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<td>18</td>
<td>PS 8076</td>
<td>Solar and Energy Storage System</td>
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<td>19</td>
<td>PS 8077</td>
<td>Wind Energy Conversion System</td>
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<td>3</td>
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<tr>
<td>20</td>
<td>PS 8255</td>
<td>Smart Grids</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>
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

UNIT II
HARDWARE SOFTWARE PARTITIONING

UNIT III
EMBEDDED NETWORKING AND INTERRUPTS SERVICE MECHANISM

UNIT IV
RTOS BASED EMBEDDED SYSTEM DESIGN
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, μC/OS-II, RT Linux
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
11. Han-Way Huang, "Embedded system Design using C8051", Cengage Learning,2009
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 algorithms and techniques used for real time systems

UNIT I INTRODUCTION

UNIT II PROGRAMMING LANGUAGES AND TOOLS

UNIT III REAL TIME DATABASES
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

UNIT V EVALUATION TECHNIQUES

TOTAL : 45 PERIODS

REFERENCES
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

UNIT II ASYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN 12

UNIT III FAULT DIAGNOSIS AND TESTABILITY ALGORITHMS 9

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
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

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.

TUTORIAL: 12

REFERENCES:

TOTAL : 60 PERIODS

ET8152 MICROCONTROLLER BASED SYSTEM DESIGN

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
UNIT II 8051 PROGRAMMING

UNIT III PIC MICROCONTROLLER

UNIT IV PERIPHERAL OF PIC MICROCONTROLLER

UNIT V SYSTEM DESIGN – CASE STUDY
Interfacing LCD Display – Keypad Interfaceing - 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:

MA8156 APPLIED MATHEMATICS FOR ELECTRICAL ENGINEERS

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)

UNIT IV LINEAR PROGRAMMING (9+3)
Formulation – Graphical solution – Simplex method – Two phase method - Transportation and Assignment Models

UNIT V FOURIER SERIES (9+3)

L:45 +T: 15 TOTAL: 60 PERIODS

BOOKS FOR STUDY:

REFERENCES:
ET 8201                  WIRELESS AND MOBILE COMMUNICATION

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

UNIT II MOBILE NETWORKS

UNIT III WIRELESS NETWORKS
Wireless LAN – IEEE 802.11 Standard-Architecture – Services – Hiper LAN, Bluetooth

UNIT IV ROUTING

UNIT V TRANSPORT AND APPLICATION LAYERS

TUTORIAL: Practicing Sessions in NS2 / Glomosim / Open Stack

TOTAL : 60 PERIODS

REFERENCES
2. C. Siva Ram Murthy and B.S. Manoj, AdHoc Wireless Networks: Architectures and protocols, Prentice Hall PTR, 2004
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

UNIT II OVERVIEW OF RTOS 9

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

TOTAL : 45 PERIODS

REFERENCES:
ET8252 SOFTWARE FOR EMBEDDED SYSTEMS

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

TOTAL: 60 PERIODS
REFERENCES

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 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

UNIT III BASIC CONSTRUCTION, FLOOR PLANNING, PLACEMENT AND ROUTING 6

UNIT 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,
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:

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Experiment Detail</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>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 in-circuit Emulators, crosscompilers, debuggers</td>
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<tr>
<td>3.</td>
<td>Programming in Higher Level Languages as C / C++ / Java / Embedded C / Embedded Java / Compilers &amp; Platforms / Linux Support Platforms / Special Embedded Design Programming Suites</td>
</tr>
<tr>
<td>4.</td>
<td>Programming with 16 bit / ARM / Embedded processors Assembly / C programming Study with peripherals; IDE, Board Support Software Tools / OS / C Compiler / others</td>
</tr>
<tr>
<td>5.</td>
<td>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 in-circuit Emulators, crosscompilers, debuggers</td>
</tr>
<tr>
<td>6.</td>
<td>Design and Implementation of Combinational and Sequential Circuits on Simulation Tools as VLSI Suite / pspice / Mentor Graphics / CAD Suites / others Experimenting on Xilinx / Altera CPLD / FPGA</td>
</tr>
<tr>
<td>7.</td>
<td>Study of one type of Real Time Operating Systems (RTOS) with VXWorks / Keil / Android / Tiny OS / Linux Support RTOS</td>
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<tr>
<td>8.</td>
<td>Simulation &amp; Programming on System Modelling with using programming environments (MATLAB / LabVIEW / MEMS Suites: Intellisuite / Comsol / other Simulation Tools)</td>
</tr>
<tr>
<td>9.</td>
<td>Programming with wired / wireless communication protocol / Network Simulators Study with Networking processors &amp; its peripherals; IDE, Board Support Software Tools / OS / C Compiler / others on in-circuit Emulators, crosscompilers, debuggers</td>
</tr>
<tr>
<td>10.</td>
<td>Programming with Fixed Point &amp; Floating Point DSP Processors With IDE, Board Support Packages &amp; 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</td>
</tr>
</tbody>
</table>

**TOTAL : 45 PERIODS**

**REFERENCES:**

3. Jan Axelsson ‘Embedded Ethernet and Internet Complete’, Penram publications
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 –

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
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

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:
3. George Coulouris and Jean Dollimore, “Distributed Systems – concepts and
   Kleinjohann C-lab, Universitat Paderborn, Germany, Kluwer Academic Pub, Boston,
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

<table>
<thead>
<tr>
<th>Course objectives</th>
<th>Training outcomes</th>
<th>Related programme outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Programming in C/ Embedded C / C++ / JAVA</td>
<td>Skill development in software programming/working in simulators, emulators, learn using the commercial</td>
<td>a,b,c,d</td>
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<tr>
<td>Network Simulators</td>
<td>packages for wired, wireless communications</td>
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<tr>
<td>Network simulation</td>
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<tr>
<td>Programming on Pervasive Computing</td>
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<tr>
<td>Java for Wireless Devices</td>
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<tr>
<td>Embedded Processors</td>
<td>The students will learn design with simulators/experiments, in programming processor boards, processor</td>
<td>2,3,4,a,c,d</td>
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<tr>
<td>uc,ARM processors</td>
<td>interfacing/designing reprogrammable system</td>
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<tr>
<td>DSP / Image / Video Processors</td>
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<tr>
<td>VHDL Programming in processors</td>
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<tr>
<td>Android / LINUX OS Internals/VxWorks/Keil Os</td>
<td>The students will skill through OS programming through API, libraries</td>
<td>a,f</td>
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<tr>
<td>Virtual Instrumentation programming</td>
<td>The students will apply programming logic for modeling/simulating embedded application development</td>
<td>a,f</td>
</tr>
<tr>
<td>Simulink/Mathlab Tools</td>
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<tr>
<td>Study on MEMS Tools</td>
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<tr>
<td>Study on process Controller modeling</td>
<td>--------------------------------------------------------------------------------------------------------</td>
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<tr>
<td>PLC/SCADA/PCB/ORCAD</td>
<td>--------------------------------------------------------------------------------------------------------</td>
<td></td>
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<tr>
<td>one CAD Tool</td>
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<tr>
<td>Entrepreneurship Skill development</td>
<td>The students will know to pickup skills for product development/establish consultancy services with</td>
<td>d,e,f,g,h</td>
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<tr>
<td></td>
<td>an outlook into selecting commercially viable market for technical demands</td>
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</tbody>
</table>

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

Design / development through simulation/ experimental analysis with report submission as one appendix chapter on any two of the following topics (relevant to the candidates project area)
1. **Network Simulators**- Design and Implement a GUI or text based network monitoring tool to record network statistics like packets sent and received, percentage errors, desktop grabbing, remote monitoring etc.

2. **Embedded Processors**- Implement an IO peripheral interface ARM/ 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. **Eunterpreneurship 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

**ET8001  AD-HOC NETWORKS**

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**

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

**UNIT III  TRANSPORT LAYER AND SECURITY PROTOCOLS 9**
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.
REFERENCES
1. C. Siva Ram Murthy and B.S. Manoj, AdHoc Wireless Networks: Architectures and protocols, Prentice Hall PTR, 2004

ET 8002 ADV COMPUTER ARCHITECTURE AND PARALLEL PROCESSING

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
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
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 multiapiro memory-multistage and combining network

UNIT III PIPELINING AND SUPERSCALAR TECHNOLOGIES
Pipeline principle and implementation-classification of pipeline processor-introduction of arithmetic,instruction,processor pipelining-pipeline mechanisms-hazards

UNIT IV HARDWARE TECHNOLOGIES
Introduction to features of advanced embedded processors through Basic Comparative study : of Architectures -addressing modes -instruction types-performance of- Parallel and scalable architectures, Multiprocessor and 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

UNIT V   OS ISSUES FOR MULTI PROCESSOR
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:
2. Advanced Computer architectuer , By Rajiv Chopra, S chand , 2010
UNIT I MODELLING WITH HARDWARE/SOFTWARE PARTITIONING 15

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

REFERENCES:
5. UYLESS black,"computer NETWORKS-protocols, STANDARDS 7 INTERFACES",2nd ED PHI,2007

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.

REFERENCES
1. William B. Ribbens, "Understanding Automotive Electronics", sixth edition,
ET8005 DIGITAL INSTRUMENTATION

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
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

UNIT III INSTRUMENT COMMUNICATION

UNIT IV VIRTUAL INSTRUMENTATION:

UNIT V CASE STUDIES
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:

ET8006 EMBEDDED LINUX

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
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
UNIT III  HOST-TARGET SETUP AND OVERALL ARCHITECTURE
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

UNIT V  MEMORY DEVICES AND FILE SYSTEM
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 Debugging

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

REFERENCES:

TOTAL = 45 PERIODS
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

UNIT II WIRELESS EMBEDDED NETWORKING

UNIT III BUILDING SYSTEM AUTOMATION
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- II, SFC, ST Programming methods- Programs for Temperature control, Valve sequencing control

UNIT IV MEASUREMENT AND EMBEDDED CONTROL OF ELECTRICAL APPARATUS

UNIT V COMMUNICATION FOR LARGE ELECTRICAL SYSTEM AUTOMATION
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
4. Jan Axelson ‘Embedded Ethernet and Internet Complete’, Penram publications

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 circuit 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


REFERENCES:

2. Rainer Waser, “Nanoelectronics and Information Technology”, Wiley 2005
6. George W. Hanson, Fundamental of nanoelectronics, Pearson education.

ET8009  PERVERSIVE 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 wake-up 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 PERVERSIVE SENSOR NETWORK  9


UNIT III PERVASIVE NETWORKING & COMPUTING

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

UNIT V EMERGING WIRELESS TECHNOLOGIES

TOTAL : 45 PERIODS

REFERENCES
2. Mullet,"Introduction to wireless telecommunications systems and networks", cengage learning, 2010 (unit 5)
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

UNIT I  AVR MICROCONTROLLER ARCHITECTURE

UNIT II  ARM ARCHITECTURE AND PROGRAMMING

UNIT III  ARM APPLICATION DEVELOPMENT

UNIT IV  MEMORY PROTECTION AND MANAGEMENT
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

TOTAL : 45 PERIODS

REFERENCES
1. Steve Furber, ‘ARM system on chip architecture’, Addision Wesley
7. LPC213x User Manual
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:**

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**

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**


**UNIT IV**

**MICROGRIDS**

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**

TEXT BOOKS:

REFERENCES

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
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
Mechanism-matrix representation-homogenous transformation-DH representation-Inverse kinematics-solution and programming-degeneracy and dexterity
UNIT III DIFFERENTIAL MOTION AND PATH PLANNING
Jacobian-differential motion of frames-Interpretation-calculation of Jacobian-Inverse Jacobian-
Robot Path planning

UNIT IV DYNAMIC MODELLING
Lagrangian mechanics- Two-DOF manipulator- Lagrange-Euler formulation – Newton-Euler
formulation – Inverse dynamics

UNIT V ROBOT CONTROL SYSTEM
Linear control schemes- joint actuators- decentralized PID control- computed torque control –
force control- hybrid position force control- Impedance/ Torque control

REFERENCES
2003.
3. Fu, Gonzalez and Lee Mcgrahill, "Robotics", international
4. R.D. Klafter, TA Chmielewski and Michael Negin, "Robotic Engineering, An Integrated

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

UNIT IV      GENETIC ALGORITHM
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

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

UNIT I  INTRODUCTION TO DIGITAL SIGNAL PROCESSING  12

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 - orthogonal 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, categorisation 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

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:

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

TOTAL : 45 Periods

REFERENCES

ET8073 SECURITY IN NETWORKS AND CRYPTOGRAPHY

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

UNIT II  PUBLIC-KEY ENCRYPTION AND HASH FUNCTIONS

UNIT III  NETWORK SECURITY PRACTICE

UNIT IV  SYSTEM SECURITY

UNIT V  WIRELESS SECURITY
TEXT BOOKS

REFERENCES

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

UNIT IV METERING FOR ENERGY MANAGEMENT
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

REFERENCES

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
TEXT BOOKS:

REFERENCES:

PS8077 WIND ENERGY CONVERSION SYSTEM

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
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
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
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
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
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

REFERENCES

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
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
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
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
UNIT V HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS

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:

REFERENCES:
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,