UNIVERSITY DEPARTMENTS

ANNA UNIVERSITY::CHENNAI 600 025

REGULATIONS – 2013 (FULL TIME)

CURRICULUM FROM I TO IV SEMESTERS FOR

M.E EMBEDDED SYSTEM TECHNOLOGIES

SEMESTER I

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	ET8101	Design of Embedded Systems	3	0	0	3
2	ET8102	Real Time Systems	3	0	0	3
3	ET8151	Advanced Digital Principles and Design	3	1	0	4
4	ET8152	Microcontroller Based System Design	3	0	0	3
5	MA8156	Applied Mathematics for Electrical Engineers	3	1	0	4
6		Elective I	3	0	0	3
		TOTAL	**18**	**2**	**0**	**20**

SEMESTER II

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	ET8201	Wireless and Mobile Communication	3	1	0	4
2	ET8251	Real Time Operating System	3	0	0	3
3	ET8252	Software for Embedded Systems	3	1	0	4
4	ET8253	VLSI Based Design Methodologies	3	1	0	4
5		Elective II	3	0	0	3
PRACTICAL						
6	ET8211	Embedded System Lab I	0	0	3	2
		TOTAL	**15**	**3**	**3**	**20**

SEMESTER III

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	ET8351	Distributed Embedded Computing	3	0	0	3
2		Elective III	3	0	0	3
3		Elective IV	3	0	0	3
PRACTICAL						
4	ET8311	Project Work Phase I	0	0	12	6
		TOTAL	**9**	**0**	**12**	**15**

SEMESTER IV

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
PRACTICAL						
1	ET8411	Project Work Phase II	0	0	24	12
		TOTAL	**0**	**0**	**24**	**12**

TOTAL CREDITS 67

Attested

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ELECTIVES

Sl.No	Code	Subject	L	T	P	C
1	ET8001	Ad-Hoc Networks	3	0	0	3
2	ET8002	Adv Computer Architecture and Parallel Processing	3	0	0	3
3	ET8003	Advanced Embedded Systems	3	0	0	3
4	ET8004	Design of Automobile Embedded System	3	0	0	3
5	ET8005	Digital Instrumentation	3	0	0	3
6	ET8006	Embedded Linux	3	0	0	3
7	ET8007	Embedded Networking and Automation of Electrical System	3	0	0	3
8	ET8008	Nano Electronics	3	0	0	3
9	ET8009	Pervasive Devices and Technology	3	0	0	3
10	ET8010	RISC Processor Architecture and Programming	3	0	0	3
11	ET8011	Smart Meters and Smart Grid Communication	3	0	0	3
12	CO8071	Robotics and Control	3	0	0	3
13	CO8151	Soft Computing Techniques	3	0	2	4
14	ET8071	Advanced Digital Signal Processing	3	0	0	3
15	ET8072	MEMS Technology	3	0	0	3
16	ET8073	Security in Networks and Cryptography	3	0	0	3
17	PS 8073	Energy Management and Auditing	3	0	0	3
18	PS 8076	Solar and Energy Storage System	3	0	0	3
19	PS 8077	Wind Energy Conversion System	3	0	0	3
20	PS 8255	Smart Grids	3	0	0	3

UNIVERSITY DEPARTMENTS

ANNA UNIVERSITY::CHENNAI 600 025

REGULATIONS – 2013 (PART TIME)

CURRICULUM FROM I TO VI SEMESTERS FOR

M.E EMBEDDED SYSTEM TECHNOLOGIES

SEMESTER I

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	ET8151	Advanced Digital Principles and Design	3	1	0	4
2	ET8152	Microcontroller Based System Design	3	0	0	3
3	MA8156	Applied Mathematics for Electrical Engineers	3	1	0	4
		TOTAL	**9**	**2**	**0**	**11**

SEMESTER II

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	ET8201	Wireless and Mobile Communication	3	1	0	4
2	ET8252	Software for Embedded Systems	3	1	0	4
3	ET8253	VLSI Based Design Methodologies	3	1	0	4
		TOTAL	**9**	**3**	**0**	**12**

SEMESTER III

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	ET8101	Design of Embedded Systems	3	0	0	3
2	ET8102	Real Time Systems	3	0	0	3
3		Elective I	3	0	0	3
		TOTAL	**9**	**0**	**0**	**9**

SEMESTER IV

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	ET8251	Real Time Operating System	3	0	0	3
2		Elective II	3	0	0	3
PRACTICAL						
3	ET8211	Embedded System Lab I	0	0	3	2
		TOTAL	**6**	**0**	**3**	**8**

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SEMESTER V

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	ET8351	Distributed Embedded Computing	3	0	0	3
2		Elective III	3	0	0	3
3		Elective IV	3	0	0	3
PRACTICAL						
4	ET8311	Project Work Phase I	0	0	12	6
		TOTAL	**9**	**0**	**12**	**15**

SEMESTER VI

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
PRACTICAL						
1	ET8411	Project Work Phase II	0	0	24	12
		TOTAL	**0**	**0**	**24**	**12**

ELECTIVES

Sl.No	Code	Subject	L	T	P	C
1	ET8001	Ad-Hoc Networks	3	0	0	3
2	ET8002	Adv Computer Architecture and Parallel Processing	3	0	0	3
3	ET8003	Advanced Embedded Systems	3	0	0	3
4	ET8004	Design of Automobile Embedded System	3	0	0	3
5	ET8005	Digital Instrumentation	3	0	0	3
6	ET8006	Embedded Linux	3	0	0	3
7	ET8007	Embedded Networking and Automation of Electrical System	3	0	0	3
8	ET8008	Nano Electronics	3	0	0	3
9	ET8009	Pervasive Devices and Technology	3	0	0	3
10	ET8010	RISC Processor Architecture and Programming	3	0	0	3
11	ET8011	Smart Meters and Smart Grid Communication	3	0	0	3
12	CO8071	Robotics and Control	3	0	0	3
13	CO8151	Soft Computing Techniques	3	0	2	4
14	ET8071	Advanced Digital Signal Processing	3	0	0	3
15	ET8072	MEMS Technology	3	0	0	3
16	ET8073	Security in Networks and Cryptography	3	0	0	3
17	PS 8073	Energy Management and Auditing	3	0	0	3
18	PS 8076	Solar and Energy Storage System	3	0	0	3
19	PS 8077	Wind Energy Conversion System	3	0	0	3
20	PS 8255	Smart Grids	3	0	0	3

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ET 8101 **DESIGN OF EMBEDDED SYSTEMS** **L T P C**
3 0 0 3

Pre-requisites: Digital logic Circuits, microcontrollers architecture & programming

OBJECTIVES

- To provide a clear understanding on the basic concepts, Building Blocks of Embedded System
- To teach the fundamentals of Embedded processor Modeling
- To study on Bus Communication in processors, Input/output interfacing
- To introduce on processor scheduling algorithms , Basics of Real time operating system
- To introduce different Phases & Modeling of embedded system with its applications to various fields

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, Incircuit emulator, Target Hardware Debugging, Boundary Scan.

UNIT II HARDWARE SOFTWARE PARTITIONING 9

Hardware/Software Co-Design-basic concepts- goals-issues in Co-Design Models -finite state machine-HFSM-PSM- Architectures control/data flow nets ,task graphs –generic codesign Methodology –approaches-challenges, System Specification languages-statecharts and modeling- Single-processor Architectures Hardware / Software duality – HW/SW portioning- Algorithm development-prototyping &emulation technique.

UNIT III EMBEDDED NETWORKING AND INTERRUPTS SERVICE MECHANISM 6

Embedded Networking: Introduction, I/O Device Ports & Buses– Serial Bus communication protocols -RS232 standard – RS485 – 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 IV 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 V EMBEDDED SYSTEM APPLICATION DEVELOPMENT WITH PROCESSOR 9

Objective, Need, different Phases & Modelling 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.

TOTAL: 45 PERIODS

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. Jorgen Staunstrup, Wayne Wolf, "Harware / Software Co-Design: Principles and Practice", Kluwer Academic Pub, 1997.
6. Shibu.K.V, "Introduction to Embedded Systems", Tata Mcgraw Hill,2009
7. Tammy Noergaard, "Embedded System Architecture, A comprehensive Guide for Engineers and Programmers", Elsevier, 2006
8. Prasad KVKK,"Embedded/Real-Time Systems-Concepts, Design & Programming-Black Book", dreamtech Press, 2010
9. Frank Vahid and Tony Gwargie, "Embedded System Design", John Wiley & sons,2002.
10. Rajib Mall "Real-Time systems Theory and Practice" Pearson Education, 2007
11. Han-Way Huang, "Embedded system Design using C8051", Cengage Learning,2009
12. Arnold S. Berger – "Embedded System Design", CMP books, USA 2002.

ET8102 **REAL TIME SYSTEMS** **LT P C**
3 0 0 3

Pre-requisites: Operating System ,Programming

OBJECTIVES

- To expose the students to the fundamentals of Real Time systems
- To teach the fundamentals of Scheduling and features of programming languages
- To study the data management system for real time
- To introduce the fundamentals of real time communication
- To teach the different algrorithms and techniques used for real time systems

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 – Task Assignment and Scheduling – Classical uniprocessor scheduling algorithms – Uniprocessor scheduling of IRIS tasks – Task assignment – Mode changes and Fault Tolerant Scheduling.

UNIT II PROGRAMMING LANGUAGES 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.

UNIT III REAL TIME DATABASES **9**

Real time Databases – Basic Definition, Real time Vs General Purpose Databases, Main Memory Databases, Transaction priorities, Transaction Aborts, Concurrency control issues, Disk Scheduling Algorithms, Two – phase Approach to improve Predictability – Maintaining Serialization Consistency – Databases for Hard Real Time Systems.

UNIT IV COMMUNICATION **9**

Real – Time Communication – Communications media, Network Topologies Protocols, Fault Tolerant Routing. Fault Tolerance Techniques – Fault Types – Fault Detection. Fault Error containment Redundancy – Data Diversity – Reversal Checks – Integrated Failure handling.

UNIT V EVALUATION TECHNIQUES **9**

Reliability Evaluation Techniques – Obtaining parameter values, Reliability models for Hardware Redundancy – Software error models. Clock Synchronization – Clock, A Nonfault – Tolerant Synchronization Algorithm – Impact of faults – Fault Tolerant Synchronization in Hardware – Fault Tolerant Synchronization in software.

TOTAL : 45 PERIODS

REFERENCES

1. C.M. Krishna, Kang G. Shin, “Real – Time Systems”, McGraw – Hill International Editions, 1997.
2. Rajib Mall, ”Real-time systems: theory and practice”, Pearson Education, 2007
3. Peter D.Lawrence, “Real Time Micro Computer System Design – An Introduction”, McGraw Hill, 1988.

4. Stuart Bennett, “Real Time Computer Control – An Introduction”, Prentice Hall of India, 1998.
5. S.T. Allworth and R.N.Zobel, “Introduction to real time software design”, Macmillan, 2nd Edition, 1987.
6. R.J.A Buhur, D.L Bailey, “An Introduction to Real – Time Systems”, Prentice – Hall International, 1999.
7. Philip.A.Laplante, “Real Time System Design and Analysis”, Prentice Hall of India, 3rd Edition, April 2004

ET8151 ADVANCED DIGITAL PRINCIPLES AND DESIGN LT P C
3 1 0 4

Pre-requisites: Digital logic Devices, Circuits, Boolean Algebra

OBJECTIVES

- To expose the students to the fundamentals of sequential system design, modelling
- To teach the fundamentals of Asynchronous circuits, switching errors
- To study on Fault identification in digital switching circuits
- To introduce logics for design of Programmable Devices
- To comparatively study the classification of commercial family of Programmable Devices

UNIT I SEQUENTIAL CIRCUIT DESIGN 9
Analysis of Clocked Synchronous Sequential Networks (CSSN) Modelling of CSSN – State Stable Assignment and Reduction – Design of CSSN – Design of Iterative Circuits – 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 – Data Synchronizers – Designing Vending Machine Controller – Mixed Operating Mode Asynchronous Circuits.

UNIT III FAULT DIAGNOSIS AND TESTABILITY ALGORITHMS 9
Fault Table Method – Path Sensitization Method – Boolean Difference Method – Kohavi Algorithm – Tolerance Techniques – The Compact Algorithm – Practical PLA’s – Fault in PLA – Test Generation – Masking Cycle – DFT Schemes – Built-in Self Test.

UNIT IV SYNCHRONOUS DESIGN USING PROGRAMMABLE DEVICES 9
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 9
Architecture with EPLD, PEEL – Realization State machine using PLD – FPGA-Aptix Field Programmable Interconnect – Xilinx FPGA – Xilinx 2000 - Xilinx 4000 family.VHDL based Designing with PLD-ROM,PAL,PLA,Sequential PLDs,Case study –Keypad Scanner

TUTORIAL: 12

LOGIC SYNTHESIS AND SIMULATION Overview of digital design with VHDL, hierarchical modelling concepts, modules and port definitions, gate level modelling, data flow modelling, behavioural modelling, 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

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

ET8152 MICROCONTROLLER BASED SYSTEM DESIGN LT P C
3 0 0 3

Pre-requisites: Basics of Processor Architecture & Programming in 8085/8051

COURSE OBJECTIVES
- To expose the students to the fundamentals of microcontroller based system design
- To teach I/O and RTOS role on microcontroller.
- To impart knowledge on
- PIC Microcontroller based system design.
- To introduce Microchip PIC 8 bit peripheral system Design
- To give case study experiences for microcontroller based applications.

UNIT I 8051 ARCHITECTURE 9
Architecture – memory organization – addressing modes – instruction set – Timers - Interrupts - I/O ports, Interfacing I/O Devices – Serial Communication.

UNIT II 8051 PROGRAMMING 9

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

UNIT III PIC MICROCONTROLLER 9

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

UNIT IV PERIPHERAL OF PIC MICROCONTROLLER 9

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

UNIT V SYSTEM DESIGN – CASE STUDY 9

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

TOTAL : 45 PERIODS

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. John Iovine, 'PIC Microcontroller Project Book ', McGraw Hill 2000
3. Myke Predko, "Programming and customizing the 8051 microcontroller", Tata McGraw Hill 2001.
4. Muhammad Ali Mazidi, Janice G. Mazidi and Rolin D. McKinlay, 'The 8051 Microcontroller and Embedded Systems' Prentice Hall, 2005.

MA8156 APPLIED MATHEMATICS FOR ELECTRICAL ENGINEERS L T P C

3 1 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 (9+3)

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

UNIT II CALCULUS OF VARIATIONS (9+3)

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 (9+3)

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 (9+3)

Formulation – Graphical solution – Simplex method – Two phase method - Transportation and Assignment Models

UNIT V FOURIER SERIES (9+3)

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.

L:45 +T: 15 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.

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ET 8201 WIRELESS AND MOBILE COMMUNICATION LT P C
3 1 0 4

Pre-requisites: Basics in Communication Engineering, programming

OBJECTIVES

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

UNIT I INTRODUCTION 9

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

UNIT II MOBILE NETWORKS 12

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

UNIT III WIRELESS NETWORKS 9

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

UNIT IV ROUTING 9

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

UNIT V TRANSPORT AND APPLICATION LAYERS 9

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

TUTORIAL: Practicing Sessions in NS2 / Glomosim / Open Stack **12**

TOTAL : 60 PERIODS

REFERENCES

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

ET 8251 REAL TIME OPERATING SYSTEM LT P C
3 0 0 3

Pre-requisites: Processor architecture, operating systems.

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
- To discuss the application development using RTOS

UNIT I REVIEW OF OPERATING SYSTEMS 15

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 Premptive scheduler- Process Synchronisation-Message queues– Mail boxes -pipes – Critical section – Semaphores – Classical synchronisation 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 RTOS APPLICATION DOMAINS 9

Case studies-RTOS for Image Processing – Embedded RTOS for Network communication – RTOS for fault-Tolerant Applications – RTOS for Control Systems.

TOTAL : 45 PERIODS

REFERENCES:

1. Silberschatz,Galvin,Gagne" Operating System Concepts,6th ed, John Wiley,2003
2. D.M.Dhamdhere," Operating Systems, A Concept-Based Approch,TMH,2008
3. Raj Kamal, "Embedded Systems- Architecture, Programming and Design" Tata McGraw Hill, 2006.
4. Herma K., "Real Time Systems – Design for distributed Embedded Applications", Kluwer Academic, 1997.
5. Charles Crowley, "Operating Systems-A Design Oriented approach" McGraw Hill 1997.
6. C.M. Krishna, Kang, G.Shin, "Real Time Systems", McGraw Hill, 1997.
7. Raymond J.A.Bhur, Donald L.Bailey, "An Introduction to Real Time Systems", PHI 1999.
8. Mukesh Sighal and N G Shi "Advanced Concepts in Operating System", McGraw Hill 2000.

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ET8252 SOFTWARE FOR EMBEDDED SYSTEMS LT P C
3 1 0 4

Pre-requisites: Basics in Programming, Embedded System & operating systems

COURSE OBJECTIVES

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

UNIT I EMBEDDED PROGRAMMING 9

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

UNIT II C PROGRAMMING TOOLCHAIN IN LINUX 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 AND EMBEDDED OS 9

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

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

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

UNIT V EMBEDDED JAVA 9

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

TUTORIAL: 12

Program Development and practice in C, C++ and Java

TOTAL : 60 PERIODS

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. Zhiqun Chen, 'Java Card Technology for Smart Cards: Architecture and Programmer's Guide', Addison-Wesley Professional, 2000.

ET8253 VLSI BASED DESIGN METHODOLOGIES LT P C
3 1 0 4

Pre-requisites: Logic design, programmable devices**,** programming

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.
- To study the Logic synthesis and simulation of digital system with Verilog HDL.

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 12

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 BASIC CONSTRUCTION, FLOOR PLANNING, PLACEMENT AND ROUTING 6

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

UNIY IV ANALOG VLSI DESIGN 6

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 12

Overview of digital design with Verilog HDL, hierarchical modelling concepts, modules and port definitions, gate level modelling, data flow modelling, behavioural modelling, task & functions,

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Verilog and logic synthesis-simulation-Design examples, Ripple carry Adders, Carry Look ahead adders, Multiplier, ALU, Shift Registers, Multiplexer, Comparator, Test Bench.

TUTORIALS:

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

L: 45+T:15 = 60 PERIODS

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.

Sl.No	Experiment Detail
1.	**Programming with 8 bit Microcontrollers /PIC Microcontrollers : Assembly /C programming** **Study with peripherals; ;IDE, Board Support Software Tools /Uc/OS-II/C Compiler/others with incircuit Emulators, crosscompilers, debuggers**
2	**I/O Programming with 8 bit Microcontrollers/PIC 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 /Embedded processors Assembly / C programming** **Study with peripherals; IDE, Board Support Software Tools /OS/ C Compiler/others**
5.	**I/O Interfacing with Embedded processors** **I/O Programming/ Timers/ Interrupts/ Serial port programming/PWM Generation/ Motor Control/ADC/DAC/ LCD/ RTC Interfacing/ Sensor Interfacing** **Study with peripherals; IDE, Board Support Software Tools /OS/C Compiler/Matlab/Labview support/others with incircuit Emulators, crosscompilers, debuggers**
6.	**Design and Implementation of Combinational and Sequential Circuits on Simulation Tools as VLSI Suite/pspice/MentorGraphics/CAD Suites/others** **Experimenting on Xilinx/Altera CPLD/FPGA**
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/ 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 incircuit 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 : 45 PERIODS

REFERENCES:

1. Mohamammad Ali Mazidi & Mazidi ' 8051 Microcontroller and Embedded Systems', Pearson Education
2. Mohammad Ali Mazidi, Rolind Mckinley and Danny Causey, 'PIC Microcontroller and Embedded Systems' Pearson Education
3. Jan Axelson 'Embedded Ethernet and Internet Complete', Penram publications
4. Kraig Mitzner, 'Complete PCB Design using ORCAD Capture and Layout', Elsevier
5. Woon-Seng Gan, Sen M. Kuo, 'Embedded Signal Processing with the Micro Signal Architecture', John Wiley & Sons, Inc., Hoboken, New Jersey 2007
6. U. Meyer-Baese 'Digital Signal Processing using Field Programmable Gate Arrays', Springer
7. Dogan Ibrahim, 'Advanced PIC microcontroller projects in C', Elsevier 2008
8. Lisa K .Wells & Jeffrey Travis,Lab Veiw for Everyone,Prentice Hall,New Jersey,1997.

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ET 8351 DISTRIBUTED EMBEDDED COMPUTING LT P C
3 0 0 3

Pre-requisites: Basics in Programming, Embedded System & operating systems

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 study the basis for network on-chip technologies

UNIT I THE HARDWARE INFRASTRUCTURE 9

Broad Band Transmission facilities – Open Interconnection 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 and the use of active components.

UNIT III DISTRIBUTED COMPUTING USING JAVA 9

IO streaming – Object serialization – Networking – Threading – RMI – multicasting – distributed databases – embedded java concepts – case studies.

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.

TOTAL : 45 PERIODS

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 Academic Pub, Boston, April 2001, 248 pp.

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ET8311 **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** ✓ **Network simulation** ✓ **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** ✓ **uc,ARM processors** ✓ **DSP / Image / Video Processors** ✓ **VHDL Programming in processors**	*2.1*	The students will learn design with simulators/experiments,in programming processor boards, processor interfacing/designing reprogrammable system	2,3,4,a,c,d
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** ✓ **one CAD Tool**	*4.1*	The students will apply programming logic for modeling/simulating embedded application development	a,f
5.0	✓ **Eunterprenership Skill development**	*5.1*	The students will know to pickup skills for 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)

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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/ 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

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16. 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.

ET8001 AD-HOC NETWORKS LT P C
3 0 0 3

Pre-requisites: Basics in networking and communication

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
- To study the basis for Network performance& Analysis

UNIT I WIRELESS LAN, PAN, WAN AND MAN 9 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.

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TOTAL : 45 PERIODS

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.

ET 8002	ADV COMPUTER ARCHITECTURE AND PARALLEL PROCESSING	LT P C 3 0 0 3

Pre-requisites: Digital logic Devices, microprocessors, fundamentals of computer architecture

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 and their memory technologies
- To teach functional capabilities required in an OS for multi programmed computer

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 Parallism

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; Hierarchial 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 Comparitive study : of Architectures -addressing modes -instruction types-performance of- Parallel and scalable architectures, Multiprocessor and Multicomputers, 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 – Synchronising 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

TOTAL : 45 PERIODS

REFERENCES:

1. Kai Hwang "Advanced Computer Architecture".Tata McGraw Hill 2000
2. . Advanced Computer architecuter , 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.

ET8003 ADVANCED EMBEDDED SYSTEMS LT P C
3 0 0 3

Pre-requisites: Computer Architecture, Network Communication

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, functions
- To introduce aspects in Protocols: Design issues, goals in Network processors
- To study the classification of commercial Network in processors

UNIT I MODELLING WITH HARDWARE/SOFTWARE PARTITIONING 15

Embedded systems, Hardware/Software Co-Design, Co-Design for System Specification and modeling- Single-processor Architectures & Multi-Processor Architectures, comparison of Co-Design Approaches, Models of Computation, Requirements for Embedded System Specification, Hardware/Software Partitioning Problem, Hardware/Software Cost Estimation, Generation of Partitioning by Graphical modeling, Formulation of the HW/SW scheduling, Optimization. HARDWARE/SOFTWARE CO-Synthesis - Problem, State-Transition Graph, Refinement and Controller Generation, Distributed System 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).

TOTAL : 45 PERIODS

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, “Network Processor 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 7 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/

ET8004 DESIGN OF AUTOMOBILE EMBEDDED SYSTEM L T P C
3 0 0 3

Pre-requisites: Embedded system ,Electrical Drives, Instrumentation, Basics in Automobile Engineering

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 introduce logics for design of automation for vehicles
- To study the classification of commercial techniques for vehicle communication

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 – types of starter motors,

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

UNIT IV DIGITAL ENGINE MANAGEMENT SYSTEMS 9

Digital Engine Control, Integrated engine control, Hybrid vehicle power train control, Vehicle cruise control- speed response-anti-locking braking system-electronic suspension with control system- electronic steering; Vehicle system schematic for interfacing with EMS; Typical constituents of the hardware of a ECU for a petrol EMS. Lambda closed loop control system.

UNIT V 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.

TOTAL : 45 PERIODS

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. Electronic Engine Control technology – Ronald K Jurgen Chilton's guide to Fuel Injection – Ford
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. Automotive Hand Book, Robert Bosch, Bently Publishers, 1997.
9. Jurgen, R., Automotive Electronics Hand Book.
10. Automotive Electricals / Electronics System and Components, Tom Denton, 3rd Edition, 2004.

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ET8005 DIGITAL INSTRUMENTATION L T P C
3 0 0 3

Pre-requisites: Digital Circuits, Basic in Measurement & Instrumentation

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
- The case studies to be developed/ discussed with demo/tutorials

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.

UNIT II INTERFACING AND DATA TRANSMISSION 6

Microprocessor based system design –Peripheral Interfaces – Data transmission systems- ime Division Multiplexing (TDM) – Digital Modulation –Pulse Modulation – Pulse Code Format – Interface systems and standards, Instrument Drivers

UNIT III INSTRUMENT COMMUNICATION 15

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

UNIT IV VIRTUAL INSTRUMENTATION: 9

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 – Counter , Timer.

UNIT V CASE STUDIES 6

PC based DAS, Data loggers, PC based process measurements like flow, temperature, pressure and level development system, Programmable Logic Controllers, CRT interface and controller with monochrome and colour video display.

TOTAL : 45 PERIODS

TEXTBOOKS:

1. A.J. Bouwens, “Digital Instrumentation” , TATA McGraw-Hill Edition, 1998.
2. Mathivanan, “PC based Instrumentation Concepts and practice”, Prentice-Hall India, 2009
3. H S Kalsi, “Electronic Instrumentation” Second Edition, Tata McGraw-Hill,2006.

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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. Jonathan W Valvano, “Embedded Microcomputer systems”, Brooks/Cole, Thomson, 2001.
7. Gary Johnson, LabVIEW Graphical Programming, Second edition, McGraw Hill, Newyork, 1997.
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.

ET8006 EMBEDDED LINUX L T P C
3 0 0 3

Pre-requisites: Basics in C Programming, operating system

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 overall architecture.
- To introduce the concept of configuring kernel using the cross-platform tool chain.
- To study about the various memory device, file systems and performance tuning.

AIM

To expose the students to the fundamentals of embedded Linux Concepts

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 8

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 8

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 MEMORY DEVICES AND FILE SYSTEM 8

MTD-Supported Devices - Disk Devices - File system Types for Embedded Devices Writing a Filesystem Image to Flash Using an NFS-Mounted Root Filesystem - Placing a Disk Filesystem on a RAM Disk - Rootfs and Initramfs - Choosing a Filesystem's Type and Layout - Embedded Bootloaders - Using the U-Boot Bootloader - Eclipse - Debugging Applications with gdb - Tracing - Performance Analysis - Memory Debuggin

TUTORIAL: 3

Practicing Shell Programming in Linux / Developing programs in GCC and Eclipse / Learning Debugging and Profiling.

TOTAL = 45 PERIODS

REFERENCES:

1. Karim Yaghmour, Jon Masters, Gilad Ben-Yossef, and Philippe Gerum, 'Building Embedded Linux Systems 2nd Edition', O'Reilly Publications, 2008
2. William von Hagen, 'Ubuntu Linux Bible 3rd Edition', Wiley Publishing Inc., 2010
3. P. Raghavan ,Amol Lad , Sriram Neelakandan, 'Embedded Linux System Design and Development', Auerbach Publications, 2006
4. Jonathan Corbet,Alessandro Rubini,"Linux Device Drivers" , O'Reilly Publications, 2011
5. Jonathan Corbet, Alessandro Rubini & Greg Kroah-Hartman, 'Linux Device Drivers 3rd Edition', O'Reilly, 2010

ET8007	EMBEDDED NETWORKING AND AUTOMATION OF ELECTRICAL SYSTEM	L T P C 3 0 0 3

Pre-requisites: Networking Concepts, Basics in Electric Engineering, I/O communication, Embedded System

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
- To introduce design of Programmable measurement & control of electrical grid

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 - Habitat Monitoring

UNIT III BUILDING SYSTEM AUTOMATION 9

Concept of Uc Based & PC based data acquisition – Multiplexing of analog inputs – Single-ended and differential inputs – Different strategies for sampling of multi channel analog inputs-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-Il,SFC,ST Programming methods-Programs for 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 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

TOTAL : 45 PERIODS

TEXT BOOKS

1. Control and automation of electrical power distribution systems, James Northcote-Green, Robert Wilson, CRC, Taylor and Francis, 2006
2. W.Bolton,Programmable Logic Controllers,5th Ed,Elseiver,2010.
3. Dogan Ibrahim, 'Advanced PIC microcontroller projects in C', Elsevier 2008
4. Jan Axelson 'Embedded Ethernet and Internet Complete', Penram publications
5. Bhaskar Krishnamachari, 'Networking wireless sensors', Cambridge press 2005
6. Peter W Gofton , "Understanding Serial Communication", Sybes International, 2000
7. Robert H. Bishop, "Learning with Lab-View" Preticee Hall, 2009
8. Sanjay Gupta, "Virtual Instrumentation, LABVIEW", TMH, New Delhi, 2003
9. Ernest O. Doeblin and Dhanesh N Manik, " Measrement Systems – Application and Design", 5th Edn, TMH, 2007.

ET8008 NANO ELECTRONICS L T P C
3 0 0 3

Pre-requisites: Engineering science, Electron devices, CMOS technology

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.
- To teach the circuits and architectural features of nano memory devices.
- To teach the different nano fabrication methods and techniques .

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.

TOTAL = 45 PERIODS

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.

ET8009 PERVASIVE DEVICES AND TECHNOLOGY L T P C
3 0 0 3

Pre-requisites: Embedded System ,Wireless Communication

COURSE OBJECTIVES

- To expose the students to the fundamentals of wireless sensor 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 study the classification of commercial family of wireless technology

UNIT I OVERVIEW OF WIRELESS SENSOR NETWORKS 12

Challenges for Wireless Sensor Networks- Characteristic requirements for WSN - Challenges for WSNs – WSN vs Adhoc Networks - Sensor node architecture – Commercially available sensor nodes – Imote, IRIS, Mica Mote, TelosB,-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 NETWORKING & COMPUTING 12

Introduction, Networking Infrastructure and Architecture of PERV NET, Mobility management, service discovery, disconnected operation, Dynamic configuration, auto registration, content based routing, Backbone Technology: Electrical Backbone Networks – Optical Backbone Networks – Wireless Backbone Networks – Wireless Access Technology - Pervasive Web Application architecture- Access from PCs and PDAs - Access via WAP

UNIT IV PERVASIVE DEVICES 6

Introduction with Case study of - PDA - Mobile Phone: Elements –Mobile Information rchitecture - Mobile Phone Design - Android Overview – The Stack – Android User Interface – Preferences, the File System, the Options Menu and Intents.

UNIT V EMERGING WIRELESS TECHNOLOGIES 6

Evolution and Deployment of Cellular Telephone Systems – 1G, 2G, 2.5G, 3G, 4G. Introduction to wireless LAN, Wireless PAN, Wireless MAN, Broadband Satellite and Microware Systems – Emerging Wireless Technologies – IEEE 802.20 Mobile Broadband Wireless Access.

TOTAL : 45 PERIODS

REFERENCES

1. Debashis saha, Amitava mukherjee ,"Networking Infrastructure for Pervasive Computing, Springer International edition, 2011 (unit 3)
2. Mullet,"Introduction to wireless telecommunications systems and networks", cengage learning, 2010 (unit 5)
3. Frank Adelstein, Sandeep K S Gupta, Golden G Richard III, Loren Schwiebert, "Fundamentals of mobile and pervasive computing, TMH, 2007.
4. Brian Fling,"Mobile Design & Development,O'Reilly,2011 (unit 4)
5. Marko Gargenta,"Learning Android", O'Reilly,2011 (unit 4)
6. Holger Karl & Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks" , John Wiley, 2005.
7. Feng Zhao & Leonidas J. Guibas, "Wireless Sensor Networks- An Information
8. Processing Approach", Elsevier, 2007.
9. Kazem Sohraby, Daniel Minoli and Taieb Znati, " Wireless Sensor Networks Technology, Protocols, and Applications", John Wiley & Sons, 2007.
10. C.Britton Rorabaugh,"Simulating Wireless Communication Systems-Practical Models in C++",Pearson Edu,2006.
11. Mohammad Ilyas And Imad Mahgaob,"Handbook Of Sensor Networks: Compact
12. Wireless And Wired Sensing Systems", CRC Press,2005
13. K. Akkaya and M. Younis, "A survey of routing protocols in wireless sensor networks", Elsevier Ad Hoc Network Journal, Vol. 3, no. 3, pp. 325--349, 2005.
14. Philip Levis, " TinyOS Programming",2006 – www.tinyos.net
15. Anna Ha´c, "Wireless Sensor Network Designs", John Wiley & Sons Ltd, 2003.

ET8010 RISC PROCESSOR ARCHITECTURE AND PROGRAMMING LT P C
3 0 0 3

Pre-requisites: Basics of Microcontrollers and Programming

COURSE OBJECTIVES

- To teach the architecture of 8 bit RISC processor
- To teach the architecture and programming of 16 bit RISC processor
- To teach the implementation of DSP in ARM processor
- To discuss on memeroy management in RISC processor
- To teach the application development with ARM processor

UNTI I AVR MICROCONTROLLER ARCHITECTURE 9

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

UNIT II ARM ARCHITECTURE AND PROGRAMMING 9

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

UNIT III ARM APPLICATION DEVELOPMENT 9

Introduction to DSP on ARM –FIR Filter – IIR Filter – Discrete Fourier transform – Exception Handling – Interrupts – Interrupt handling schemes- Firmware and bootloader – Example: Standalone - Embedded Operating Systems – Fundamental Components - Example Simple little Operating System

UNIT IV MEMORY PROTECTION AND MANAGEMENT 9

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

UNIT V DESIGN WITH ARM MICROCONTROLLERS 9

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

TOTAL : 45 PERIODS

REFERENCES

1. Steve Furber, 'ARM system on chip architecture', Addision Wesley
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.
5. ARM Architecture Reference Manual
6. LPC213x User Manual

ET8011 SMART METERS AND SMART GRID COMMUNICATION LT P C
3 0 0 3

Pre-requisites: Basics in Instrumentation, Power system and communication

COURSE OBJECTIVES

- To teach the fundamentals of automated meters and Grids.
- To teach on functional components of Smart meters
- To discuss on need of smart grid for power systems
- To teach the significance of microgrid and its needs
- To teach the communication and protocols for power system

UNIT I INTRODUCTION: 9

Introduction to Smart grid and metering technology- Smart energy management technical architecture-Functions of Smart Grid and smart meters, Opportunities and challenges-Difference between conventional and smart grid-meters, Concept of Resilient and Self Healing Grid, recent developments and International policies in Smart Grid. IEC 61850 protocol standards.

UNIT II SMART METERS 9

Smart metering**-**Smart Meters types- hardware architecture- software architecture-requirements- communication protocols- Real Time Prizing, Smart Appliances, Automatic Meter Reading- MEMS, Smart Sensors- Smart actuators- Advanced metering infrastructure- spectrum analyzer.

UNIT III SMART GRID AND APPLICATIONS 9

Outage Management System, Plug in Hybrid Electric Vehicles, Vehicle to Grid, Home and Building Automation- Smart Substations, Substation Automation, Feeder Automation-Geographic Information System(GIS), Intelligent Electronic Devices and their application for monitoring and protection- -Smart city- Wide Area Measurement System, Phase Measurement Unit- Power Quality and EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring and Power Quality Audit.

UNIT IV MICROGRIDS 9

Concept of microgrid, need and applications of microgrid, formation of microgrid, Issues of interconnection, protection and control of microgrid. Plastic and Organic solar cells, Thin film solar cells, Variable speed wind generators, fuelcells, microturbines, Captive power plants, Integration of renewable energy sources.

UNIT V INFORMATION AND COMMUNICATION TECHNOLOGY FOR SMART GRID AND METERS 9

Home Area Networks for smart grid - IEEE802.15.4- ITU G.hn-IEEE 802.11, Field Area Networks -power-line communications- IEEE P1901 /HomePlug, RF mesh, Wide-area Networks for Smart Grid- Fiber Optics, WiMAX, sensor networks, Information Management in Smart Grid - SCADA, CIM. Networking Issues in Smart Grid -Wireless Mesh Network- CLOUD Computing - Security and Privacy in Smart Grid and smart meters -Broadband over Power line.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Ali Keyhani, Mohammad N. Marwali, Min Dai "Integration of Green and Renewable Energy in Electric Power Systems", Wiley
2. Stuart Borlase, " Smart Grid: infrastructure, technology and Solutions".2012 CRC Press
3. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, "Smart Grid: Technology and Applications", Wiley
4. Jean Claude Sabonnadière, Nouredine Hadjsaïd, "Smart Grids", Wiley Blackwell
5. Peter S. Fox Penner, "Smart Power: Climate Changes, the Smart Grid, and the Future of Electric Utilities", Island Press; 1 edition 8 Jun 2010
6. S. Chowdhury, S. P. Chowdhury, P. Crossley, "Microgrids and Active Distribution Networks." Institution of Engineering and Technology, 30 Jun 2009
7. Stuart Borlase, "Smart Grids (Power Engineering)", CRC Press

REFERENCES

1. Andres Carvallo, John Cooper, "The Advanced Smart Grid: Edge Power Driving Sustainability: 1", Artech House Publishers July 2011
2. James Northcote, Green, Robert G. Wilson "Control and Automation of Electric Power Distribution Systems (Power Engineering)", CRC Press
3. Mladen Kezunovic, Mark G. Adamiak, Alexander P. Apostolov, Jeffrey George Gilbert "Substation Automation (Power Electronics and Power Systems)", Springer
4. R. C. Dugan, Mark F. McGranghan, Surya Santoso, H. Wayne Beaty, "Electrical Power System Quality", 2nd Edition, McGraw Hill Publication
5. Yang Xiao, "Communication and Networking in Smart Grids", CRC Press

CO8071 ROBOTICS AND CONTROL LT 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

REFERENCES

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

CO8151 SOFT COMPUTING TECHNIQUES LT P C
3 0 2 4

PROGRAM 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, decomposition, cylindrical extension, fuzzy relation – Fuzzy membership functions.

UNIT II NEURAL NETWORKS FOR MODELLING AND CONTROL 9

Modeling of non linear systems using ANN- NARX,NNSS,NARMAX - 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–Introduction to Support Vector Regression – Familiarization of ANFIS Tool Box.

TOTAL : 45+30 = 75 PERIODS

Soft Computing Techniques - Lab

To implement adaline and madaline with bipolar inputs and outputs using NN toolbox.
To implement back propagation for a given input pattern using NN toolbox.
To implement discrete hopfield network and test for given input pattern using NN toolbox.
To implement fuzzy set operation and properties using FUZZY toolbox.
To perform max-min composition of two matrices obtained from Cartesian product using 'm file' In MATLAB.
Write a program to verify the various laws associated with fuzzy set using FUZZY toolbox.
Write a matlab program for maximizing $f(x) = x^2$ using GA, where x is ranges from 0 to 31 (Perform only 5 iterations). Find the objective function and 'x' value.
Design FLC for a FOPDT process using FUZZY toolbox.
Design a Neuro model for an inverted pendulum using NN toolbox.
Design Fuzzy model for an inverted pendulum using FUZZY toolbox.

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. George J.Klir and Bo Yuan, "Fuzzy Sets and Fuzzy Logic: Theory and Applications", Prentice Hall, First Edition, 1995.
4. David E.Goldberg, "Genetic Algorithms in Search, Optimization, and Machine Learning", Pearson Education, 2009.
5. W.T.Miller, R.S.Sutton and P.J.Webrose, "Neural Networks for Control", MIT Press, 1996.
6. C.Cortes and V.Vapnik, "Support-Vector Networks, Machine Learning", 1995.

ET8071 ADVANCED DIGITAL SIGNAL PROCESSING L T P C
3 0 0 3

Pre-requisites: Basics of Signal Processing, Mathematics of Transforms, Microcontroller

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
- To discuss on Application development with commercial family of DS Processors
- To design & develop logical functions of DSProcessors with Re-Programmable logics &Devices

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, 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, catogorisation of DSP Processors, Fixed Point (Blackfin),Floating Point (SHARC),TI TMS 320c6xxx & OMAP processors TMS320C54X & 54xx on Basic Architecture – comparison : of functional variations of Computational building blocks, MAC, Bus Architecture and memory, Data Addressing, Parallelism and pipelining, Parallel I/O interface, Memory Interface, Interrupt, DMA (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, Parallel 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 , CODEC Interface .

UNIT V VLSI IMPLEMENTATION 9

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

TOTAL : 45 PERIODS

REFERENCE BOOKS:

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.

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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.

ET 8072 MEMS TECHNOLOGY L T P C
3 0 0 3

Pre-requisites: Basic Instrumentation ,Material Science, Programming

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
- To give exposure to different MEMS and NEMS devices.

UNIT I MEMS:MICRO-FABRICATION, MATERIALS AND ELECTRO-MECHANICAL CONCEPTS 9

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

UNIT II ELECTROSTATIC SENSORS AND ACTUATION 9

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

UNIT III THERMAL SENSING AND ACTUATION 9

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

UNIT IV PIEZOELECTRIC SENSING AND ACTUATION 9

Piezoelectric effect-cantilever 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

TOTAL : 45 PERIODS

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.

ET8073 SECURITY IN NETWORKS AND CRYPTOGRAPHY LT P C
3 0 0 3

Pre-requisites: Basics of Signal Processing, Mathematics of Transforms, microcontroller

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 communication.
- To teach the fundamentals of Secured system operation.
- To teach the fundamentals of Security in wireless communication.

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.

TOTAL : 45 PERIODS

TEXT BOOKS

1. William Stallings, “Cryptography And Network Security – Principles and Practices”, Pearson Education, 3rd Edition, 2003.

REFERENCES

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

PS8073 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.

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.

PS8076 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

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.

PS8077 WIND ENERGY CONVERSION SYSTEM LT 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 modeling - 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 modeling issue.

TOTAL: 45 PERIODS

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.

PS8255 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, Concept of Resilient & Self Healing Grid, Present development & International policies in Smart Grid, Diverse perspectives from experts and global Smart Grid initiatives.

UNIT II SMART GRID TECHNOLOGIES 9

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

UNIT III SMART METERS AND ADVANCED METERING INFRASTRUCTURE 9

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

UNIT IV POWER QUALITY MANAGEMENT IN SMART GRID 9

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

UNIT V HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS 9

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

TOTAL : 45 PERIODS

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,