCADA/PCB/ORCAD/MPlab** ✓ **one CAD Tool**	4.1	The students will apply programming logic for modeling/simulating embedded application development	a,f
5.0	✓ **Entrepreneurship Skill development**	5.1	The students will know to pickup skills for Embedded product development/establish consultancy services with an outlook into selecting commercially viable market for technical demands	d,e,f,g,h,

Evaluation Scheme:
Two Assignment submissions based on project domain work as listed below =20 % of Mark of Sessionals and End Semester examination as per university norms.

Design / development through simulation/ experimental analysis with report submission as one appendix chapter on any two of the following topics (relevant to the candidates project area)

1. **Network Simulators-**Design and Implement a GUI or text based network monitoring tool to record network statistics like packets sent and received, percentage errors, desktop grabbing, remote monitoring etc.

2. **Embedded Processors-** Implement an IO peripheral interface ARM family/ PIC / MSP 430 /any advanced embedded Processor through Study of CAN / I2C / Ethernet/any serial bus communication protocol for IO interface

3. **Virtual Instrumentation programming to design smart metering** Design and Implement though GUI suite /tool to record Sensor data recording with signal analysis to discuss on system performance and controller scheme.

4. **Study on process Controller modelling -**with math lab suite with modeling, analysis for Embedded control of Machines

5. **VHDL Programming on Programmable Logic Devices -**Design and Implementation with using Xilinx/Altera FPGA / CPLD on Design ,verification of simple Combinational/Sequential Circuits

6. **Study on CAD Tool-** device modeling,codesign ,verification,analysis

7. **DSP / Image / Video Processing -** Simulation / Implementation of any one its algorithm

8. **Network simulation-** using NS2/ Programming of TCP/IP protocol stack /any network simulator tools -Network Deployment, security concepts.

9. **Programming in C/ Embedded C / C++ / JAVA-** Embedded Application development

10. **Android / LINUX OS Internals/VxWorks/Keil -**Study on programming of the OS through one API for Driver interfaces, Disk driver and Terminal drivers

11. **Programming on Pervasive Computing** on mobile device application Platform through any one Operating System **/**Palm OS / Windows CE/ Embedded Linux -J2ME / Symbian /Android

12. **Java for Wireless Devices** to Set up the development environment with Basic Data types, Libraries ,Wireless Messaging, Architecture for messaging application, Messaging API, Making a device connection using HTTP

13. **Study on MEMS –**device, structural modeling & analysis using CAD lab SUITE

14. **PLC/SCADA/PCB study-**develop one Case Study as Application with suitable platform.

15. **Eunterprenership Skill development through Product Design with Cost Estimation –** Learn through survey on : project/product identification, development plan and execution, the Activity planning, schedule development ,Integration Management configuration management, Time management-,Cost estimation, Quality Management planning , Human Resource Management- Organizational planning , staff acquisition, Communication Management- Information distribution , reporting, Risk Management- Procurement Management- contract, Legal & Government rules on administration.

ET7411 **PROJECT WORK PHASE II** **L T P C**
0 0 24 12

ET7001 **AD HOC NETWORKS** **LT P C**
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 routing protocols
- To study on network OSI Layers
- To introduce on concepts for network deployment, Network performance& Analysis
- 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 LAN, PAN, WAN AND MAN **9**

Characteristics of wireless channel, Fundamentals of WLANs, IEEE 802.11 standard, HIPERLAN Standard, First-, Second-, and third- generation cellular systems, WLL, Wireless ATM, IEEE 802.16 standard, HIPERACCESS, AdHoc Wireless Internet.

UNIT II MAC, ROUTING AND MULTICAST ROUTING PROTOCOLS **9**

MAC Protocols: Design issues, goals and classification, Contention –based protocols with reservation and scheduling mechanisms, Protocols using directional antennas. Routing protocols: Design issues and classification, Table-driven, On-demand and Hybrid routing protocols, Routing protocols with efficient flooding mechanisms, Hierarchical and power-aware routing protocols. Multicast Routing Protocols: Design issues and operation, Architecture reference model, classification, Tree-based and Mesh-based protocols, Energy-efficient multicasting.

UNIT III TRANSPORT LAYER AND SECURITY PROTOCOLS **9**

Transport layer Protocol: Design issues, goals and classification, TCP over AdHoc wireless Networks, Security, Security requirements, Issues and challenges in security provisioning, Network security attacks, Security routing. Quality of Service: Issues and challenges in providing QoS, Classification of QoS solutions, MAC layer solutions, Network layer solutions, QoS frameworks.

UNIT IV ENERGY MANAGEMENT **9**

Need, classification of battery management schemes, Transmission power management schemes, System power management schemes.Wireless Sensor Networks: Architecture, Data dissemination, Date gathering, MAC protocols, location discovery, Quality of a sensor network.

UNIT V PERFORMANCE ANALYSIS **9**

ABR beaconing, Performance parameters, Route-discovery time, End-to-end delay performance, Communication throughput performance, Packet loss performance, Route reconfiguration/repair time, TCP/IP based applications.

NOTE

Discussions/Practice on Workbench : on Zigbee /other Protocols with respect to understanding the importance of network components,networking Layers

TOTAL : 45 PERIODS

COURSE OUTCOMES:

- The learning process delivers insight onto role of various communication standards applicable in building automation during data transfer and communication in systems.
- Improved Employability and entrepreneurship capacity due to knowledge upgradation on recent trends in embedded systems design.

REFERENCES

1. C. Siva Ram Murthy and B.S. Manoj, AdHoc Wireless Networks: Architectures and protocols, Prentice Hall PTR, 2004
2. C.-K.Toh, AdHoc Mobile Wireless Networks: Protocols and Systems, Prentice Hall PTR, 2001
3. Mohammad Ilyas, The Handbook of AdHoc Wireless Networks, CRC press, 2002
4. Charles E. Perkins, AdHoc Networking, Addison – Wesley, 2000
5. Stefano Basagni, Marco Conti, Silvia Giordano and Ivan Stojmenovic, Mobile AdHoc Networking, Wiley – IEEE press, 2004.
6. Carlos De Morais Cordeiro,"Ad HOC & Sensor Networks,Theory & Application,World Sceintific,2010.

ET7002	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 TECHNOLGIES 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 Multicomputer, Multivector 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- *SIMD, MIMD-introduction to Parallel Algorithms &Programming concepts for multiprocessors*-- Memory Management-Cache Replacement, Memory Mapping, comparison addressing modes-Back plane Bus system-arbitration schemes- cache performance issues- 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 MULTI PROCESSOR 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

Discussions/Practice on Workbench : modelling/ Computing Algorithms /ALU Functional Blocks

TOTAL : 45 PERIODS

COURSE OUTCOMES:

- The learning process delivers insight into familiarizing onto commercial processor technology that involves multicore processors with improved design strategies.
- 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 Hill 2000
2. Advanced Computer architecture , By Rajiv Chopra, S Chand , 2010
3. John L. Hennessy, David A. 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 Hill 2003.
10. Harry F. Jordan Gita Alaghaband, “Fundamentals of Parallel Processing”. Pearson Education, 2003.
11. Richard Y. Kain, “Advanced computer architecture – A system Design Approach”, PHI, 2003.

ET7005 **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 devices, file systems and performance tuning.
- To introduce the concept of configuring kernel using the cross-platform tool chain.
- 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 PLATFORM 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 Platform Toolchain

UNIT III HOST-TARGET SETUP AND OVERALL 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 Tool chain- Case study on programming one serial driver for developing application using Linux Driver

NOTE

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

COURSE OUTCOMES:

- The learning process delivers insight onto role of freeware/open source Linux for building own Embedded Applications

- 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', O'Reilly Publications, 2008
2. P.Raghavan,Amol Lad,Sriram Neelakandan,"EmbeddedLinux System Design & Development,Auerbach Publications, 2012
3. William von Hagen, 'Ubuntu Linux Bible 3rd Edition', Wiley Publishing Inc., 2010
4. P. Raghavan ,Amol Lad , Sriram Neelakandan, 'Embedded Linux System Design and Development', Auerbach Publications, 2006
5. Jonathan Corbet, Alessandro Rubini & Greg Kroah-Hartman, 'Linux Device Drivers 3rd Edition', O'Reilly, 2011

ET7004 DESIGN OF AUTOMOBILE 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; Control objectives linked to fuel economy-volumetric, thermal, air-fuel ratio, Oxidizing catalytic efficiency, emission limits and vehicle performance; advantages of using Electronic engine controls – open and closed loop fuel control; Electronic ignition-Block diagram of ignition system and fuel injection system, multi point fuel injection, Direct injection; Architecture of a EMS with multi point injection, programmed ignition-recent trend in hybrid vehicles

UNIT II SENSORS, ACTUATORS, CONTROLLERS FOR VEHICLES 9

sensors used and their characteristics- airflow rate –crank shaft and throttle position-hall effect-exhaust gas oxygen sensors, sensors interface to the ECU; Actuators and their characteristics – exhaust gas recirculation-solenoid, actuators interface to the ECU; Electrical fuel pump, speedometer, oil and temperature gauges, horn, wiper system, starter motors and circuits –batteries-types-rating-performance characteristics-programmable power supply.

UNIT III SOFTWARE FOR ENGINE MANAGEMENT SYSTEMS 9

Development methodologies for system software and superposed application software related to specific engines and vehicles; System diagnostic standards and control software for compliance for meeting diagnostic and regulation requirements- cruise control- speed response-anti-locking braking

system-electronic suspension with control system- electronic steering; Vehicle system schematic for interfacing with EMS

UNIT IV AUTOMOTIVE TELEMATICS 9

Role of Bluetooth, CAN, LIN and flexray 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 and for control-automatic transmission-electronic clutch.

UNIT V AUTOMOTIVE INFOTAINMENT SYSTEMS 9

Types of AI-Features-electronic dash board instruments-Parking Aid Control-Touch Screen Displays-Diagnostics-Network Management

NOTE

Discussions/Exercice/ AUTOSAR/ simulator /Practice on Workbench/: on the basics of interfacing sensors, actuators to microcontrollers, role of Instrumentation software packages / special microcontrollers for i/o port communication applicable to vehicles

TOTAL:45 PERIODS

COURSE OUTCOMES:

- The learning process delivers insight onto role of automation, communication systems in vehicles
- 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", sixth edition,
2. Uwe Kiencke, Lars Nielsen, "Automotive Control Systems: For Engine, Driveline, and Vehicle", Springer; 1 edition, March 30, 2000
3. Jack Erjavec,Jeff Arias,"Alternate Fuel Technology-Electric ,Hybrid& Fuel Cell Vehicles",Cengage ,2012
4. Shih-Lin Wu,Yu-Chee Tseng,{"Wireless Ad Hoc Networking,PAN,LAN,SAN,Aurebach Pub,2012
5. Judge, A.W., "Modern Electrical Equipment of Automobiles", Chapman & Hall London, 1992.
6. Young, A.P., & Griffiths.L., "Automobile Electrical Equipment", English Languages Book Society & New Press, 1990.
7. Automotive Electricals Electronics System and Components, Robert Bosch Gmbh, 4th Edition, 2004.
8. Krzysztof Iniewski,"Smart Grid ,Infrastructure & Networking",TMcGH,2012
9. Jurgen, R., Automotive Electronics Hand Book.
10. Automotive Electricals / Electronics System and Components, Tom Denton, 3rd Edition, 2004.

CO7152 **SOFT COMPUTING TECHNIQUES** **LT P C**

3 0 0 3

COURSE OBJECTIVES

- To review the fundamentals of ANN and fuzzy set theory.
- To make the students understand the use of ANN for modeling and control of non-linear system and to get familiarized with the ANN tool box.
- To impart knowledge of using Fuzzy logic for modeling and control of non-linear systems and get familiarized with the FLC tool box.
- To make the students to understand the use of optimization techniques.
- To familiarize the students on various hybrid control schemes, P.S.O and get familiarized with the ANFIS tool box.

UNIT I OVERVIEW OF ARTIFICIAL NEURAL NETWORK (ANN) & FUZZY LOGIC 9

Review of fundamentals - Biological neuron, Artificial neuron, Activation function, Single Layer Perceptron – Limitations – Multi Layer Perceptron – Back propagation algorithm (BPA); Fuzzy set theory – Fuzzy sets – Operation on Fuzzy sets - Scalar cardinality, fuzzy cardinality, union and intersection, complement (yager and sugeno), equilibrium points, aggregation, projection, composition, fuzzy relation – Fuzzy membership functions.

UNIT II NEURAL NETWORKS FOR MODELLING AND CONTROL 9

Generation of training data - optimal architecture – Model validation- Control of non linear system using ANN- Direct and Indirect neuro control schemes- Adaptive neuro controller – Case study - Familiarization of Neural Network Control Tool Box.

UNIT III FUZZY LOGIC FOR MODELLING AND CONTROL 9

Modeling of non linear systems using fuzzy models(Mamdani and Sugeno) –TSK model - Fuzzy Logic controller – Fuzzification – Knowledge base – Decision making logic – Defuzzification-Adaptive fuzzy systems- Case study - Familiarization of Fuzzy Logic Tool Box.

UNIT IV GENETIC ALGORITHM 9

Basic concept of Genetic algorithm and detail algorithmic steps, adjustment of free parameters. Solution of typical control problems using genetic algorithm. Concept on some other search techniques like Tabu search, Ant-colony search and Particle Swarm Optimization.

UNIT V HYBRID CONTROL SCHEMES 9

Fuzzification and rule base using ANN–Neuro fuzzy systems-ANFIS –Optimization of membership function and rule base using Genetic Algorithm and Particle Swarm Optimization - Case study– Familiarization of ANFIS Tool Box.

TOTAL : 45 PERIODS

COURSE OUTCOMES

Students,

- Will be able to know the basic ANN architectures, algorithms and their limitations.
- Also will be able to know the different operations on the fuzzy sets.
- Will be capable of developing ANN based models and control schemes for non-linear system.
- Will get expertise in the use of different ANN structures and online training algorithm.
- Will be knowledgeable to use Fuzzy logic for modeling and control of non-linear systems.
- Will be competent to use hybrid control schemes and P.S.O.

REFERENCES

1. Laurene V.Fausett, "Fundamentals of Neural Networks, Architecture, Algorithms, and Applications", Pearson Education, 2008.
2. Timothy J.Ross, "Fuzzy Logic with Engineering Applications", Wiley, Third Edition, 2010.
3. David E.Goldberg, "Genetic Algorithms in Search, Optimization, and Machine Learning", Pearson Education, 2009.
4. W.T.Miller, R.S.Sutton and P.J.Webrose, "Neural Networks for Control", MIT Press, 1996.
5. George J.Klir and Bo Yuan, "Fuzzy Sets and Fuzzy Logic: Theory and Applications", Prentice Hall, First Edition, 1995.
6. N.P Padhy, S.P. Simon "Soft Computing With MATLAB Programming",OXFORD print Feburary 2015.

ET7074 MEMS TECHNOLOGY L T P C
3 0 0 3

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 CONEPTS 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 piezo electric actuator model-properties of piezoelectric materials-Applications.

UNIT V CASE STUDIES 9

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

NOTE
Discussions/Exercise/Practice on Workbench : on the basics /device model design aspects of thermal/peizo/resistive sensors etc.

TOTAL : 45 PERIODS

COURSE OUTCOME:

- The learning process delivers insight onto design of micro sensors, embedded sensors & actuators in power aware systems like grid
- 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 microfabrication”,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.

ET7003 ADVANCED EMBEDDED SYSTEMS L T P C
3 0 0 3

COURSE OBJECTIVES

- To expose the students to the concepts of HARDWARE/SOFTWARE Modelling, partioning, co-simulation.
- To expose the students to the fundamentals of the internals of a router and hardware architecture for protocol processing,
- To study on Fundamentals on design attributes of functional units of Network processors their architecture, through the classification of commercial Network in processors
- To introduce aspects in Protocols: Design issues, goals in Network 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 MODELLING WITH HARDWARE/SOFTWARE PARTITIONING 15

Embedded systems, Hardware/Software Co-Design, Co-Design for System Specification and modeling- compare Single-processor Architectures & Multi-Processor Architectures, Requirements for Embedded System Specification, Hardware/Software Partitioning - Graphical modeling, Formulation of the HW/SW scheduling, Hardware/Software CO-Synthesis.

UNIT II EMBEDDED PROCESSOR FOR NETWORK PROTOCOL PROCESSING 9

Introduction and overview, basic terminology and example systems, review of protocols and packet format, Conventional computer hardware architecture, basic packet processing, packet processing functions, protocol software on a conventional processor, hardware architecture for protocol

processing, classification and forwarding, switching fabrics, Hardware/Software Traffic management implementation

UNIT III INTRODUCTION TO ADVANCED ARCHITECTURE: NETWORK PROCESSOR 6

Network processors, the complexity of network processor design, network processor architectural Overview and comparison of commercial network processors: the Intel network processor, RISC processor, packet processor hardware.

UNIT IV SCALING IN NETWORK PROCESSORS 6

Scalability With Parallelism And Pipelining - issues in scaling a network processor-Complexity Of Network Processor Design (packet processing, ingress & egress processing, Macroscopic Data Pipelining And Heterogeneity etc) - Network Processor fun : Packet Flow, Clock Rates, software architecture, Assigning Functionality To The Processor Hierarchy.

UNIT V CLASSIFICATION OF NETWORK PROCESSORS 9

Basis in Classification of network processors- Multichip pipeline, configurable instruction set processors, packet processor-Issues In Scaling A Network Processor (processing hierarchy and scaling)–functional configurations in commercial Network Processors : Multi-Chip Pipeline, Augmented RISC Processor, Embedded Processor Plus Coprocessors- Design Tradeoffs and consequences (Programmability Vs. Processing Speed , speed vs functionality. etc).

NOTE

Discussions/Exercise/Practice on Workbench : on commercial processor technology through comparisons on to the design strategies used in multicore processors

TOTAL : 45 PERIODS

COURSE OUTCOMES:

- The learning process delivers insight onto role of multicore processors specifically designed for networking during data transfer and communication systems like electrical grid
- Improved Employability and enterprenership capacity due to knowledge upgradation on recent trends in embedded systems design .

REFERENCES:

1. Douglas E. Comer ”Network System Design using Network Processors” Prentice Hall, 2006.
2. Jorgen Staunstrup, Wayne Wolf, “Harware/Software Co-Design:Principles and Practice”, Kluwer Academic Pub, 1997.
3. Patrick Crowley, M A Franklin, H Hadimioglu, PZ Onufryk, “NetworkProcessor Design, Issues and Practices Vol – I, 2, Morgan Kauffman, Elsevier2011
4. Deepankar Medhi, Karthikeyan Ramasamy, “Network Routing : Algorithms,Protocols, and Architecture”, Elsevier, 2007.
5. UYLESS black,’computer NETWORKS-Protocols,STANDARDS INTERFACES’,2nd ED,PHI,2007
6. Ralf Niemann, “Hardware/Software Co-Design for Data Flow Dominated Embedded Systems”, Kluwer Academic Pub, 1998.
7. Jorgen Staunstrup, Wayne Wolf, “Harware/Software Co-Design:Principles and Practice”, Kluwer Academic Pub, 1997.
8. Giovanni De Micheli, Rolf Ernst Morgon, “Reading in Hardware/Software Co-Design” Kaufmann Publishers, 2001.
9. http://www.npforum.org/; http://www.intel.com/design/network/products/npfamily/

ET7073 **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 onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

UNIT I DATA ACQUISITION SYSTEMS **9**

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 Modulation - Digital Displays for Instrumentation.

UNIT II INSTRUMENT COMMUNICATION **15**

Introduction, Modem standards, Basic requirements of Instrument Bus Communications standards, interrupt and data handshaking , serial bus- basics, Message transfer, Fault confinement – comparison of RS-232, USB, RS-422, RS-485,Ethernet Bus- CAN standards interfaces - Interface systems and standards, Instrument Drivers-Field bus: general considerations, network design with Use of field buses in industrial plants, functions, international standards, performance- use of Ethernet networks, field bus advantages and disadvantages-Instrumentation network design ,advantages and limitations of open networks, HART network and Foundation field bus network general considerations, network design- Mod Bus, PROFIBUS-PA: Basics, architecture, model, network design and system configuration.

UNIT III PROGRAMMABLE LOGIC CONTROLLERS, **6**

Need for PLC, Ladder Diagram, role of PLC for Industrial instrumentation and automation.

UNIT IV VIRTUAL INSTRUMENTATION: **10**

Block diagram and Architecture – Data flow techniques – Graphical programming using GUI – Real time Embedded system –Intelligent controller – Software and hardware simulation of I/O communication blocks-peripheral interface – ADC/DAC – Digital I/O – Controller, Timer.

UNIT V CASE STUDIES **5**

PC based DAS, Data loggers, PC based process measurements using sensors, actuators, CRT interface and controller with monochrome and colour video display.

NOTE

Discussions/Exercise/Practice on Workbench : on Digital Control of sensors, Relays,Solenoids, DC/ STEPPER motor, LCD graphics Interface, SD Card storage interface

TOTAL : 45 PERIODS

COURSE OUTCOMES:

- The learning process delivers insight onto role of various communication standards applicable in building instrument based automation during data transfer and communication in systems like large industrial processes.

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

REFERENCES:

1. Jonathan W Valvano, “Embedded Microcomputer systems”, Brooks/Cole, Thomson, 2010.
2. Mathivanan, “PC based Instrumentation Concepts and practice”, Prentice-Hall India, 2009
3. W.Bolton,Programmable Logic Controllers,5th Ed,Elseiver,2010.
4. Joseph J. Carr, “Elements of Electronic Instrumentation and Measurement”, Pearson Education, 2003.
5. K.Padmanabhan, S.Ananthi A Treatise on Instrumentation Engineering ,I K Publish,2011
6. A.J. Bouwens, “Digital Instrumentation” , TATA McGraw-Hill Edition, 1998.
7. Cory L.Clark,”Labview Digital Signal Processing & Digital Communication,TMcH,2005
8. Lisa K. wells & Jeffrey Travis, Lab VIEW for everyone, Prentice Hall, New Jersey,1997.
9. Kevin James, PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control, Newnes, 2000.
10. Noltingk B.E., “Instrumentation Reference Book”, 2nd Edition, Butterworth Heinemann, 1995.
11. H S Kalsi, “Electronic Instrumentation” Second Edition, Tata McGraw-Hill,2006.

ET7006	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 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-WSN 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 & Charecteristics: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 etc

TOTAL : 45 PERIODS

COURSE OUTCOMES:

- The learning process delivers insight onto design of automation, communication systems through wired, wireless technology for monitoring and control of grid.
- Improved Employability and enterprenership capacity due to knowledge upgradation on recent trends in embedded systems design .

REFERRENCE:

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 Sensor Networks,O'Reilly,2011
4. W.Bolton,Programmable Logic Controllers,5th Ed,Elseiver,2010.
5. Shih-Lin Wu,Yu-Chee Tseng,{"Wireless Ad Hoc Networking,PAN,LAN,SAN,Aurebach Pub,2012
6. Jan Axelson 'Embedded Ethernet and Internet Complete', Penram publications
7. Bhaskar Krishnamachari, 'Networking wireless sensors', Cambridge press 2005
8. Peter W Gofton , "**Understanding Serial Communication**", Sybes International, 2000
9. Robert H. Bishop, "**Learning with Lab-View**" Preticee Hall, 2009
10. Sanjay Gupta, "**Virtual Instrumentation, LABVIEW"**, TMH, New Delhi, 2003
11. Ernest O. Doeblin and Dhanesh N Manik, " **Measrement Systems – Application and Design"**, 5th Edn, TMH, 2007.

ET7008 **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 NANOSCALE CMOS **9**

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

UNIT III NANOELECTRONIC 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 NANOELECTRONIC 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

Discussions/Practice on Workbench : on modelling of analog &digital devices.

TOTAL = 45 PERIODS

COURSE OUTCOMES:

- 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”, Wiley 2005

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 Nanoelectronics: 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.

ET7010 PERVASIVE DEVICES AND TECHNOLOGY L T P C
3 0 0 3

COURSE OBJECTIVES

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

UNIT I OVERVIEW OF WIRELESS SENSOR NETWORKS 12

Challenges for Wireless Sensor Networks- Characteristic requirements for WSN - Challenges for WSNs – WSN vs Adhoc Networks -Physical layer and transceiver design considerations in WSNs, introduction to fundamentals of MAC protocols - Low duty cycle protocols and wakeup concepts - Contention-based protocols - Schedule-based protocols -the IEEE 802.15.4 MAC protocol- Energy usage profile, Choice of modulation scheme, Dynamic modulation scaling, Antenna considerations- Applications of sensor networks

UNIT II ISSUES IN PERVASIVE SENSOR NETWORK 9

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 - Examples of Operating Systems – TinyOS, 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 PERVASIVE FOR SMART GRID APPLICATION 12

Introduction, Networking Infrastructure and Architecture of PERV NET, Mobility management, service discovery, disconnected operation, Smart Grid structure-metering-standards-Data Management Principles

UNIT IV PERVASIVE DEVICES 6

Introduction to use of special uC for networking with Case study of Sensor node architecture – compare Commercially available sensor nodes –Imote, IRIS, Mica Mote-Communication Standards-Zigbee, Z-Wave.

UNIT V EMERGING WIRELESS TECHNOLOGIES 6

Evolution and comparison of Cellular Systems – 1G, 2G, 2.5G, 3G, 4G. Introduction to wireless LAN, Wireless PAN, Wireless MAN, - Wireless Backbone Networks – Wireless Access Technology - Pervasive Web Application architecture- Access from PCs and PDAs -Emerging Wireless Technologies – IEEE 802.20 Mobile Broadband Wireless Access.

NOTE

Discussions/Exercise/Practice on Workbench : on the basics of Zigbee protocols,sensor motes, role of special microcontrollers for Zigbee communication etc

TOTAL : 45 PERIODS

COURSE OUTCOMES:

- The learning process delivers insight onto building of automation, communication with microcontrollers into systems like grid
- Improved Employability and enterprenership capacity due to knowledge upgradation on recent trends in embedded systems design

REFERENCES

1. Debashis saha, Amitava mukherjee ,"Networking Infrastructure for Pervasive Computing, Springer International edition, 2011 (unit 3)
2. Robert Faludi,"Building Wireless Sensor Networks,O'Reilly,2011
3. Mullet,"Introduction to wireless telecommunications systems and networks", cengage learning, 2010 (unit 5)
4. Krzysztof Iniewski,"Smart Grid ,Infrastructure & Networking",TMcGH,2012
5. Frank Adelstein, Sandeep K S Gupta, Golden G Richard III, Loren Schwiebert, "Fundamentals of mobile and pervasive computing, TMH, 2007.
6. Brian Fling,"Mobile Design & Development,O'Reilly,2011 (unit 4)
7. Marko Gargenta,"Learning Android", O'Reilly,2011 (unit 4)
8. Shih-Lin Wu,Yu-Chee Tseng,{"Wireless Ad Hoc Networking,PAN,LAN,SAN,Aurebach Pub,2012
9. Holger Karl & Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks" , John Wiley, 2005.
10. Feng Zhao & Leonidas J. Guibas, "Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007.

ET7007 EMBEDDED PRODUCT DEVELOPMENT L T P C
3 0 0 3

OBJECTIVE

- Aims at providing the basic concepts of product design, product features & its architecture
- Clarity in creative thinking in developing automation into consumer products of market value
- To know the techniques & procedures as are adopted in Industry for Product manufacture
- Elaborate understanding for developing an embedded product by choice of functional blocks, HW/SW parameters.
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability& entrepreneurship skills

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 –Product Architecture--changes - variety – component Standardization –example case study on Conceptual Design of DeskJet Printer as a product.

UNIT II INTRODUCTION TO APPROACHES IN PRODUCT DEVELOPMENT 9

Product development management - establishing the architecture - creation - 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 – Support tools for the benchmarking process, trend analysis- Setting product specifications- product performance analysis -Industrial Design-Robust Design – Testing Methodologies.

UNIT III INDUSTRIAL DESIGN 8

Integrate process design - Managing costs - Robust design –need for Involving CAE, CAD, CAM, IDE tools –Simulating product performance and manufacturing processes electronically - Estimation of Manufacturing cost-reducing the component costs and assembly costs – Minimize system complexity - Prototype basics - Principles of prototyping - Planning for prototypes- Economic & Cost Analysis - Understanding and representing tasks-baseline project planning -accelerating the project-project execution.

UNIT IV DEVELOPMENT BASED ON REVERSE ENGINEERING 6

Basics on Data reverse engineering – Three data Reverse engineering strategies – Finding reusable software components – Recycling real-time embedded software based approach and its logical basics-Cognitive approach to program understated – Integrating formal and structured methods in reverse engineering – Incorporating reverse engineering for consumer product development-ethical aspects in reverse engineering.

UNIT V DEVELOPING EMBEDDED PRODUCT DESIGN 10

Discussions on Creating Embedded System Architecture(with at least one Case study example: Mobile Phone /Adaptive Cruise Controller/ Robonoid about) -Architectural Structures- Criteria in

selection of Hardware & Software Components, product design by Performance Testing, Costing, Benchmarking ,Documentation

NOTE
Term Project/Presentation on specific product design can be given for Assessment – 3 (Optional)

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- Improved knowledge up gradation on recent trends in embedded systems design with understand the integration of customer requirements in product design
- apply structural approach to concept generation, creativity, selection and testing so that student can have a basic knowledge in the common features a product through industrial design, design of Consumer specific product , its Reverse Engineering manufacture , economic analysis and product architecture.
- Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design.

REFERENCES

1. "Product Design and Development", Karl T.Ulrich and Steven D.Eppinger, McGraw –Hill International Edns.1999
2. George E.Dieter, Linda C.Schmidt, “Engineering Design”, McGraw-Hill International Edition,4th Edition, 2009, ISBN 978-007-127189-9
3. "Effective Product Design and Development", Stephen Rosenthal, Business One Orwin, Homewood, 1992,ISBN, 1-55623-603-4
4. Product Design Techniques in Reverse Engineering and New Product Development, KEVIN OTTO & KRISTIN WOOD, Pearson Education (LPE),2001.
5. Kevin Otto, Kristin Wood, “Product Design”, Indian Reprint 2004, Pearson Education,ISBN 9788177588217
6. Yousef Haik, T. M. M. Shahin, “Engineering Design Process”, 2nd Edition Reprint, Cengage Learning, 2010, ISBN 0495668141
7. Clive L.Dym, Patrick Little, “Engineering Design: A Project-based Introduction”, 3rd Edition, John Wiley & Sons, 2009, ISBN 978-0-470-22596-7
8. Design Recovery for Maintenance and Reuse, T J Biggerstaff, IEEE Corpn. July 1991
9. White paper on RE, S. Rugaban, Technical Report, Georgia Instt. of Technology, 1994
10. Reverse Engineering, Katheryn, A. Ingle, McGraw-Hill, 1994
11. Data Reverse Engineering, Aiken, Peter, McGraw-Hill, 1996
12. Reverse Engineering, Linda Wills, Kluiver Academic Publishers, 1996
13. Robert,Edward & Betty,”Industrial Marketing”,2nd Edition,PHI,2007.

PW7251 SCADA SYSTEM AND APPLICATIONS MANAGEMENT **L T P C**

3 0 0 3

COURSE OBJECTIVE:

- To understand about the SCADA system components and SCADA communication protocols
- To provide knowledge about SCADA applicatios in power system

UNIT I INTRODUCTION TO SCADA **9**

Evolution of SCADA, SCADA definitions, SCADA Functional requirements and Components, SCADA Hierarchical concept, SCADA architecture, General features, SCADA Applications, Benefits

UNIT II SCADA SYSTEM COMPONENTS **9**

Remote Terminal Unit (RTU), Interface units, Human- Machine Interface Units (HMI), Display Monitors/Data Logger Systems, Intelligent Electronic Devices (IED), Communication Network, SCADA Server, SCADA Control systems and Control panels

UNIT III SCADA COMMUNICATION **9**

SCADA Communication requirements, Communication protocols: Past, Present and Future, Structure of a SCADA Communications Protocol, Comparison of various communication protocols, IEC61850 based communication architecture, Communication media like Fiber optic, PLCC etc. Interface provisions and communication extensions, synchronization with NCC, DCC.

UNIT IV SCADA MONITORING AND CONTROL **9**

Online monitoring the event and alarm system, trends and reports, Blocking list, Event disturbance recording. Control function: Station control, bay control, breaker control and disconnector control.

UNIT V SCADA APPLICATIONS IN POWER SYSTEM **9**

Applications in Generation, Transmission and Distribution sector, Substation SCADA system Functional description, System specification, System selection such as Substation configuration, IEC61850 ring configuration, SAS cubicle concepts, gateway interoperability list, signal naming concept. System Installation, Testing and Commissioning.

CASE STUDIES:

SCADA Design for 66/11KV and 132/66/11KV or 132/66 KV any utility Substation and IEC 61850 based SCADA Implementation issues in utility Substations,

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- This course gives knowledge about various system components and communication protocols of SCADA system and its applications.

REFERENCES:

1. Stuart A. Boyer: SCADA-Supervisory Control and Data Acquisition, Instrument Society of America Publications,USA,2004
2. Gordon Clarke, Deon Reynders: Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems, Newnes Publications, Oxford, UK,2004
3. William T. Shaw, Cybersecurity for SCADA systems, PennWell Books, 2006
4. David Bailey, Edwin Wright, Practical SCADA for industry, Newnes, 2003
5. Michael Wiebe, A guide to utility automation: AMR, SCADA, and IT Systems for Electric Power, PennWell 1999
6. Dieter K. Hammer, Lonnie R. Welch, Dieter K. Hammer, "Engineering of Distributed Control Systems", Nova Science Publishers, USA, 1st Edition, 2001

HV7072 DESIGN OF SUBSTATIONS L T P C
3 0 0 3

OBJECTIVE:

- To provide in-depth knowledge on design criteria of Air Insulated Substation (AIS) and Gas Insulated Substation (GIS).
- To study the substation insulation co-ordination and protection scheme.
- To study the source and effect of fast transients in AIS and GIS.

UNIT I INTRODUCTION TO AIS AND GIS 9

Introduction – characteristics – comparison of Air Insulated Substation (AIS) and Gas Insulated Substation (GIS) – main features of substations, Environmental considerations, Planning and installation- GIB / GIL

UNIT II MAJOR EQUIPMENT AND LAYOUT OF AIS AND GIS 9

Major equipment – design features – equipment specification, types of electrical stresses, mechanical aspects of substation design- substation switching schemes- single feeder circuits; single or main bus and sectionalized single bus- double main bus-main and transfer bus- main, reserve and transfer bus- breaker-and-a- half scheme-ring bus

UNIT III INSULATION COORDINATION OF AIS AND GIS 9

Introduction – stress at the equipment – insulation strength and its selection – standard BILs – Application of simplified method – Comparison with IEEE and IEC guides.

UNIT IV GROUNDING AND SHIELDING 9

Definitions – soil resistivity measurement – ground fault currents – ground conductor – design of substation grounding system – shielding of substations – Shielding by wires and masts.

UNIT V FAST TRANSIENTS PHENOMENON IN AIS AND GIS 9

Introduction – Disconnector switching in relation to very fast transients – origin of VFTO – propagation and mechanism of VFTO – VFTO characteristics – Effects of VFTO.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

- Awareness towards substation equipment and their arrangements.
- Ability to design the substation for present requirement with proper insulation coordination and protection against fast transients.

REFERENCES

1. Andrew R. Hileman, “Insulation coordination for power systems”, Taylor and Francis, 1999.
2. M.S. Naidu, “Gas Insulation Substations”, I.K. International Publishing House Private Limited, 2008.
3. Klaus Ragallar, “Surges in high voltage networks” Plenum Press,New York, 1980.
4. “Power Engineer’s handbook”, TNEB Association.
5. Pritindra Chowdhuri, “Electromagnetic transients in power systems”, PHI Learning Private Limited, New Delhi, Second edition, 2004.
6. “Design guide for rural substation”, United States Department of Agriculture, RUS Bulletin, 1724E-300, June 2001.
7. AIEE Committee Report, “Substation One-line Diagrams,” AIEE Trans. on Power Apparatus and Systems, August 1953
8. Hermann Koch , “Gas Insulated Substations”, Wiley-IEEE Press,2014

PS7071 DISTRIBUTED GENERATION AND MICRO GRID L T P C
3 0 0 3

OBJECTIVES

- To illustrate the concept of distributed generation
- To analyze the impact of grid integration.
- To study concept of Microgrid and its configuration

UNIT I INTRODUCTION 9

Conventional power generation: advantages and disadvantages, Energy crises, Non-conventional energy (NCE) resources: review of Solar PV, Wind Energy systems, Fuel Cells, micro-turbines, biomass, and tidal sources.

UNIT II DISTRIBUTED GENERATIONS (DG) 9

Concept of distributed generations, topologies, selection of sources, regulatory standards/ framework, Standards for interconnecting Distributed resources to electric power systems: IEEE 1547. DG installation classes, security issues in DG implementations. Energy storage elements: Batteries, ultra-capacitors, flywheels. Captive power plants

UNIT III IMPACT OF GRID INTEGRATION 9

Requirements for grid interconnection, limits on operational parameters,: voltage, frequency, THD, response to grid abnormal operating conditions, islanding issues. Impact of grid integration with NCE sources on existing power system: reliability, stability and power quality issues.

UNIT IV BASICS OF A MICROGRID 9

Concept and definition of microgrid, microgrid drivers and benefits, review of sources of microgrids, typical structure and configuration of a microgrid, AC and DC microgrids, Power Electronics interfaces in DC and AC microgrids,

UNIT V CONTROL AND OPERATION OF MICROGRID 9

Modes of operation and control of microgrid: grid connected and islanded mode, Active and reactive power control, protection issues, anti-islanding schemes: passive, active and communication based techniques, microgrid communication infrastructure, Power quality issues in microgrids, regulatory standards, Microgrid economics, Introduction to smart microgrids.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

- Students will attain knowledge on the various schemes of conventional and non-conventional power generation.
- Students will have knowledge on the topologies and energy sources of distributed generation.
- Students will learn about the requirements for grid interconnection and its impact with NCE sources
- Students will understand the fundamental concept of Microgrid.

REFERENCES

1. "Voltage Source Converters in Power Systems: modelling, Control and Applications", Amirnaser Yezdani, and Reza Iravani, IEEE John Wiley Publications.
2. "Power Switching Converters: Medium and High Power", DorinNeacsu, CRC Press, Taylor & Francis, 2006.
3. "Solar Photo Voltaics", Chetan Singh Solanki, PHI learning Pvt. Ltd., New Delhi,2009
4. "Wind Energy Explained, theory design and applications," J.F. Manwell, J.G. McGowan Wiley publication
5. "Biomass Regenerable Energy", D. D. Hall and R. P. Grover, John Wiley, New York, 1987.
6. "Renewable Energy Resources" John Twidell and Tony Weir, Tyalor and Francis Publications, Second edition.

PW7351 ENERGY MANAGEMENT AND AUDITING L T P C

3 0 0 3

COURSE OBJECTIVES

- To study the concepts behind economic analysis and Load management.
- To emphasize the energy management on various electrical equipments and metering.
- To illustrate the concept of lighting systems and cogeneration.

UNIT I INTRODUCTION 9

Need for energy management - energy basics- designing and starting an energy management program – energy accounting -energy monitoring, targeting and reporting- energy audit process.

UNIT II ENERGY COST AND LOAD MANAGEMENT 9

Important concepts in an economic analysis - Economic models-Time value of money- Utility rate structures- cost of electricity-Loss evaluation Load management: Demand control techniques-Utility monitoring and control system- HVAC and energy management-Economic justification

UNIT III ENERGY MANAGEMENT FOR MOTORS, SYSTEMS, AND ELECTRICAL EQUIPMENT 9

Systems and equipment- Electric motors-Transformers and reactors-Capacitors and synchronous machines

UNIT IV METERING FOR ENERGY MANAGEMENT 9

Relationships between parameters-Units of measure-Typical cost factors- Utility meters - Timing of meter disc for kilowatt measurement - Demand meters - Paralleling of current transformers - Instrument transformer burdens-Multitasking solid-state meters - Metering location vs. requirements- Metering techniques and practical examples

UNIT V LIGHTING SYSTEMS & COGENERATION 9

Concept of lighting systems - The task and the working space -Light sources - Ballasts - Luminaries - Lighting controls-Optimizing lighting energy - Power factor and effect of harmonics on power quality - Cost analysis techniques-Lighting and energy standards Cogeneration: Forms of cogeneration - feasibility of cogeneration- Electrical interconnection.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

- Students will develop the ability to learn about the need for energy management and auditing process
- Learners will learn about basic concepts of economic analysis and load management.
- Students will understand the energy management on various electrical equipments.
- Students will have knowledge on the concepts of metering and factors influencing cost function
- Students will be able to learn about the concept of lighting systems, light sources and various forms of cogeneration

TEXT BOOKS

1. Barney L. Capehart, Wayne C. Turner, and William J. Kennedy, Guide to Energy Management, Fifth Edition, The Fairmont Press, Inc., 2006
2. Eastop T.D & Croft D.R, Energy Efficiency for Engineers and Technologists,. Logman Scientific & Technical, ISBN-0-582-03184, 1990.

REFERENCES

1. Reay D.A, Industrial Energy Conservation, 1st edition, Pergamon Press, 1977.
2. IEEE Recommended Practice for Energy Management in Industrial and Commercial Facilities, IEEE, 196.
3. Amit K. Tyagi, Handbook on Energy Audits and Management, TERI, 2003.

ET7071 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 DSprocessors & develop logical functions of DSProcessors with Re-Programmable logics &Devices
- To discuss on Application development with commercial family of DS 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 INTRODUCTION TO DIGITAL SIGNAL PROCESSING 12

Introduction, A Digital Signal-Processing System, The Sampling Process, Discrete Time Sequences, Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Linear Time-Invariant Systems, Decimation and Interpolation, Basics of Digital Filters, FIR Filters, IIR Filters.

UNIT II WAVELET TRANSFORM 6

Introduction to continuous wavelet transform- discrete wavelet transform -orthogonal wavelet decomposition- Multiresolution Analysis-Wavelet function-DWT,bases,orthogonal Basis-Scaling function, Wavelet coefficients- ortho normal wavelets and their relationship to filter banks- Digital filtering interpolation (i) Decomposition filters, (ii) reconstruction, the signal- Example MRA- Haar & Daubechies wavelet.

UNIT III ARCHITECTURES OF COMMERCIAL DIGITAL SIGNAL PROCESSORS 12

Introduction, categorization of DSP Processors, Fixed Point (Blackfin),Floating Point (SHARC),TI TMS 320c6xxx & OMAP processors TMS320C54X & 54xx on Basic Architecture – study : of functional variations of Computational building blocks(with comparison onto their MAC, Bus Architecture and memory, Interrupt- I/O interface, Memory Interface, DMA through one example Architecture in each of these case studies).

UNIT IV INTERFACING I/O PERIPHERALS FOR DSP BASED APPLICATIONS 6

Introduction, External Bus Interfacing Signals, Memory Interface, I/O Interface, Programmed I/O, Interrupts and I / O Direct Memory Access (DMA).**-**Introduction, Design of Decimation and Interpolation Filter, FFT Algorithm, PID Controller ,Application for Serial Interfacing, DSP based Power Meter, Position control

UNIT V VLSI IMPLEMENTATION 9

Low power Design-need for Low power VLSI chips-Basics of DSP system architecture design of functional units, Filter using VHDL programming, Mapping of DSP algorithm onto hardware.

NOTE

Discussions/Exercise/Practice on Workbench : Signal analysis transforms, Filter design concepts with simulation tools as Matlab /Labview/ CCS suites to understand the commercial DSP processor technology.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

- The conceptual aspects of Signal processing Transforms are introduced.
- The comparison on commercial available DSProcessors helps to understand system design through processor interface
- The possibility to develop system on chip design will be explored.

REFERENCES:

1. John G. Proaks, Dimitris G. Manolakis, “Digital Signal Processing”, Pearson Education 2002.
2. Avatar Sing, S. Srinivasan, “Digital Signal Processing- Implementation using DSP Microprocessors with Examples from TMS320C54xx”, Thomson India,2004.
3. Lars Wanhammer, “DSP Integrated Circuits”, Academic press, 1999,NewYork.
4. Lyla B Das,” Embedded Systems-An Integrated Approach”,Pearson2013
5. Ashok Ambardar,”Digital Signal Processing: A Modern Introduction”,Thomson India edition, 2007.
6. Raghuveer M.Rao and Ajit S. Bapardikar, Wavelet transforms- Introduction to theory and applications, Pearson Education, 2000.
7. K.P. Soman and K.L. Ramchandran,Insight into WAVELETS from theory to practice, Eastern Economy Edition, 2008
8. Ifeachor E. C., Jervis B. W ,”Digital Signal Processing: A practical approach, Pearson-Education, PHI/ 2002
9. B Venkataramani and M Bhaskar **“**Digital Signal Processors**”**, TMH, 2nd, 2010
10. Peter Pirsch **“**Architectures for Digital Signal Processing”, John Weily, 2007
11. Vinay K.Ingle,John G.Proakis,”DSP-A Matlab Based Approach”,Cengage Learning,2010
12. Taan S.Elali,”Discrete Systems and Digital Signal Processing with Matlab”,CRC Press2009.

PS7073 OPTIMISATION TECHNIQUES L T P C
3 0 0 3

COURSE OBJECTIVES

- To introduce the different optimization problems and techniques
- To study the fundamentals of the linear and non-linear programming problem.
- To understand the concept of dynamic programming and genetic algorithm technique

UNIT I INTRODUCTION 9

Definition, Classification of optimization problems, Classical Optimization Techniques, Single and Multiple Optimization with and without inequality constraints.

UNIT II LINEAR PROGRAMMING (LP) 9

Simplex method of solving LPP, revised simplex method, duality, Constrained optimization, Theorems and procedure, Linear programming, mathematical model, solution technique, duality.

UNIT III NON LINEAR PROGRAMMING 9

Steepest descent method, conjugates gradient method, Newton's Method, Sequential quadratic programming, Penalty function method, augmented Lagrange multiplier method.,

UNIT IV DYNAMIC PROGRAMMING (DP) 9

Multistage decision processes, concept of sub-optimization and principle of optimality, Recursive relations, Integer Linear programming, Branch and bound algorithm

UNIT V GENETIC ALGORITHM 9

Introduction to genetic Algorithm, working principle, coding of variables, fitness function, GA operators; Similarities and differences between Gas and traditional methods; Unconstrained and constrained optimization using genetic Algorithm, real coded gas, Advanced Gas, global optimization using GA, Applications to power system.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

- Students will learn about different classifications of optimization problems and techniques.
- Students will attain knowledge on linear programming concepts
- Students will understand the application of non- linear programming in optimization techniques
- Students will understand the fundamental concepts of dynamic programming
- Students will have knowledge about Genetic algorithm and its application to optimization in power system.

TEXT BOOKS

1. S.S. Rao ,"Optimization – Theory and Applications", Wiley-Eastern Limited, 1984.
2. G.Luenberger," Introduction of Linear and Non-Linear Programming" , Wesley Publishing Company, 2011.

REFERENCE BOOKS:

1. Computational methods in Optimization, Polak , Academic Press,1971.
2. Optimization Theory with applications, Pierre D.A., Wiley Publications,1969.
3. Taha, H. A., Operations Research: An Introduction, Seventh Edition, Pearson Education Edition, Asia, New Delhi ,2002.

PS7074	SOLAR AND ENERGY STORAGE SYSTEM	L T P C
		3 0 0 3

COURSE OBJECTIVES

- To Study about solar modules and PV system design and their applications
- To Deal with grid connected PV systems
- To Discuss about different energy storage systems

UNIT I INTRODUCTION **9**

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

UNIT II STAND ALONE PV SYSTEM **9**

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

UNIT III GRID CONNECTED PV SYSTEMS **9**

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

UNIT IV ENERGY STORAGE SYSTEMS **9**

Impact of intermittent generation – Battery energy storage – solar thermal energy storage – pumped hydroelectric energy storage

UNIT V APPLICATIONS **9**

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

TOTAL : 45 PERIODS

COURSE OUTCOMES:

- Students will develop more understanding on solar energy storage systems
- Students will develop basic knowledge on standalone PV system
- Students will understand the issues in grid connected PV systems
- Students will study about the modelling of different energy storage systems and their performances
- Students will attain more on different applications of solar energy

TEXT BOOKS

1. Eduardo Lorenzo G. Araujo, Solar electricity engineering of photovoltaic systems, Progensa,1994.
2. Stuart R.Wenham, Martin A.Green, Muriel E. Watt and Richard Corkish, Applied Photovoltaics, 2007,Earthscan, UK.

REFERENCES:

1. Frank S. Barnes & Jonah G. Levine, Large Energy storage Systems Handbook , CRC Press, 2011.
2. Solar & Wind energy Technologies – McNeils, Frenkel, Desai, Wiley Eastern, 1990
3. Solar Energy – S.P. Sukhatme, Tata McGraw Hill,1987.

PS7075 WIND ENERGY CONVERSION SYSTEM L T P C
3 0 0 3

COURSE OBJECTIVES

- To learn the design and control principles of Wind turbine.
- To understand the concepts of fixed speed and variable speed, wind energy conversion systems.
- To analyze the grid integration issues.

UNIT I INTRODUCTION 9

Components of WECS-WECS schemes-Power obtained from wind-simple momentum theory-Power coefficient-Sabinin's theory-Aerodynamics of Wind turbine

UNIT II WIND TURBINES 9

HAWT-VAWT-Power developed-Thrust-Efficiency-Rotor selection-Rotor design considerations-Tip speed ratio-No. of Blades-Blade profile-Power Regulation-yaw control-Pitch angle control-stall control-Schemes for maximum power extraction.

UNIT III FIXED SPEED SYSTEMS 9

Generating Systems- Constant speed constant frequency systems -Choice of Generators-Deciding factors-Synchronous Generator-Squirrel Cage Induction Generator- Model of Wind Speed- Model wind turbine rotor - Drive Train model- Generator model for Steady state and Transient stability analysis.

UNIT IV VARIABLE SPEED SYSTEMS 9

Need of variable speed systems-Power-wind speed characteristics-Variable speed constant frequency systems synchronous generator- DFIG- PMSG -Variable speed generators modelling - Variable speed variable frequency schemes.

UNIT V GRID CONNECTED SYSTEMS 9

Wind interconnection requirements, low-voltage ride through (LVRT), ramp rate limitations, and supply of ancillary services for frequency and voltage control, current practices and industry trends wind interconnection impact on steady-state and dynamic performance of the power system including modelling issue.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- Students will attain knowledge on the basic concepts of Wind energy conversion system.
- Students will have the knowledge of the mathematical modelling and control of the Wind turbine
- Students will develop more understanding on the design of Fixed speed system
- Students will study about the need of Variable speed system and its modelling.
- Students will learn about Grid integration issues and current practices of wind interconnections with power system.

TEXT BOOKS

1. L.L.Freris "Wind Energy conversion Systems", Prentice Hall, 1990
2. S.N.Bhadra, D.Kastha,S.Banerjee,"Wind Electrical Sytems",Oxford University Press,2010.

REFERENCES
1. Ion Boldea, "Variable speed generators", Taylor & Francis group, 2006.
2. E.W.Golding "The generation of Electricity by wind power", Redwood burn Ltd., Trowbridge,1976.
3. N. Jenkins," Wind Energy Technology" John Wiley & Sons,1997
4. S.Heir "Grid Integration of WECS", Wiley 1998.

PS7255 **SMART GRIDS** **L T P C**
3 0 0 3

COURSE 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 (Transmission) 9
Technology Drivers, Smart energy resources, Smart substations, Substation Automation, Feeder Automation ,Transmission systems: EMS, FACTS and HVDC, Wide area monitoring, Protection and control

UNIT III SMART GRID TECHNOLOGIES (Distribution) 9
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 IV 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 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

COURSE OUTCOMES:
- Students will develop more understanding on the concepts of Smart Grid and its present developments.
- Students will study about different Smart Grid technologies.
- Students will acquire knowledge about different smart meters and advanced metering infrastructure.

- Students will have knowledge on power quality management in Smart Grids
- Students will develop more understanding on LAN, WAN and Cloud Computing for Smart Grid applications.

TEXT BOOKS

1. Stuart Borlase "Smart Grid :Infrastructure, Technology and Solutions",CRC Press 2012.
2. Janaka Ekanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, "Smart Grid: Technology and Applications", Wiley.

REFERENCES*:*

1. 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, November 2011.
2. Xi Fang, Satyajayant Misra, Guoliang Xue, and Dejun Yang "Smart Grid – The New and Improved Power Grid: A Survey" , IEEE Transaction on Smart Grids,

PW7072 ELECTRIC VEHICLES AND POWER MANAGEMENT L T P C
3 0 0 3

COUSE OBJECTIVE:

- 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

COURSE OUTCOME:

- This course equips the student to understand the operation of Electric vehicles and various energy storage technologies for electrical vehicles.

REFERENCES

1. Iqbal Hussain, CRC Press, Taylor & Francis Group, Second Edition (2011).
2. Ali Emadi, Mehrdad Ehsani, John M.Miller Vehicular Electric Power Systems, Special Indian Edition, Marcel dekker, Inc 2010

ET7013 SECURITY IN NETWORKS AND CRYPTOGRAPHY 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-Hellman Key Exchange – Elliptic Curve Cryptography – Message Authentication and Hash Functions – 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 SYSTEM SECURITY 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

Discussions/Exercice/Practice on Workbench : on the basics /numerical design aspects of encryption,decryption keys/password creation etc

TOTAL : 45 PERIODS

COURSE OUTCOME:

- 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 .

REFERRENCE:

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. Bruce Schneier, “Applied Cryptography”, John Wiley and Sons Inc, 2001.
4. Stewart S. Miller, “Wi-Fi Security”, McGraw Hill, 2003.
5. Charles B. Pfleeger, Shari Lawrence Pfleeger, “Security In Computing”, 3rd Edition, Pearson Education, 2003.
6. Mai, “Modern Cryptography: Theory and Practice”, First Edition, Pearson Education, 2003.

ET7072	DIGITAL IMAGE PROCESSING	L T P C
		3 0 0 3

COURSE OBJECTIVES

- To understand the techniques for image enhancement.; image segmentation;the techniques for compression etc for Grey scale & Color Images

UNIT I IMAGE REPRESENTATION 9

Image representation-Image Basis Functions- Two dimensional DFT- Discrete Cosine TransformWalsh- Hadamard transform-Wavelet transform- Principal component analysis.

UNIT II IMAGE ENHANCEMENT AND RESTORATION 9

Gray level transformation techniques- Spatial domain techniques - Half toning, Median filtering, contrast stretching, Histogram Equalization- Frequency domain techniques - Weiner filteringHomomorphic filtering- PSFs for different forms of blur - noise models- color image processing.

UNIT III IMAGE SEGMENTATION 9

Segmentation - Similarity and dissimilarity methods- Thresholding - Edge based and Region based methods- Hough transform- Morphological operations - Clustering methods.

UNIT IV IMAGE COMPRESSION 9

Source coding techniques - Run length coding - Shannon- Fano coding- Huffman coding- Arithmetic coding- LZW coding - Transform and Predictive compression methods - Vector quantization- case studies - JPEG-MPEG.

UNIT V COLOR IMAGE PROCESSING 9

Percception of color,color model,chromaticity diagram,color image -quantization, filtering,gamma correction,pseudo color ,segmentation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- To be able to design and implement image enhancement schemes; compression schemes.; restoration schemes; segmentation schemes

REFERENCES:

1. Gonzalez R. C. and Woods R.E., “Digital Image Processing”, 3rd Edition, Prentice- Hall, 2008.
2. Jayaraman,Esakirajan,Veerakumar,”Digital Image Processing”;McGrawHill,2013
   William K. Pratt, “Digital Image Processing”, John Wiley, 4th Edition, 2007.
4. Sonka M, “Image Processing, Analysis and Machine Vision”, Vikas Publishing Home (Thomson) 2001.
5. Schalkoff R.J., “Digital Image Processing & Computer Vision”, John Wiley & Sons, 1992.
6. Richard O. Duda, Peter E. Hart and David G. Stork., “Pattern Classification”, Wiley, 2001.
7. J.W. Woods, "Multidimensional Signal, Image, Video Processing and Coding", 2nd Edition, Academic Press, 2012.
8. Jain A.K., “Fundamentals of Digital Image Processing”, PHI Learning Private Ltd., 1989.

CO7073	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

COURSE 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.

ET7012 REAL TIME SYSTEMS L T P C
3 0 0 3

OBJECTIVES

- To teach the fundamentals of Real Time systems
- To introduce the concepts related to Scheduling and Programming Languages
- To make them understand the process of real-time system design
- To have an understanding about fault tolerance and reliability

UNIT I INTRODUCTION 9

Introduction – Issues in Real Time Computing – Structure of a Real Time System – Task classes Performance Measures for Real Time Systems – Estimating Program Run Times – Characteristics of Real-time Systems – Classification of Real-time systems – Applications of Real-time Systems – Safety and Reliability. Basic Concepts of Scheduling: Real-time applications - Basic concepts for real-time task scheduling. Scheduling of Independent Tasks: Basic on-line algorithms for periodic tasks - Hybrid task sets scheduling.

UNIT II SCHEDULING IN REAL-TIME SYSTEMS 9

Scheduling of Dependent Tasks: Tasks with precedence relationsships - Tasks sharing critical resources. Scheduling schemes for handling overload: Scheduling techniques in overload conditions - Handling real-time tasks with varying timing parameters - Handling overload conditions for hybrid task sets. Multiprocessor scheduling: Introduction - First results and comprison with uniprocessor scheduling - schedualability conditions - Scheduling algorithms.

UNIT III PROGRAMMING LANGUAGE AND TOOLS 9

Programming Languages and Tools – Desired language characteristics – Data typing – Control

structures Facilitating Hierarchical Decomposition, Packages, Run time (Exception) Error handling – Overloading and Generics – Multitasking – Low level programming – Task Scheduling – Timing Specifications – Programming Environments – Run-time support. A Taxonomy of Real-Time Software Architectures:

UNIT IV REAL-TIME SYSTEM DESIGN 9

General Introduction to Design of Real-time Systems: Specification Document – Preliminary Design – Single-program approach – Foreground/Background System – Multi-tasking approach – Mutual Exclusion – Monitors – Rendezvous. Real-time System Development Methodologies: Yourdon Methodology – Ward and Mellor Method – Hatley and Pirbhai Method – MASCOT – Basic Features of MASCOT – Basics Features – General Design Approach – Textual Representation of MASCOT Designs – Other Features – The PAISLey System for Real-time Software Development. Design Analysis: Petri Nets.

UNIT V FAULT TOLERANCE AND RELIABILITY EVALUATION TECHNIQUES 9

Fault Tolerance Techniques – Fault Types – Fault Detection – Fault Error containment – Redundancy – Data Diversity – Reversal Checks – Integrated Failure handling. Reliability Evaluation Techniques: Obtaining parameter values – Reliability models for Hardware Redundancy – Software error models. Case Studies: Advanced Control in Thermal Power Plants / Current Status of Microcomputer Applications in Railway Transportation Systems.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

- The learning process delivers insight into incorporating schedulers into various embedded & computational processes with improved design strategies.
- Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design.

REFERENCE BOOKS

1. C.M. Krishna, Kang G. Shin, “Real-Time Systems”, McGraw Hill International Editions, 1997.
2. Stuart Bennett, “Real-time Computer Control”, Second Edition, Pearson Education Ltd., 2012.
3. Francis Cottet, Joelle Delacroix and Zoubir Mammeri, “ Scheduling in Real-Time Systems”, John Wiley & Sons Ltd., 2002.
4. Rajib Mall, “Real-Time Systems: Theory and Practice”, Pearson Education.
5. TimeSys Corporation, “The Concise Handbook Of Real-Time Systems”, TimeSys Corporation, Pittsburgh, PA, 2002.
6. Spyros G Tzafestas and J K Pal, “Real Time Microcomputer Control of Industrial Processes”, Kluwer Academic Publishers, The Netherlands, 1990.
7. NPTEL Videos: http://nptel.ac.in/courses/106105036/2

ET7075 VLSI BASED DESIGN METHODOLOGIES L T P C
3 0 0 3

COURSE OBJECTIVES

- To give an insight to the students about the significance of CMOS technology and fabrication process.
- To teach the importance and architectural features of programmable logic devices.
- To introduce the ASIC construction and design algorithms
- To teach the basic analog VLSI design techniques, Logic synthesis and simulation of digital system with Verilog HDL
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

UNIT I CMOS DESIGN 9

Overview of l VLSI design Methodologies- Logic design with CMOS-transmission gate circuits-Clocked CMOS-dynamic CMOS circuits, Bi-CMOS circuits- Layout diagram, Stick diagram-IC fabrications – Low Power VLSI techniques-Trends in IC technology.

UNIT II PROGRAMABLE LOGIC DEVICES 9

Programming Techniques-Anti fuse-SRAM-EPROM and EEPROM technology –Re-Programmable Devices Architecture- Logical blocks, I/O blocks, Interconnects, Xilinx- XC9500,Cool Runner - XC5200, SPARTAN, Virtex - Altera MAX 7000-Flex 10K-Cyclone,Stratix.

UNIT III ASIC CONSTRUCTION, FLOOR PLANNING, PLACEMENT AND ROUTING 9

System partition – FPGA partitioning – Partitioning methods- floor planning – placement- physical design flow – global routing – detailed routing – special routing- circuit extraction – DRC.

UNIT IV ANALOG VLSI DESIGN 9

Introduction to analog VLSI- Design of CMOS 2stage-3 stage Op-Amp –High Speed and High frequency op-amps-Super MOS- Analog primitive cells-realization of neural networks- Introduction to FPAA.

UNIT V LOGIC SYNTHESIS AND SIMULATION 9

Overview of digital design with Verilog HDL, hierarchical modelling concepts, modules and port definitions, gate level modelling, data flow modelling, behavioural modelling, task & functions, Verilog and logic synthesis-simulation-Design examples,Ripple carry Adders, Carry Look ahead adders, Multiplier, ALU, Shift Registers, Multiplexer, Comparator, Test Bench.

NOTE

Discussions/Practice on Workbench : Practice Digital design with Verilog HDL, gate level modelling, -simulation-Design examples like say Ripple carry Adders, Carry Look ahead adders, Multiplier, ALU, Shift Registers, Multiplexer, Comparator, on Xilinx Platform/Processor Supported Test Bench

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- The learning process delivers insight into developing design logic/arithmetic functionalities of various embedded & computational arithmetic/logic functionalities evolvable in processors with improved design strategies.
- Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design .

REFERENCES:

1. M.J.S Smith, “Application Specific integrated circuits”,Addition Wesley Longman Inc.1997.
2. Kamran Eshraghian,Douglas A.pucknell and Sholeh Eshraghian,”Essentials of VLSI circuits and system”, Prentice Hall India,2005.
3. Wayne Wolf, “ Modern VLSI design “ Prentice Hall India,2006.
4. Mohamed Ismail ,Terri Fiez, “Analog VLSI Signal and information Processing”, McGraw Hill International Editions,1994.
5. Samir Palnitkar, “Veri Log HDL, A Design guide to Digital and Synthesis” 2nd Ed,Pearson,2005.

CO7072 MULTI SENSOR DATA FUSION L T P C

3 0 0 3

COURSE OBJECTIVES

- To educate on sensor data inference hierarchy and fusion models.
- To educate on the algorithms used for data fusion.
- To educate on Kalman filter and its application to decision identity fusion.
- To educate on advanced filtering and sensor fusion concepts.
- To introduce various high performance data structures.

UNIT I MULTISENSOR DATA FUSION INTRODUCTION 9

sensors and sensor data, Use of multiple sensors, Fusion applications. The inference hierarchy: output data. Data fusion model. Architectural concepts and issues. Benefits of data fusion, Mathematical tools used:Algorithms, co-ordinate transformations, rigid body motion. Dependability and Markov chains, Meta – heuristics.

UNIT II ALGORITHMS FOR DATA FUSION 9

Taxonomy of algorithms for multisensor data fusion. Data association. Identity declaration.

UNIT III ESTIMATION: 9

Kalman filtering, practical aspects of Kalman filtering, extended Kalmal filters. Decision level identify fusion. Knowledge based approaches.

UNIT IV ADVANCED FILTERING 9

Data information filter, extended information filter. Decentralized and scalable decentralized estimation. Sensor fusion and approximate agreement. Optimal sensor fusion using range trees recursively. Distributed dynamic sensor fusion.

UNIT V HIGH PERFORMANCE DATA STRUCTURES: 9

Tessellated, trees, graphs and function. Representing ranges and uncertainty in data structures. Designing optimal sensor systems with in dependability bounds. Implementing data fusion system.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

- Ability to explain and use multiple sensor data in data fusion model.
- Capable to use algorithms for data fusion.

- Ability to estimate using kalman filter.
- Ability to estimate using advance filtering such as data, extended information filtering.
- Ability to handle various high performance data structures.

REFERENCES:

1. David L. Hall, Mathematical techniques in Multisensor data fusion, Artech House, Boston, 1992.
2. R.R. Brooks and S.S. Iyengar, Multisensor Fusion: Fundamentals and Applications with Software, Prentice Hall Inc., New Jersey, 1998.
3. Arthur Gelb, Applied Optimal Estimation, The M.I.T. Press, 1982.
4. James V. Candy, Signal Processing: The Model Based Approach, McGraw –Hill Book Company, 1987.

ET7009 OPEN SOURCE SOFTWARE L T P C
3 0 0 3

COURSE OBJECTIVES:

- Define open source software
- Identify and discuss various software licensing models
- Understand the motivation, theory, strengths and weaknesses of open source software.
- Become familiar with Linux, MySQL, PHP, Python, Apache and other Tools and technologies
- 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 9

Open Source Terminologies: Open Source Software, Freeware, Shareware, Proprietary Software - Introduction to Open sources - Need of Open Sources - Advantages of Open Sources - Application of Open Sources. Open source operating systems: LINUX: Introduction - General Overview - Kernel Mode and user mode - Process - Advanced Concepts - Scheduling - Personalities- Cloning - Signals - Development with Linux.

UNIT II OPEN SOURCE DATABASE 9

MySQL: Introduction - Setting up account - Starting, terminating and writing your own SQL programs - Record selection Technology - Working with strings - Date and Time - Sorting Query Results - Generating Summary - Working with metadata - Using sequences - MySQL and Web.

UNIT III OPEN SOURCE PROGRAMMING LANGUAGES 9

PHP: Introduction - Programming in web environment - variables - constants - data types - operators - Statements - Functions - Arrays - OOP - String Manipulation and regular expression - File handling and data storage - PHP and SQL database - PHP and LDAP - PHP Connectivity - Sending and receiving E-mails - Debugging and error handling - Security - Templates.

UNIT IV PYTHON 9

Syntax and Style - Python Objects - Numbers - Sequences - Strings - Lists and Tuples - Dictionaries - Conditionals and Loops - Files - Input and Output - Errors and Exceptions - Functions - Modules - Classes and OOP - Execution Environment.

UNIT V OPEN SOURCE WEB SERVER, TOOLS AND TECHNOLOGIES 9

General Overview of Web Server - Case Study: Apache Web server - Working with Web Server - Configuring and using Apache Web services - Case Study: Apache Tomcat - Open Source IDE - Modeling Tools - Mozilla Firefox - Wikipedia - Eclipse.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- The student will have a clear understanding about the terms, tools & programming Languages in the open source category for application development
- Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design.

REFERENCES:

1. Remy Card, Eric Dumas and Frank Mevel, "The Linux Kernel Book", Wiley Publications, 2003
2. Steve Suchring, "MySQL Bible", John Wiley, 2002
3. Rasmus Lerdorf and Levin Tatroe, "Programming PHP", O'Reilly, 2002
4. Wesley J. Chun, "Core Phython Programming", Prentice Hall, 2001
5. Martin C. Brown, "Perl: The Complete Reference", 2nd Edition, Tata McGraw-HillPublishing Company Limited, Indian Reprint 2009.
6. Steven Holzner, "PHP: The Complete Reference", 2nd Edition, Tata McGraw-HillPublishing Company Limited, Indian Reprint 2009.
7. Vikram Vaswani, "MYSQL: The Complete Reference", 2nd Edition, Tata McGraw-Hill Publishing Company Limited, Indian Reprint 2009.
8. Vivek Chopra, Sing Li, Jeff genender, "Professional Apache Tomcat 6", Wiley India, 2007

ET7011 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 datatypes 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, Subprocesses, 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 unittest 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

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,Powerful OOPs,O'reilly,2011
2. Guttag, John. Introduction to Computation and Programming Using Python. MIT Press, 2013.
3. Zelle, John M. Python Programming: An Introduction to Computer Science. 1st ed. Franklin Beedle& Associates, 2003
4. Budd, Timothy. Exploring Python. McGraw-Hill Science, 2009.

ET7014 **WEB TECHNOLOGIES AND TRENDS** **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To teach the fundamentals of Internet Technology.
- To teach on functional components Web services, data management
- To discuss on significance of SOA in embedded networking
- To teach the need of Cloud Computing, its services for embedded applications
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

UNIT I WEB ESSENTIALS **9**

Web Essentials: Clients, Servers, and Communication. The Internet-Basic Internet Protocols -The World Wide Web-HTTP request message-response message-Web Clients Web Servers-Case Study. Markup Languages: XHTML. An Introduction to HTML History-Versions-Basic XHTML Syntax and Semantics-Some Fundamental HTML Elements-Relative URLs-Lists-tables-Frames-Forms-XML Creating HTML Documents Case Study.

UNIT II WEB DATA **9**

Representing Web Data: XML-Documents and Vocabularies- Versions and Declaration-Namespaces JavaScript and XML: Ajax-DOM based XML processing Event-oriented Parsing: SAX-Transforming XML Documents-Selecting XML Data: XPATH-Template based Transformations: XSLT-Displaying XML Documents in Browsers.

UNIT III SERVICE ORIENTED ARCHITECTURE **9**

Roots of SOA – Characteristics of SOA - Comparing SOA to client-server and distributed internet architectures – Anatomy of SOA- How components in an SOA interrelate - Principles of service orientation

UNIT IV INTRODUCTION TO CLOUD COMPUTING **9**

Basics of Cloud Computing – History of Cloud Computing – Cloud Architecture – Cloud Storage – Why Cloud Computing Matters – Advantages of Cloud Computing – Disadvantages of Cloud Computing – Companies in the Cloud Today – Cloud Services

UNIT V USING CLOUD SERVICES **9**

Collaborating on Calendars, Schedules and Task Management – Exploring Online Scheduling Applications – Exploring Online Planning and Task Management – Collaborating on Event Management – Collaborating on Contact Management – Collaborating on Project Management – Collaborating on Word Processing - Collaborating on Databases – Storing and Sharing Files

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- The learning process delivers insight onto role of Web enabled communication systems in networking for large scale systems like the grid
- Improved Employability and entrepreneurship capacity with knowledge up gradation on recent trends in embedded systems design.

REFERENCES:

1. Jeffrey C. Jackson, "Web Technologies--A Computer Science Perspective", Pearson Education, 2006.

2. Thomas Erl**, "**Service-Oriented Architecture: Concepts, Technology, and Design", Pearson Education, 2005.
3. Michael Miller, Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online, Que Publishing, August 2008.
4. Rajkumar Buyya, Christian Vecchiola, and Thamarai Selvi, Mastering Cloud Computing, Morgan Kaufmann, ISBN: 978-0-12-411454-8, Burlington, Massachusetts, USA, May 2013.
5. Anthony t. velte,'Cloud computing a practical approach',TATA McGRAW-HILL,2011.
6. Deitel, Deitel, Goldberg, "Internet & World Wide Web How To Program", Third Edition, Pearson Education, 2006.
7. Bates, "Developing Web Applications", Wiley, 2006.