VISION OF THE DEPARTMENT

The vision of Anna University is to be a world class institution by producing professionals with high technical knowledge, professional skills and ethical values, and remain as a preferred partner to the industry and community for their economic and social development through excellence in teaching, research and consultancy. Anna University shall be recognized as a point of reference, a catalyst, a facilitator, a trend setter and a leader in technical education.

MISSION OF THE DEPARTMENT

To produce full fledged Electrical and Electronics Engineers to cater to the needs of the modern industries and be useful for building the nation.
1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

I. To prepare students, for having career in industries/entrepreneurship through startups/teaching in Institutions/research in organizations that meet, the needs of national and international interest

II. To develop among students, the ability to develop embedded solutions using processor based computation and communication to build smart solutions for purpose of system automation.

III. To encourage students, to work in interdisciplinary groups.

IV. To provide students good foundation in mathematical, scientific, engineering fundamentals and hardware-software programming intelligence.

V. To provide the students with knowledge to be involved with the technology advancements and future developments for system automation of societal value.

VI. To promote student awareness, for life-long learning and introduce them to professional ethics and code of practice.

2. PROGRAMME OUTCOME (POs):

On successful completion of the P.G Programme,

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<th>PO</th>
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<td>1.</td>
<td>Engineering knowledge</td>
<td>To disseminate knowledge of the principles and practices of the electrical and electronics based industries regarding intelligent automation using dedicated processors supported with computation and communication technology.</td>
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<td>2.</td>
<td>Problem analysis</td>
<td>Capability to analyze regular operations and critical event operations of systems so as design fault tolerant smart solutions through fast switching.</td>
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<td>3.</td>
<td>Development of solutions</td>
<td>Be able to design and develop Embedded system automation based on dedicated ICs that have computation, networking and control capacity.</td>
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<td>Technical development</td>
<td>Able to incorporate software programming skills and interfacing onto complex computation and communication dependant Hardcore processors.</td>
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<td>5.</td>
<td>Modern tool usage</td>
<td>Skill to work on professional software languages, standard modeling and analysis tools &amp; commercial packages with communication protocols and computation platforms for analysis and design of system automation.</td>
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<td>Conduct investigations of complex problems</td>
<td>Be able to identify problems in electrical and electronic systems, analyze the problems, and solve them with creativity, supporting consumer applications.</td>
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<td>7.</td>
<td>Project management and finance</td>
<td>Competency to indigenously develop newer solutions in embedded automation by observing scientific strategies in smart</td>
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UNIVERSITY DEPARTMENTS
REGULATIONS - 2019
CHOICE BASED CREDIT SYSTEM
M.E. EMBEDDED SYSTEM TECHNOLOGIES (FULL TIME)
CURRICULUM AND SYLLABUS I TO IV SEMESTERS

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ANNA UNIVERSITY, CHENNAI
UNIVERSITY DEPARTMENTS
REGULATIONS - 2019
CHOICE BASED CREDIT SYSTEM
M.E. EMBEDDED SYSTEM TECHNOLOGIES (PART TIME)
CURRICULUM AND SYLLABUS I TO VI SEMESTERS

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COURSE OBJECTIVES:
- To provide knowledge on the basics, building blocks of Embedded System.
- To discuss Input/output Interfacing & Bus Communication with processors.
- To teach automation using scheduling algorithms and Real time operating system.
- To discuss on different Phases & Modeling of a new embedded product.
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills.

UNIT I INTRODUCTION TO EMBEDDED SYSTEMS

UNIT II EMBEDDED NETWORKING BY PROCESSORS

UNIT III 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- context switching, interrupt latency and deadline shared memory, message passing-, Interprocess Communication – synchronization between processes-semaphores, Mailbox, pipes, priority inversion, priority inheritance, comparison of Real time Operating systems: VxWorks, uC/OS-II, RT Linux.

UNIT IV MODELLING WITH HARDWARE/SOFTWARE DESIGN APPROACHES

UNIT V EMBEDDED SYSTEM APPLICATION DEVELOPMENT
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.
NOTE:
Practice through Mini Project/Exercise/Discussions on Design, Development of embedded Products like: Digital Camera / Adaptive Cruise control in a Car / Mobile Phone / Automated Robonoid / discussions on interface to Sensors, GPS, GSM, Actuators

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will demonstrate the ability

CO1: To understand the functionalities of processor internal blocks, with their requirement.
CO2: Observe that Bus standards are chosen based on interface overheads without sacrificing processor performance.
CO3: Understand the role and features of RT operating system, that makes multitask execution possible by processors.
CO4: Understand that using multiple CPU based on either hardcore or softcore helps data overhead management with processing-speed reduction for uC execution.
CO5: Guidelines for Embedded consumer product design based on phases of product development.

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REFERENCES:
COURSE OBJECTIVES:

- To teach the architecture of PIC Microcontroller and RISC processor.
- To compare the architecture and programming of 8,16,32 bit (NUVOTON, ARM Cortex M Series) RISC processor.
- To teach the implementation of DSP in ARM processor.
- To discuss on memory management, application development in RISC processor.
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills.

UNIT I PIC MICROCONTROLLER


UNIT II ARM ARCHITECTURE


UNIT III PERIPHERALS OF PIC AND ARM MICROCONTROLLER


UNIT IV ARM MICROCONTROLLER PROGRAMMING

- ARM general Instruction set – Thumb instruction set – Introduction to DSP on ARM – Implementation example of Filters

UNIT V DESIGN WITH PIC AND ARM MICROCONTROLLERS


TOTAL: 45 PERIODS

NOTE:
Discussions/Exercice/Practice on Workbench: on Programming practices on the KEIL Work Bench for Simple ASM/C / Input & output interfacing programs with ARM 7/ARM 9/Nuvoton Processors

COURSE OUTCOMES:

At the end of this course, the students will demonstrate the ability

CO1: To understand the basics and requirement of processor functional blocks.
CO2: Observe the specialty of RISC processor Architecture.
CO3: Incorporate I/O hardware interface of a processor based automation for consumer application with peripherals.
CO4: Incorporate I/O software interface of a processor with peripherals.
CO5: Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in commercial embedded processors
ET5103 SOFTWARE FOR EMBEDDED SYSTEMS L T P C 4 0 0 4

COURSE OBJECTIVES:
- To expose the students to the fundamentals of embedded Programming.
- To Introduce the GNU C Programming Tool Chain in Linux.
- To study the basic concepts of embedded C.
- To teach the basics of Python Programming.
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills.

UNIT I BASIC C PROGRAMMING 12
Typical C Program Development Environment - Introduction to C Programming - Structured Program Development in C - Data Types and Operators - C Program Control - C Functions - Introduction to Arrays.

UNIT II EMBEDDED C 12
UNIT III  C PROGRAMMING TOOL-CHAIN 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 - Introduction to GNU C Library.

UNIT IV  PYTHON PROGRAMMING  
Introduction - Parts of Python Programming Language - Control Flow Statements - Functions - Strings - Lists - Dictionaries - Tuples and Sets.

UNIT V  MODULES, PACKAGES AND LIBRARIES IN PYTHON  

TOTAL: 60 PERIODS

COURSE OUTCOMES:

CO1: Understanding of C programming and its salient features for embedded systems
CO2: The learning process delivers insight into various programming languages/software compatible to embedded process development with improved design & programming skills.
CO3: Developing knowledge on C programming in Linux environment.
CO4: Able to write python programming for Embedded applications.
CO5: Improved Employability and entrepreneurship capacity due to knowledge upgradation on recent trends in embedded programming skills.

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TEXTBOOKS:

REFERENCES:

17
COURSE OBJECTIVES:
To impart knowledge and skills required for research and IPR:
- Problem formulation, analysis and solutions.
- Technical paper writing / presentation without violating professional ethics
- Patent drafting and filing patents.

UNIT I RESEARCH PROBLEM FORMULATION  
Meaning of research problem- Sources of research problem, criteria characteristics of a good research problem, errors in selecting a research problem, scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, necessary instrumentations.

UNIT II LITERATURE REVIEW  
Effective literature studies approaches, analysis, plagiarism, and research ethics.

UNIT III TECHNICAL WRITING / PRESENTATION  
Effective technical writing, how to write report, paper, developing a research proposal, format of research proposal, a presentation and assessment by a review committee.

UNIT IV INTRODUCTION TO INTELLECTUAL PROPERTY RIGHTS (IPR)  

UNIT V INTELLECTUAL PROPERTY RIGHTS (IPR)  

TOTAL: 30 PERIODS

COURSE OUTCOMES:
1. Ability to formulate research problem
2. Ability to carry out research analysis
3. Ability to follow research ethics
4. Ability to understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity
5. Ability to understand about IPR and filing patents in R & D.

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REFERENCES:

ET5111
EMBEDDED SYSTEM LAB – I

COURSE OBJECTIVES:
- To involve the students to Practice on Workbench /Software Tools/ Hardware Processor Boards with the supporting Peripherals.
- To teach the concepts of algorithm development & programming on software tools and Digital processors with peripheral interfaces.
- To encourage students to practice in opensource software / packages / tools
- To train though hands-on practices in commercial and licensed Hardware-software suites
- Practicing through the subdivisions covered within experiments listed below to expose the students into the revising the concepts acquired from theory subjects.

<table>
<thead>
<tr>
<th>Domain</th>
<th>EXPERIMENT DETAIL</th>
<th>EQUIPMENT/ SUPPORTS REQUIRED</th>
<th>TRAINING OUTCOMES</th>
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<tbody>
<tr>
<td></td>
<td>Programming with 8 bit Microcontrollers # Assembly programming</td>
<td>8051/ other 8 bit Microcontrollers with peripherals; IDE, Board Support Software Tools /C Compiler/others</td>
<td>The students will learn design with simulators/experiments, in programming processor boards, processor interfacing/ designing digital controllers</td>
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<td></td>
<td>Study on In-circuit Emulators, cross compilers, debuggers</td>
<td>8051 Microcontrollers with peripherals; IDE, Board Support Software Tools /C Compiler/others</td>
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<td></td>
<td>Programming with 8 bit Microcontrollers # C programming</td>
<td>8051/ other 8 bit Microcontrollers with peripherals; IDE, Board Support Software Tools /C Compiler/others</td>
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<tr>
<td></td>
<td>Study on in-circuit Emulators, cross compilers, debuggers</td>
<td>8051 Microcontrollers with peripherals; IDE, Board Support Software Tools /C Compiler/others</td>
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<td></td>
<td>I/O Programming with 8 bit Microcontrollers I/O Interfacing : Timers/ Interrupts/ Serial port</td>
<td>8051/ other 8 bit Microcontrollers with peripherals; IDE, Board Support Software Tools /C Compiler/others</td>
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<tr>
<td>Programming/PWM Generation/ Motor Control/ADC/DAC/ LCD/ RTC Interfacing/ Sensor Interfacing</td>
<td>with interface</td>
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<tr>
<td><strong>4. Programming with AVR/ PIC Microcontrollers:</strong>&lt;br&gt; ✓ Assembly ✓ C programming ✓ Programming ✓ Interfacing peripherals</td>
<td>AVR/ PIC Microcontrollers with peripherals; IDE, Board Support Software Tools /C Compiler/others</td>
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<tr>
<td>Study on in-circuit Emulators, cross compilers, debuggers</td>
<td>The students will learn design with simulators/experiments, in programming processor boards, processor interfacing/ designing digital controllers</td>
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<tr>
<td><strong>5. I/O Programming with AVR/ PIC Microcontrollers</strong>&lt;br&gt; I/O Interfacing : Timers/ Interrupts/ Serial port programming/PWM Generation/ Motor Control/ADC/DAC/ LCD/ RTC Interfacing/ Sensor Interfacing</td>
<td>AVR/ PIC Microcontrollers with peripherals; Board Support Software Tools, peripherals with interface</td>
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P = 60  TOTAL = 60

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

**COURSE OUTCOMES:**
At the end of this course, the students will demonstrate the ability in

CO1: The Laboratory experiments exposes insight into various embedded processors of CISC and RISC architecture / computational processors with peripheral interface.

CO2: Understanding the fundamental concepts of how process can be controlled with uC.

CO3: working on programming logic of Processor based on software suites(simulators, emulators)

CO4: Incorporate I/O software interface of a processor with peripherals.

CO5: Improved Employability and entrepreneurship capacity due to knowledge upgradation on recent trends in interfacing and use of commercial embedded processors
REFERENCES:

ET5112 EMBEDDED PROGRAMMING LAB - I LT P C 0 0 4 2

COURSE OBJECTIVES:

- To involve the students to Practice on Workbench /Software Tools/ Hardware Processor Boards with the supporting Peripherals.
- To teach the concepts of algorithm development & programming on software tools and Digital processors with peripheral interfaces.
- To encourage students to practice in opensource softwares / packages / tools
- To train though hands-on practices in commercial and licensed Hardware-software suites
- Practicing through the subdivisions covered within experiments listed below to expose the students into the revising the concepts acquired from theory subjects.
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<th>Domain</th>
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<tbody>
<tr>
<td>1.</td>
<td>Programming in Higher Level Languages/ Platforms</td>
<td>C/C++/Java/Embedded C/Embedded Java/ Compilers &amp;Platforms/cloud/APP development/Big data analytics</td>
<td>The students will learn design with simulators/ programming environments</td>
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<tr>
<td>2.</td>
<td>Programming with Arduino Microcontroller Board : Study on Incircuit Emulators, cross compilers, debuggers</td>
<td>Arduino Boards with peripherals ;IDE, Board Support Software Tools /Compiler/others</td>
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<td>3.</td>
<td>VHDL Programming in FPGA processors</td>
<td>Processor Boards with Board Support Tools &amp; Interfaces</td>
<td>The students will learn design, modeling &amp; simulation of Combinational, Sequential, Synchronous, Asynchronous circuits with simulators/experiments ,in programming processor boards, processor interfacing/designing reprogrammable system</td>
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<tr>
<td>4.</td>
<td>Programming &amp; Simulation in Simulators /Tools/others</td>
<td>Simulation Tools as Proteus/ ORCAD</td>
<td>The students will learn design with experiments, in programming suites/ simulators/EV /Signal processing/Tool Bench.</td>
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<td>Programming &amp; Simulation in Simulators /Tools/others</td>
<td>Simulation Tools as MATLAB /others</td>
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P = 60  TOTAL= 60

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

**COURSE OUTCOMES:**
At the end of this course, the students will demonstrate the ability in
CO1: Developing Optimized code for embedded processor
CO2: Understanding the fundamental concepts of how process can be realized using Software Modules
CO3: Circuit and System level simulators to develop solution for embedded based applications.
CO4: Incorporate I/O software interface of a processor with peripherals.
CO5: Improved Employability and entrepreneurship capacity due to knowledge up gradation on Embedded computing and algorithm development with programming concepts.

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ET5201 EMBEDDED LINUX LT P C 3 1 0 4

COURSE OBJECTIVES:
- To impart knowledge about Linux Operating System
- To expose the students to the fundamentals of Linux Operating system and its basic commands.
- To Teach about the various Linux distributions and running them on a typical Embedded Board.
- To demystify the details of various Embedded Boards and programming them.
- To give an introduction to Linux Device Drivers.

UNIT I LINUX FUNDAMENTALS 12

UNIT II CROSS-DEVELOPMENT TOOLCHAIN 12
UNIT III  RUNNING LINUX ON EMBEDDED BOARDS

UNIT IV  CROSS-COMPILATION AND INTERFACING TO THE RASPBERRY PI BUSSES

UNIT V  INTRODUCTION TO LINUX DEVICE DRIVERS

TOTAL: 60 PERIODS

COURSE OUTCOMES: At the end of this course, students will have the following knowledge and skills

CO1: Thorough understanding of Linux and its commands
CO2: Differentiate Embedded Linux from its Desktop counterpart and its internals
CO3: Successfully run Linux on an Embedded Board, Use Eclipse IDE for Cross-compilation
CO4: Able to write a simple device driver in Linux
CO5: Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded linux skills.

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

UNIT I REVIEW OF OPERATING SYSTEMS
Basic Principles - Operating System structures – System Calls – Files – Processes – Design and Implementation of processes – Communication between processes – Introduction to Distributed operating system – Embedded operating systems

UNIT II OVERVIEW OF RTOS

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

UNIT IV REALTIME KERNEL
Principles – Design issues – Polled Loop Systems – RTOS Porting to a Target – Comparison and Basic study of various RTOS like – VX works – Linux supportive RTOS – C Executive.

UNIT V APPLICATION DEVELOPMENT
Discussions on Basics of Linux supportive RTOS – uCOS-C Executive for development of RTOS Application – Case study

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: Understanding Operating System structures and types.
CO2: Insight into scheduling, disciplining of various processes execution.
CO3: Provide knowledge on various RTOS support modelling
CO4: Understanding commercial RTOS Suite features to work on real time processes design.
CO5: Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in RTOS and embedded automation design.

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Verified
REFERENCES:

ET5251 VLSI DESIGN AND ARCHITECTURE

COURSE OBJECTIVES:
- To understand the basic concepts of VLSI and CMOS design.
- To introduce the IC fabrication methods.
- To study the architectures of various RPLDs.
- To introduce the basics of analog VLSI design and its importance.
- To learn about the programming of Programmable device using Hardware description Language.

UNIT I CMOS DESIGN
Review of switching devices and logics- MOSFET Scaling- MOS Transistor Model- CMOS inverter-
- determination of pull up / pull down ratios, Nano MOSFET- CMOS based combinational logic &
- sequential design- Dynamic CMOS & clocking – Transmission Gates- BiCMOS- Low power VLSI.

UNIT II IC FABRICATION
Overview of IC Fabrication - NMOS, PMOS, CMOS, SOI, BiCMOS fabrication- Stick Diagrams,
- Design Rules and Layout - recent trends in IC fabrication.

UNIT III PROGRAMMABLE LOGIC DEVICES AND ASIC DESIGN
Programming techniques- Architecture of CPLD and FPGA – advanced FPGA devices- ASIC
- physical design– Logic Implementation with PLDs.

UNIT IV ANALOG VLSI DESIGN
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 HDL PROGRAMMING
Overview of digital design with HDL, structural, data flow and behavioural modeling- logic
- synthesis-simulation-Combinational and Sequential logic design examples, Ripple carry Adders,
- Carry Look ahead adders, Multiplier, ALU, Test Bench.

TOTAL: 60 PERIODS

COURSE OUTCOMES:
CO1: The learning process delivers insight into developing CMOS design techniques and
development of low power VLSI logic circuits.
CO2: Insight into IC fabrication methods.
CO3: Improved skill set in RPLD/SOC usage for real time applications.
CO4: Design and development of reprogrammable analog devices and its usage for embedded applications.
CO5: Understating and usage of HDL computational processes with improved design strategies.

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TEXTBOOKS:

ET5211 EMBEDDED SYSTEM LAB - II LT P C 0 0 4 2

COURSE OBJECTIVES:
- To involve the students to Practice on Workbench /Software Tools/ Hardware Processor Boards with the supporting Peripherals.
- To teach the concepts of algorithm development & programming on software tools and Digital processors with peripheral interfaces.
- To encourage students to practice in opensource softwares / packages / tools
- To train though hands-on practices in commercial and licensed Hardware-software suites
- Practicing through the subdivisions covered within experiments listed below to expose the students into the revising the concepts acquired from theory subjects.

<table>
<thead>
<tr>
<th>SL.</th>
<th>EXPERIMENT DETAIL</th>
<th>EQUIPMENT/ SUPPORTS REQUIRED</th>
<th>TRAINING OUTCOMES</th>
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<tbody>
<tr>
<td></td>
<td>Programming ARM processor</td>
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<td>Subject</td>
<td>Tools/Platforms</td>
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</tr>
<tr>
<td>1.</td>
<td>ARM7 / ARM9/ARM Cortex Study on Incircuit Emulators, crosscompilers, debuggers</td>
<td>Microcontrollers with peripherals; IDE, Board Support Software Tools/Keil/uCOS Compiler/others</td>
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<tr>
<td>5.</td>
<td>Programming with DSP processors</td>
<td>Processor Boards with Board Support Tools &amp; Interfaces</td>
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<td></td>
<td>Smart System Design using Embedded HW/SW modules</td>
<td>AMI/EV and hybrid vehicles</td>
<td>The students will learn indigenous designing of Automation that will help them to become entrepreneurs</td>
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P = 60 TOTAL = 60

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

**COURSE OUTCOMES:**
At the end of this course

**CO1:** students will learn design with simulators/experiments, in programming processor boards, processor interfacing/designing digital controllers

**CO2:** design & simulation of Arithmetic, Logic programs, Filters, Signal analysis with simulators/experiments, in programming processor boards, processor interfacing/Tools

**CO3:** Understand and able to develop real-time solution for embedded applications

**CO4:** The students will learn programming, compiling in various tools & software domains

**CO5:** Improved Employability and entrepreneurship capacity due to knowledge upgradation on recent trends in commercial embedded processors and its programmable interfacing

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</table>
COURSE OBJECTIVES:

- To involve the students to Practice on Workbench /Software Tools/ Hardware Processor Boards with the supporting Peripherals.
- To teach the concepts of algorithm development & programming on software tools and Digital processors with peripheral interfaces.
- To encourage students to practice in opensource softwares / packages /tools
- To train through hands-on practices in commercial and licenced Hardware-software suites
- Practicing through the subdivisions covered within experiments listed below to expose the students into the revising the concepts acquired from theory subjects.

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<th>SL.</th>
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<th>TRAINING OUTCOMES</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>Programming in Freeware softwares/ Platforms</td>
<td>Programming Compilers &amp; Platforms on freeware</td>
<td>The students will learn programming, compiling in various tools &amp; software domains</td>
</tr>
</tbody>
</table>
| 2.  | Software & Modelling tools | Personal Computers, Licensed software programming/modelling tools &  
✓ Study on MEMS Tools  
✓ Study on process Controller modeling  
✓ PLC/SCADA/PCB  
✓ one type CAD Tool | |
| 3.  | Programming & Simulation in GUI Simulators /Tools/others | Simulation Tools as Labview /others | |
| ✓ Graphical User interface simulations & modeling of instrumentation & controllers | |
| 4.  | Programming & Simulation in Python Simulators/Tools/others | Programming in Python Platform | The students will learn programming, compiling in various tools & software domains |
### Linux programming Tool chain

**PC with Linux OS**

**Learning the various components of Linux Development tool chain**

\[ P = 60 \quad \text{TOTAL} = 60 \]

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

**COURSE OUTCOMES:**
At the end of this course, the students will demonstrate the ability in

- **CO1:** Developing Optimized algorithms for embedded processor on IDE and compilers
- **CO2:** Understanding the concepts of how process can be realized using Software Modules
- **CO3:** Device, Circuit and System level simulators/emulators to develop embedded applications.
- **CO4:** Incorporate I/O software interface using IDE and High level languages with processor
- **CO5:** Improved Employability and entrepreneurship capacity due to knowledge upgradation on Embedded programming concepts

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COURSE OBJECTIVES

- To provide a hands on training on embedded systems technologies
- To improve the understanding ability and the presentation skills of the students
- To provide an insight of developing optimized embedded solution for supplications
- To emphasize the need of Hardware/Software co-design and its usage for real time applications.
- To provide guidance for entrepreneurship.

Note 1: (Mini project work can encourage seminar presentations and hands-on training of concepts learnt through theory subjects and also make preliminary exposure to domain topics in synchronism with PROJECT WORK PHASE)

MINI PROJECT WORK : COURSE OBJECTIVES AND OUTCOMES

<table>
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<tr>
<th>1.0</th>
<th>COURSE OBJECTIVES</th>
<th>TRAINING OUTCOMES</th>
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<tbody>
<tr>
<td></td>
<td>Programming in</td>
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<tr>
<td></td>
<td>✓ C/ Embedded C / C++ / JAVA/Python/others</td>
<td>Skill development in software programming/working in simulators, emulators, learn using the commercial packages for wired, wireless communications</td>
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<tr>
<td></td>
<td>✓ Network Simulators</td>
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<td></td>
<td>✓ Multicore Processors suites</td>
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<td>✓ Programming on Pervasive Computing</td>
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<td>✓ Java for Wireless Devices</td>
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<tr>
<th>2.0</th>
<th>Programming Embedded Processors</th>
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<tr>
<td></td>
<td>✓ uC,ARM processor family</td>
<td>The students will learn design with simulators/experiments, in programming processor boards, processor interfacing/designing reprogrammable system</td>
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<td>✓ DSP / pSoC/Image / Video Processors</td>
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<td>✓ VHDL Programming in FPGA processors</td>
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<td>✓ Multicore Processors</td>
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<tr>
<th>3.0</th>
<th>Programming Embedded OS</th>
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<tr>
<td></td>
<td>✓ Android / LINUX OS Internals/VxWorks/ Keil Os/ TinyOS/Device-driver programming/ ApplicationDevelopment/others</td>
<td>The students will skill through OS programming through API, libraries</td>
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<td>4.0</td>
<td>Modelling/Simulation Suites</td>
<td>The students will apply programming logic for modeling/simulating embedded application development</td>
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<td>✓ Communication Protocols</td>
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<td>✓ IED Standards</td>
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<td>✓ Virtual Instrumentation programming</td>
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<td>✓ Simulink/Mathlab Tools</td>
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<tr>
<td>✓ Study on MEMS Tools</td>
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<td>✓ process Controller modeling</td>
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<td>✓ PLC/SCADA/PCB/ORCAD</td>
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<td>✓ CAD Tools</td>
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<tr>
<td>✓ UML/Modelling Tools</td>
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<tr>
<td>5.0</td>
<td>✓ Entrepreneurship Skill development</td>
<td>The students will know to pickup skills for product development/establish consultancy services with an outlook into selecting commercially viable market for technical demands</td>
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</table>

**COURSE OUTCOMES**

CO1 : Skill development in software programming/working in simulators, emulators, learn using the commercial packages for wired, wireless communications

CO2 : The students will learn design with simulators/emulator for experiments in programming processor boards, processor interfacing/designing reprogrammable system

CO3: The students will skill through OS programming through API, libraries

CO4 : Apply programming logic for modeling/simulating embedded application development

CO5 : The students will know to pickup skills for product development/establish consultancy services with an outlook into selecting commercially viable technical demands in the industry

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TOTAL: 90 PERIODS
COURSE OBJECTIVES

- To provide a hands on skills by training on domains of embedded systems technologies
- To improve the design ability and the oral, written presentation skills of the students
- To provide an insight of developing optimized embedded solution for system automation
- To emphasize the need of Hardware & Software design tools usage for real time applications.
- To enhance capacity to compete for placement and developing ability for entrepreneurship.

<table>
<thead>
<tr>
<th>DOMAIN</th>
<th>COURSE OBJECTIVES THROUGH DOMAINS</th>
<th>TRAINING OUTCOMES</th>
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</thead>
<tbody>
<tr>
<td>1.0</td>
<td>Programming in C/ Embedded C / C++ / JAVA</td>
<td>Skill development in software programming/working in simulators, emulators, learn using the commercial packages for wired, wireless communications</td>
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<tr>
<td></td>
<td>Network Simulators</td>
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<td>Network simulation</td>
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<td>Programming on Pervasive Computing</td>
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<td>Java for Wireless Devices</td>
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<td>2.0</td>
<td>Embedded Processors</td>
<td>The students will learn design with simulators/experiments, in programming processor boards, processor interfacing/designing reprogrammable system</td>
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<td>DSP / Image / Video Processors</td>
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<td>3.0</td>
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<td>5.0</td>
<td>Entrepreneurship development</td>
<td>The students will know to pickup skills for product development/establish consultancy services with an outlook into selecting commercially viable technical demands of the country</td>
</tr>
</tbody>
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PRE-REQUISITES: choice of project title from the listed broad domain of research topics for Project work:
Design / development through simulation/ experimental analysis with report submission (relevant to the candidates project area) by individuals for getting skilled up through learning & practicing chosen domains of interest.

Project work domain is to be chosen to enhance student's capacity to work in Research Areas of interest. The domains of work will add value to the Department’s research activity or by working in domains of Industrial importance.

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. **Smart system design** for smart grid, smart metering, smart cities, smart buildings, Vehicles and vehicle autonomy, AI based applications, Automation, E-health.

4. **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.

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

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

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

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

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. **Network simulation** using NS2/ Programming of TCP/IP protocol stack /any network simulator tools -Network Deployment, security concepts.- 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. **Entrepreneurship Skill development through Product Design with Cost Estimation** – Learn through survey on on : project/product identification, development plan and execution, the Activity planning, schedule development ,Integration Management

COURSE OUTCOMES

CO1: At the end of this course, the students will demonstrate the ability in any of the listed Domains their Design, Development capability in Building Automation for a process through Hardware & Software Tools.

CO2: Pre-Requisites insists choice of project title from the enlisted broad domain of research topics for Project work:

CO3: Project work to enhance students’ capacity to work in Research Areas of the Department interests or of Industrial importance.

CO4: The Viva-Voce Examination will demonstrate this skill through Oral and Written Communication as presented in the Thesis Book.

CO5: Improved Employability and entrepreneurship capacity due to knowledge upgradation with getting skilled up through learning & practicing in Design / development through simulation/ experimental analysis with project report submission (relevant to the candidates’ project area) by individuals.

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ET5001 WIRELESS AND MOBILE COMMUNICATION  LT P C 3 0 0 3

COURSE OBJECTIVES:

- To expose the students to the fundamentals of wireless communication technologies.
- To teach the fundamentals of wireless mobile network protocols.
- To study on wireless network topologies, network routing protocols.
- To introduce the basis for classification of commercial family of wireless communication technologies.
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills.

UNIT I INTRODUCTION

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

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of this course, the students will demonstrate the ability in

- **CO1:** The learning process delivers insight categorizing various embedded & communication protocols for networking
- **CO2:** Configuration strategies of distributed static & mobile secured systems.
- **CO3:** Deployment of distributed Wireless & mobile networks
- **CO2:** Establishment routing of distributed static & mobile systems
- **CO5:** Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded Communication Technologies.

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

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ET5002 AD HOC NETWORKS LT P C 3 0 0 3

COURSE OBJECTIVES:
- To expose the students to the fundamentals of wireless communication technologies.
- To teach the fundamentals of wireless mobile network routing protocols
- To study on network OSI Layers
- To introduce on concepts for network deployment, Network performance & Analysis
- To involve Discussions/Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

UNIT I WIRELESS LAN, PAN, WAN AND MAN

UNIT II MAC, ROUTING AND MULTICAST ROUTING PROTOCOLS

UNIT III TRANSPORT LAYER AND SECURITY PROTOCOLS

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

UNIT V PERFORMANCE ANALYSIS
ABR beaconing, Performance parameters, Route-discovery time, End-to-end delay performance, Communication throughput performance, Packet loss performance, Route reconfiguration/repair time, TCP/IP based applications.
NOTE: Discussions/Practice on Workbench: on Zigbee/other Protocols with respect to understanding the importance of network components, Networking Layers

COURSE OUTCOMES:
At the end of this course, the students will demonstrate the ability in
CO1: The learning delivers insight categorizing various generations of wireless communication protocols for networking
CO2: Establishment routing of distributed static & mobile systems.
CO3: Deployment of distributed Wireless & mobile secured networks
CO4: Deployment of energy aware distributed Wireless sensor networks
CO5: Improved Employability and entrepreneurship capacity due to knowledge upgradation on recent trends in embedded Communication Technologies.

TOTAL: 45 PERIODS

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

ET 5073 CRYPTOGRAPHY AND NETWORK SECURITY LT P C 3 0 0 3

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

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

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Understanding the significance of security for communication
CO2: Delivers Insight of security mechanism and architecture.
CO3: Applying the security algorithms for real time applications.
CO4: The learning process delivers insight onto role of security aspects during data transfer and communication systems like electrical grid
CO5: Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems and secured system design.
REFERENCES:

COURSE OBJECTIVES:
- To expose the students to the fundamentals of Network communication technologies.
- To teach the fundamentals of Java, Internet and Java card.
- To develop distributed embedded system with Java.
- To teach the smart card and Apps development.
- To involve Discussions/ Practice in familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills.

UNIT I NETWORK INFRASTRUCTURE
- Broad Band Transmission facilities – Open Interconnection standards – networking devices
- Network diagram – Network management – Network Security – Cluster computers

UNIT II JAVA TECHNOLOGY FOR EMBEDDED SYSTEMS

UNIT III SMART CARD TECHNIQUES
- Smart Card basics – Java card technology overview – Java card Types – Card components
- SMART CARD MICROCONTROLLERS – Contactless Cards – Smart Card Operating Systems— smart card Security Techniques

UNIT IV ANDROID FRAMEWORK
- Android SDK – Access to Hardware – Framework development – Peer-to-Peer communication – Android security design and architecture – Case study

UNIT V DEVELOPING DISTRIBUTED REAL-TIME SYSTEM APPLICATIONS
- Developing MATLAB Real-Time Targets - Using the xPC Target – Building various Distributed Real Time Applications

TOTAL: 45 PERIODS

COURSE OUTCOMES:
- CO1: The learning process delivers insight into involving JAVA concepts & internet based Communication to establish decentralized control mechanism of system
- CO2: Understanding the software and hardware architecture for distributed computing
- CO3: Able to develop solution for smart card

Attested

Director
Centre for Academic Courses
Anna University, Chennai-600 025
CO4: Able to develop Apps based on android SDK.
CO5: Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded system computing environment.

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ET5072 AUTOMOTIVE EMBEDDED SYSTEM LT P C
3 0 0 3

COURSE OBJECTIVES:
- To expose the students to the fundamentals and building of Electronic Engine Control systems,
- To teach on functional components and circuits for vehicles
- To discuss on programmable controllers for vehicles management systems
- To teach logics of automation & commercial techniques for vehicle communication
- To introduce the embedded systems concepts for E-vehicle system development.

UNIT I BASIC OF ELECTRONIC ENGINE CONTROL SYSTEMS
Overview of Automotive systems, fuel economy, air-fuel ratio, emission limits and vehicle performance; Automotive microcontrollers- Electronic control Unit- Hardware & software selection and requirements for Automotive applications – open source ECU-RTOS - Concept for Engine management-Standards; Introduction to AUTOSAR and Introduction to Society SAE- Functional safety ISO 26262- Simulation and modeling of automotive system components.

UNIT II SENSORS AND ACTUATORS FOR AUTOMOTIVES
Review of sensors- sensors interface to the ECU, conventional sensors and actuators, Modern sensor and actuators - LIDAR sensor- smart sensors- MEMS/NEMS sensors and actuators for automotive applications.

UNIT III VEHICLE MANAGEMENT SYSTEMS
Electronic Engine Control-engine mapping, air/fuel ratio spark timing control strategy, fuel control, electronic ignition- Adaptive cruise control - speed control-anti-locking braking system-electronic
suspension - electronic steering , Automatic wiper control- body control system ; Vehicle system schematic for interfacing with EMS, ECU. Energy Management system for electric vehicles- Battery management system , power management system-electrically assisted power steering system- Adaptive lighting system- Safety and Collision Avoidance.

UNIT IV ONBOARD DIAGNOSTICS AND TELEMATICS


UNIT V ELECTRIC VEHICLES


NOTE: Miniproject/Discussions/Practice on Workbench/AUTOSAR/ Vehicle simulators / modeling packages on the basics of interfacing sensors, actuators specific to automobile-microcontrollers/ special automobile-microcontrollers for i/o port communication applicable to vehicles

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: The learning process delivers insight into the significance of the role of embedded system for automotive applications.
CO2: Understanding the need, selection of sensors and actuators and interfacing with ECU
CO3: Applying the Embedded concepts for vehicle management and control systems.
CO4: Understanding the need of Electrical vehicle and able to apply the embedded system technology for various aspects of EVs
CO5: Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design and its application in automotive systems.

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REFERENCES:

5. Electronic Engine Control technology – Ronald K Jurgen Chilton’s guide to Fuel Injection – Ford

ET5076 MEMS TECHNOLOGY LT P C 3 0 0 3

COURSE OBJECTIVES:
- To introduce the diverse technological and functional approaches of MEMS and applications.
- To understand the microstructures and fabrication methods.
- To provide an insight of micro sensors, actuators.
- To emphasis the need and role of MEMS process techniques.
- To update the ongoing trends and real time applications of MEMS technology.

UNIT I INTRODUCTION TO MEMS
Overview of Micro electro mechanical systems (MEMS), devices and technologies, Laws of scaling- multi disciplinary nature of MEMS- Survey of materials- Smart Sensors-Applications of MEMS.

UNIT II MICRO-MACHINING AND MICROFABRICATION TECHNIQUES
Photolithography- Film deposition, Etching Processes- wafer bonding- Bulk micro machining, silicon surface micro machining- LIGA process.

UNIT III MICRO SENSORS AND MICRO ACTUATORS
Transduction mechanisms in different energy domain- Micromachined capacitive, Piezoelectric, piezoresistive and Electromechanical and thermal sensors/actuators and applications

UNIT IV MEMS PROCESS TECHNIQUES
Simulation and modeling of MEMS components - Computer- aided design for MEMS layout, SOI, Metal and Poly MUMPs- Microsystem Design and Packaging -Rapid product development.

UNIT V MEMS APPLICATION AND RECENT TRENDS

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: Understanding the material properties and the significance of MEMS for industrial automation.
CO2: Knowledge delivery on micromachining and micro fabrication.
CO3: Applying the fabrication mechanism for MEMS sensor and actuators.
CO4: Applying the concepts of MEMS to models, simulate and process the sensors and actuators.
CO5: Improved Employability and entrepreneurship capacity due to knowledge upgradation on MEMS technology.

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ET5077 NANO ELECTRONICS LT P C 3 0 0 3

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

UNIT I INTRODUCTION
Overview of nanotechnology – Implication on science, engineering and technology- Particles-, waves, Wave mechanics, schrodinger equation- Electron transport in semiconductors and nanostructures, Nano materials and its properties- Electrical and Electronics Applications of Nanotechnology.
UNIT II  NANO SCALE CMOS
Survey of modern electronics and trends towards nano electronics CMOS scaling, challenges and limits, static power, device variability, interconnect - CNT-FET, FinFET, FerroFET - Surround gate FET nanoscale CMOS circuit design and analysis

UNIT III  NANO ELECTRONIC DEVICES

UNIT IV  NANO ELECTRONIC COMPUTATION AND MEMORIES

UNIT V  FABRICATION TECHNIQUES

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

TOTAL : 45 PERIODS

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

CO1: Understand the properties of electron and the significance of nanotechnology.
CO2: Concept of nanoscale CMOS devices and its various issues.
CO3: Apply the concept of nanotechnology and understand the significance of nanoelectronic devices.
CO4: Understand the nano configurations of computational processors and memories with improved design strategies.
CO5: Learn and understand the nano fabrication techniques.

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REFERENCES:
2. Rainer Waser, “Nanoelectronics and Information Technology”, Wiley 2005

46
6. George W. Hanson, Fundamental of nano electronics, Pearson education.

ET5004  RECONFIGURABLE PROCESSOR AND SoC DESIGN

COURSE OBJECTIVES:
- To familiarize the need and role of Reconfigurable Processor for embedded system applications.
- To introduce the Reconfigurable Processor technologies
- To teach the salient features and architecture of FPGA.
- To provide an insight and architecture significance of SOC.
- To impart the knowledge of Reconfigurable embedded Processor for real time applications.

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

UNIT II  FPGA TECHNOLOGIES

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

UNIT IV  RECONFIGURABLE SOC PROCESSORS
SoC Overview –Architecture and applications of Virtex II pro ,Zynq-7000, Excalibur, Cyclone V - A7, E5- FPSLIC- Multicore SoCs.

UNIT V  RECONFIGURABLE PROCESSOR AND SOC APPLICATIONS
Reconfigurable processor based DC motor control- digital filter design- mobile phone development- High Speed Data Acquisition -Image Processing application-controller implementation for mobile robot- Crypto-processor.

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

TOTAL: 45 PERIODS

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

CO1: Understand the need of reconfigurable computing and hardware-software co design
CO2: Understand the significance of FPGA technology
CO3: Apply the concept of FPGA technology and understand FPGA architectures.
CO4: Understand the operation of SoC processor.
CO5: Apply and improve Employability and entrepreneurship capacity due to knowledge up-gradation on reconfigurable computing and SoC design

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2. Ian Grout , "Digital system design with FPGAs and CPLDs" Elsevier, 2008

ET5078 ROBOTICS AND AUTOMATION LT P C 3 0 0 3

COURSE OBJECTIVES:
- To teach the need of embedded system technology for robot building
- To Study The Various Parts Of Robots And Fields Of Robotics.
- To Study The Various Kinematics And Inverse Kinematics Of Robots.
- To Study The Trajectory Planning For Robot.
- To Study The Control Of Robots For Some Specific Applications.

UNIT I  INTRODUCTION TO ROBOTICS

UNIT II  POWER SOURCES AND SENSORS
Hydraulic, Pneumatic And Electric Drives – Determination Of HP Of Motor And Gearing Ratio –

UNIT III MANIPULATORS, ACTUATORS AND GRIPPERS 9

UNIT IV KINEMATICS AND PATH PLANNING 9
Solution Of Inverse Kinematics Problem – Multiple Solution Jacobian Work Envelop – Hill Climbing Techniques –path planning algorithms- Robot Programming Languages- Simulation and modeling of simple

UNIT V CASE STUDIES 9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: Selection of suitable embedded boards for robots
CO2: Understanding the concepts of robotics & automation and Working Of Robot
CO3: Analyze the Function of Sensors and actuators In the Robot
CO4: Write Program to Use a Robot For a Typical Application
CO5: Apply and improve Employability and entrepreneurship capacity due to knowledge up-gradation on Embedded system based robot development

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COURSE OBJECTIVES:
- To understand about the smart system technologies and its role in real time applications
- To expose students to different open source platforms and Attributes.
- To teach the architecture and requirements of Home Automation.
- To provide an insight into smart appliances and energy management concepts.
- To familiarize the design and development of embedded system based system design.

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

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

UNIT III  HOME AUTOMATION:

UNIT IV  SMART APPLIANCES AND ENERGY MANAGEMENT

UNIT V  EMBEDDED SYSTEMS AND ROBOTICS

TOTAL: 45 PERIODS

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

COURSE OUTCOMES:
CO1: Students will develop more understanding on the concepts of smart system design and its present developments.
CO2: Students will study about different embedded open source and cost effective techniques for developing solution for real time applications.
CO3: Students will acquire knowledge on different platforms and Infrastructure for Smart system design.
CO4: Students will learn about smart appliances and energy management concepts.
CO5: Apply and improve Employability and entrepreneurship capacity due to knowledge upgradation on embedded system technologies.

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ET5006 DIGITAL IMAGE PROCESSING SYSTEM LT P C 3 0 0 3

COURSE OBJECTIVES:
The objectives of this course to impart knowledge in
- the fundamentals of image processing
- the techniques involved in image enhancement
- the low and high-level features for image analysis
- the fundamentals and significance of image compression
- the hardware for image processing applications

UNIT I FUNDAMENTALS OF IMAGE PROCESSING
Introduction to image processing systems, sampling and quantization, color fundamentals and models, image operations – arithmetic, geometric and morphological. Multi-resolution analysis – image pyramids
UNIT II IMAGE ENHANCEMENT

UNIT III IMAGE SEGMENTATION AND FEATURE ANALYSIS

UNIT IV IMAGE COMPRESSION

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course students will comprehend

CO1: Able to understand the fundamentals of image processing.
CO2: Able to understand the techniques involved in image enhancement, segmentation and compression.
CO3: Able to analyze their real-time applications
CO4: Able to implement image processing applications using software and hardware.
CO5: Develop real time solutions for applications

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

REFERENCES:

ET5007 ADVANCED DIGITAL SYSTEMS DESIGN LT P C 3 0 0 3

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

UNIT I SEQUENTIAL CIRCUIT DESIGN 9

UNIT II ASYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN 9

UNIT III FAULT DIAGNOSIS AND TESTABILITY ALGORITHMS 9

UNIT IV SYNCHRONOUS DESIGN USING PROGRAMMABLE DEVICES 9
Architecture of EPLD, Programmable Electrically Erasable Logic - 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
FPGA Fundamentals– SRAM based FPGA architecture – Advanced FPGA features – FPGA selection and Design decisions - Xilinx Spartan and Virtex family.

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

TOTAL: 45 PERIODS

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COURSE OUTCOMES:
At the end of this course, the students will demonstrate the ability in

CO1: incorporating synchronous switching logics, with clocked circuits design
CO2: incorporating asynchronous switching logics, with clocked circuits design
CO3: applying the testing algorithms and fault diagnostic techniques for digital systems
CO3: Observe the detection of Error and correction for error free circuitry
CO4: Design of computation logics of processors using IEEE standard Software Emulator on reconfigurable device like FPGAs
CO5: Improved Employability and entrepreneurship capacity due to knowledge up gradation on digital circuits design, testing and programming of reconfigurable digital logic processors.

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ET5008 COMPUTER ARCHITECTURE AND PARALLEL PROCESSING

COURSE OBJECTIVES:
- To educate the students about the fundamentals of parallel processing uC
- To teach the fundamentals of network topologies for multiprocessors
- To discuss on different pipeline designs, memory technologies
- To introduce features of parallel processors, OS for multiprogramming.
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

54
UNIT I THEOREY OF PARALLELISM IN PROCESSOR
Parallel Computer models – the state of computing-introduction to parallel processing- parallelism in uniprocessors& Multiprocessors, parallel architectural classification schemes-speedup performance laws-issues in H/W-S/W parallelism

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-Hierarchical bus systems-Crossbar switch and multiport memory-multistage and combining network

UNIT III PIPELINING AND MULTITHREADED ARCHITECTURE TECHNOLOGIES
Pipeline principle and implementation-classification of pipeline processor-introduction of arithmetic, instruction, processor pipelining-pipeline mechanisms-hazards-Introduction to multithreaded Architecture-Cluster computing

UNIT IV HARDWARE TECHNOLOGIES

UNIT V OS ISSUES FOR MULTI PROCESSOR
Introduction-Need for Preemptive OS – Synchronising and Scheduling in Multiprocessor OS-, Usual OS scheduling Techniques, threads – Classification of multi processor OS – Software requirements of multiprocessor OS; Distributed scheduler in shared memory systems

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

TOTAL: 45 PERIODS

OUTCOMES:
CO1: To understand the basics and requirement of parallelism in processor functionals.
CO2: Observe the specialty of Interconnection Networks within processor through Comparative study on parallel architectures within multicore processors.
CO3: Understand on instruction and processor pipelining mechanisms
CO4: Design aspects and Software requirements of multiprocessor OS
CO5: Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded processors.

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2. Advanced Computer architecture, By Rajiv Chopra, S Chand, 2010

ET5009 NETWORK EMBEDDED PROCESSELT P C 3 0 0 3

COURSE OBJECTIVES:
• To expose the students to the concepts of HARDWARE/SOFTWARE Modelling partitioning, co-simulation.
• To expose the students to the fundamentals of the internals of a router and hardware architecture for protocol processing,
• To study on Fundamentals on design attributes of functional units of Network processors their architecture, through the classification of commercial Network in processors
• To introduce aspects in Protocols: Design issues, goals in Network processors
• To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills.

UNIT I HARDWARE/SOFTWARE PARTITIONING IN EMBEDDED PROCESSOR 9

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 ARCHITECTURE OF NETWORK PROCESSORS
Network processors, the complexity of network processor design, network processor architectural Overview and comparison of commercial network processors- Case study on the Intel network processor, RISC processor, packet processor hardware.

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

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: To understand the basics and requirement of Hardware/Software Partitioning in processor functional.
CO2: Observe the speciality of Interconnection Networks based on packets within multicore processors.
CO3: Understand on instruction and processor pipelining for packets processing mechanisms
CO4: Study the Design configurations in commercial Network Processors
CO5: Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in parallel computation embedded processors.

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5. UYLESS black,’computer NETWORKS-Protocols,STANDARDS INTERFACES’,2nd ED,PHI,2007

ET5071 ADVANCED DIGITAL SIGNAL PROCESSING LT P C 3 0 0 3

COURSE OBJECTIVES:
- To expose 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 teach the fundamentals of audio signal processing & its application
- To discuss on Application development with commercial family of DS Processors
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

UNIT I INTRODUCTION TO DIGITAL SIGNAL PROCESSING 6

UNIT II WAVELET TRANSFORM 9
Introduction to continuous wavelet transform- discrete wavelet transform -orthogonal wavelet decomposition- Multiresolution Analysis-Wavelet function-DWT,bases,orthogonal Basis-Scaling function, Wavelet coefficients- Multirate signal processing and their relationship to filter banks- Digital filtering interpolation(i) Decomposition filters, (ii) reconstruction, the signal- Example MRA-Haar & Daubechies wavelet.

UNIT III AUDIO SIGNAL PROCESSING 12
Introduction to Speech and Audio Processing - Speech Signal Processing- Pitch-period estimation, all-pole and all-zero filters- convolution - autoregressive model, autocorrelation estimation, General structure of speech coders; Requirements of speech codecs –quality, LPC model of speech production- LPC encoders and decoders-Power spectral density, periodogram ,Spectral measures of audio signal.
UNIT IV ARCHITECTURES OF COMMERCIAL DIGITAL SIGNAL PROCESSORS 12
Introduction, catgorisation of DSP Processors-one case example Architecture Processor for Fixed Point (Blackfin),Floating Point & Speech Processor- Basics of Architecture – study of functional variations of Computational building blocks(with comparison onto their MAC, Bus Architecture, I/O interface, application).

UNIT V IMPLEMENTATION OF DSP BASED SYSTEMS 6
Introduction- Interfacing processor- Memory Interface-I/O Interface-Mapping of DSP algorithm onto hardware -Design of Filter-FFT Algorithm- Application with DSP based Interfacing- Power Meter; DSP as motor control

NOTE: Discussions/Miniproject/Practice on Workbench : Signal analysis transforms, Filter design concepts with simulation tools as Matlab /Labview/ VLSI/CCS/other suites to understand the commercial DSP processor technology and practice in programming.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: The concepts of Time and frequency analysis of Signal Transforms based on signal types.
CO2: The fundamentals of Time-Frequency Transforms are introduced
CO3: Analyze the quality and properties of speech based on DSP
CO4: Study features through comparison on commercial available DSPProcessors
CO5: Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in signal processing for embedded systems design.

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ET5010 EMBEDDED PRODUCT DEVELOPMENT LT P C 3 0 0 3

COURSE OBJECTIVES:
- Aims at providing the basic concepts of product design, product features & its architecture
- Creative thinking in developing automation into consumer products of market value
- To know the techniques & procedures that are practiced in Industry for Product manufacture
- Developing an embedded product with hardware-software components.
- Need for knowing role of IDE Tools, reverse engineering.

UNIT I CONCEPTS OF PRODUCT DEVELOPMENT

UNIT II INTERFACES FOR PRODUCT DEVELOPMENT
Product development management - establishing the architecture - clustering -geometric layout development - Fundamental and incidental interactions - architecture of the chunks - creating detailed interface specifications-Portfolio Architecture- Productivity-quality assurance-value addition- advertisement-Benchmarking - competitive benchmarking - product performance analysis

UNIT III APPROACHES FOR NEW PRODUCT DEVELOPMENT

UNIT IV INDUSTRIAL DESIGN
UNIT V DEVELOPING EMBEDDED PRODUCT

Creating Embedded System Architecture (with at least one Case study example: Mobile Phone / Adaptive Cruise Controller / Robonoid about ) - Architectural Structures - Criteria in selection of Hardware & Software Components, product design by modeling, Performance, Testing.

NOTE: Miniproject/ Discussions/ Assignment with a prototype design of a new product elucidating its design and development.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- CO1: Improved knowledge upgradation on recent trends in embedded systems design with understand the integration of customer requirements in product design
- CO2: Apply structural approach to concept generation, creativity, selection and testing so that student can have a basic knowledge in the common features a product has and how to incorporate them suitably in developing it as a commercial grade product.
- CO3: Understand various aspects of design such as industrial design, design of Consumer specific product, its Reverse Engineering manufacture, economic analysis through product architecture
- CO4: Observe the success strategies practiced by Industries in New Product Development
- CO5: To involve Miniproject/ Discussions/ Practice/ Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability & entrepreneurship skills

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ET5075 EMBEDDED NETWORKING AND AUTOMATION LT P C
OF ELECTRICAL SYSTEM 3 0 0 3

COURSE OBJECTIVES:
- To discuss the fundamentals building blocks of a digital instrument.
- Introduce wired, WSN for configuring metering network
- Discuss requirements for grid automation using meters.
- To discuss networking configuration to develop PAN.
- To discuss the functions of digital instrument Power quality monitoring.

UNIT I BUILDING SYSTEM AUTOMATION 9

UNIT II EMBEDDED NETWORKING OF INSTRUMENT CLUSTER 9

UNIT III AUTOMATION OF SUBSTATION 9

UNIT IV METERING OF SMART GRID 9
Characteristics of Smart Grid - Generation by Renewable Energy Sources based on solar grid - Challenges in Smart Grid and Microgrids- electrical measurements with AMI - Smart meters for EV plug in electric vehicles power management - Home Area Netmetering and Demand side Energy Management applications.

UNIT V SMART METERS FOR PQ MONITORING 9
Power Quality issues of Grid connected Renewable Energy Sources - Smart meters for Power Quality monitoring and Control - Power Quality issues - Surges – Flicker - Interharmonics - Transients – Power Quality Benchmarking – Power Quality Meters - Meter data management In Smart Grid-, communication enabled Power Quality metering

NOTE: Mini project/ Discussions/Exercise on Workbench / simulators: on the basics interface of sensors, actuators to microcontrollers, role of virtual Instrumentation software packages simulators/ special microcontrollers for i/o port communication etc

TOTAL: 45 PERIODS
COURSE OUTCOMES:
CO1: The criteria of choice of sensors, components to build meters.
CO2: The demand for BUS communication protocols are introduced.
CO3: Analyze the need and standards in Substation automation.
CO4: Deployment of PAN for metering networked commercial applications.
CO5: Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded networked communications.

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ET5074 DIGITAL INSTRUMENTATION LT P C 3 0 0 3

COURSE OBJECTIVES:
- To expose the students to the fundamentals of wired embedded networking techniques.
- To expose the students to the fundamentals of wireless embedded networking.
- To study on design of automation tools to model instrumentation.
- To introduce design wireless networking for monitoring grid.
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills.
UNIT I  DIGITAL METER INFRASTRUCTURE

UNIT II  DIGITAL METERING OF PROCESS
Introduction – sensors and Digital Meters for vibration, temperature, pressure measurement of system- Multichannel DSO -Data loggers -meter data analytics -PC based process measurements - Digital Signal Sources- automating meter with Data analysis & display control.

UNIT III  METERING WITH VIRTUAL INSTRUMENTATION
VI-Introduction, Block diagram and Architecture –VI for testing Real time process– Graphical programming using GUI – ADC/DAC – Digital I/O – Counter , Timer-I/O GUI-VI for Intelligent metering and control – Software and hardware of I/O communication blocks-peripheral interface

UNIT IV  METERING BASED ON WIRELESS NETWORK

UNIT V  AUTOMATED METERING OF ELECTRICAL SYSTEMS
Digital meters and Instrumentation for electrical measurements- metering to test electrical components - meters for Smart grid management-AMI needs in smart grid- Meter data management -communication enabled metering.

NOTE : Miniproject / Discussions/ Practice on Workbench : on Digital meter ,Control of Relays/ Solenoids, DC/ STEPPER motor, Battery,Display Interface; modeling process metering and control /designing of Digital meter with wired /wireless communication interface suites / Virtual Laboratory tools.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of this course, the students will demonstrate the ability in

CO1: The concepts of Time and frequency analysis of Signal Transforms based on signal types.
CO2: The fundamentals of Time-Frequency Transforms are introduced
CO3: Analyze the quality and properties of speech based on DSP
CO4: Study through comparison on commercial available DSPProcessors
CO5: Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design.

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ET5011 WEB TECHNOLOGIES AND TRENDS  LT P C  3 0 0 3

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

UNIT I WEB ESSENTIALS

UNIT II WEB DATA
UNIT III  SERVICE ORIENTED ARCHITECTURE  

UNIT IV  INTRODUCTION TO CLOUD COMPUTING  

UNIT V  USING CLOUD SERVICES  

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: Able to get a strong insight onto role of Web enabled communication systems.
CO2: Able to understand the use of networking for large scale systems
CO3: Able to use Web based technologies for product development
CO4: Able to use cloud computing for simple applications.
CO5: Able to gain improved employability and entrepreneurship capacity

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COURSE OBJECTIVES:
- To introduce and define open source software
- To identify and discuss various software licensing models
- Understand the motivation, theory, strengths and weaknesses of open source software.
- Become familiar with Linux, MySQL, PHP, Python, Apache and other Tools and technologies
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

UNIT I  INTRODUCTION

UNIT II  OPEN SOURCE DATABASE

UNIT III  OPEN SOURCE PROGRAMMING LANGUAGES

UNIT IV  SOFTWARE DEVELOPMENT USING OPEN SOURCE SYSTEMS

UNIT V  OPEN SOURCE WEB SERVER, TOOLS AND TECHNOLOGIES

COURSE OUTCOMES:
CO1: The student will have a clear understanding about the terms, tools used for Open source software
CO2: Able to use programming Languages in the open source category for application development.
CO3: Able to gain improved employability and entrepreneurship capacity
CO4: Able to develop solutions to problems using open source tools available
CO5: Able to get an insight into the recent trends in embedded system design

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REFERENCES:
8. Vivek Chopra, Sing Li, Jeff genender, “Professional Apache Tomcat 6”, Wiley India, 2007

CO5152  INTELLIGENT CONTROLLERS  LT P C
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COURSE OBJECTIVES
To educate the students on
- Design of ANN and fuzzy set theory.
- Analysis and implementation of ANN and Fuzzy logic for modeling and control of Non-linear system and to get familiarized with the Matlab toolbox.
- Impart the knowledge of various optimization techniques and hybrid schemes with the ANFIS tool box.

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

UNIT II  NEURAL NETWORKS FOR MODELLING AND CONTROL  9
Generation of training data - optimal architecture – Model validation- Control of non linear system using ANN- Direct and Indirect neuro control schemes- Adaptive neuro controller – Case study - Familiarization of Neural Network Control Tool Box.

UNIT III  FUZZY LOGIC FOR MODELLING AND CONTROL  9

Attested

Vivek Chopra, Sing Li, Jeff genender, “Professional Apache Tomcat 6”, Wiley India, 2007
UNIT IV  GENETIC ALGORITHM  9
Basic concept of Genetic algorithm and detail algorithmic steps, adjustment of free parameters. Solution of typical control problems using genetic algorithm. Concept on some other search techniques like Tabu search, Ant-colony search and Particle Swarm Optimization.

UNIT V  HYBRID CONTROL SCHEMES  9
Fuzzification and rule base using ANN–Neuro fuzzy systems–ANFIS–Optimization of membership function and rule base using Genetic Algorithm and Particle Swarm Optimization - Case study– Familiarization of ANFIS Tool Box.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Ability to
CO1: Understand the basic architectures of NN and Fuzzy sets
CO2: Design and implement ANN architectures, algorithms and know their limitations.
CO3: Identify and work with different operations on the fuzzy sets.
CO4: Develop ANN and fuzzy logic based models and control schemes for non-linear systems.
CO5: Understand and explore hybrid control schemes and PSO

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REFERENCES:
COURSE OBJECTIVES
To educate the students
• On several fundamental concepts and methods for machine learning.
• And get acquainted with basic learning algorithms and techniques and their applications.
• Acquire knowledge in processing, analyzing and handling data sets.
• Demonstrate typical applications of various clustering based learning algorithms

UNIT 1 INTRODUCTION TO MACHINE LEARNING 12

UNIT II DATA PREPROCESSING 12

UNIT III SUPERVISED LEARNING 12

UNIT IV CLUSTERING AND UNSUPERVISED LEARNING 12

UNIT V BAYESIAN LEARNING 12

TOTAL: 60 PERIODS

COURSE OUTCOMES:
At the end of this course, the students will demonstrate the ability
CO1: To understand the basic theory underlying machine learning.
CO2: A range of machine learning algorithms along with their strengths and weaknesses.
CO3: To formulate machine learning problems corresponding to different applications.
CO4: To apply machine learning algorithms to solve problems of moderate complexity.
CO5: To read current research papers and understand the issues raised by current research.
REFERENCES:
3. Jiawei Han, Micheline Kamber, Jian Pei, Data Mining: Concepts and Techniques: Concepts and Techniques, Elsevier, 2011.

HV5072 DESIGN OF SUBSTATIONS

COURSE OBJECTIVES:
- To provide in-depth knowledge on design criteria of Air Insulated Substation (AIS) and Gas Insulated Substation (GIS).
- To obtain the knowledge about layout of AIS and GIS with proper Right of Way.
- To study the substation insulation co-ordination and protection scheme.
- To study the source and effect of fast transients in AIS and GIS.

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

UNIT II MAJOR EQUIPMENT AND LAYOUT OF AIS AND GIS
Major equipment – design features – equipment specification, types of electrical stresses, mechanical aspects of substation design- substation switching schemes- single feeder circuits; single or main bus and sectionalized single bus- double main bus-main and transfer bus- main, reserve and transfer bus- breaker-and-a- half scheme-ring bus

UNIT III INSULATION COORDINATION OF AIS AND GIS

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

UNIT V FAST TRANSIENTS PHENOMENON IN AIS AND GIS

TOTAL : 45 PERIODS

COURSE OUTCOMES:
CO1 Ability to understand the fundamental components of AIS AND GIS.
CO2 Ability to understand the role of major equipment and layout of AIS AND GIS.
CO3 Ability to understand the insulation coordination of AIS and GIS.
CO4 Ability to understand the significance of grounding and shielding.
CO5 Ability to know about the effects of fast transients in Substation equipment.
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PW5078 SCADA SYSTEM AND APPLICATIONS MANAGEMENT

COURSE OBJECTIVES:
- To understand the basic concepts and components of SCADA
- To introduce the SCADA communication protocols
- To apply the SCADA technology to power systems for automation
- To provide knowledge about SCADA based energy management centre.
- To emphasise the role of SCADA monitoring and control concepts.

UNIT I INTRODUCTION TO SCADA
SCADA overview, general features, SCADA architecture, SCADA Applications, Benefits, Remote Terminal Unit (RTU), Human- Machine Interface Units (HMI), Display Monitors/Data Logger Systems, Intelligent Electronic Devices (IED), Communication Network, SCADA Server, SCADA Control systems and Control panels

UNIT II SCADA COMMUNICATION
SCADA Communication requirements, Communication protocols: Past, Present and Future, Structure of a SCADA Communications Protocol, Comparison of various communication protocols, IEC61850 based communication architecture, Communication media like Fiber optic, PLC etc. Interface provisions and communication extensions, synchronization with NCC, DCC, IOT, Cyber cell, Redundancy of Network.

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

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

**UNIT IV ENERGY MANAGEMENT CENTRE**
Functions, production control and load management, economic despatch, distributed centres and power pool management, energy management system and its role.

**UNIT V SCADA MONITORING AND CONTROL**
Online monitoring the event and alarm system, trends and reports, Blocking list, Event disturbance recording. Control function: Station control, bay control, breaker control and disconnector control.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**
- CO1: Students will learn the SCADA system components and its significance.
- CO2: Students will understand the need and advantages of communication protocols for SCADA
- CO3: Students will get implementation knowledge about the application of SCADA to Power System.
- CO4: Students will get exposure to the best operating mechanism for Energy centre based on SCADA concepts
- CO5: Students will understand the need and importance of monitoring and control logic for SCADA based power systems.

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**REFERENCES:**
COURSE OBJECTIVES:

- To provide knowledge about electric vehicle architecture and power train components.
- To know the concepts of dynamics of electrical vehicles.
- To impart knowledge on vehicle control for standard drive cycles of hybrid electrical vehicles (HEVs).
- To understand the concept of energy storage systems.
- To provide knowledge about different energy sources and energy management in HEVs.

UNIT I  HYBRID ELECTRIC VEHICLE ARCHITECTURE AND POWER TRAIN COMPONENTS


UNIT II  MECHANICS OF HYBRID ELECTRIC VEHICLES

Fundamentals of vehicle mechanics - Tractive force, power and energy requirements for standard drive cycles of HEV’s - Motor torque and power rating and battery capacity.

UNIT III  CONTROL OF DC AND AC MOTOR DRIVES

Speed control for constant torque, constant HP operation of all electric motors - DC/DC chopper based four quadrant operation of DC motor drives, inverter based V/f operation (motoring and braking) of induction motor drives, vector control operation of Induction motor and PMSM, Brushless DC motor drives, Switched reluctance motor (SRM) drives.

UNIT IV  ENERGY STORAGE SYSTEMS


UNIT V  HYBRID VEHICLE CONTROL STRATEGY AND ENERGY MANAGEMENT

HEV supervisory control - Selection of modes - power split mode - parallel mode - engine brake mode - regeneration mode - series parallel mode - energy management of HEV’s.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Learned the electric vehicle architecture and power train components.
CO2: Acquired the concepts of dynamics of electrical vehicles.
CO3: Able to understand the vehicle control for standard drive cycles of hybrid electrical vehicles (HEVs).
CO4: Ability to design and select energy storage systems.
CO5: Acquired the knowledge of different energy sources and energy management in HEVs.

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DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025
REFERENCES:

PW5251 ENERG Y MANAGEMENT AND AUDIT    LT P C 3 1 0 4

COURSE OBJECTIVES:
- To study the concepts behind economic analysis and Load management.
- To understand the basics of materials and energy balance.
- To analyze the energy efficiency in thermal utilities.
- To know the concept of compressed air system.
- To illustrate the concept of lighting systems and cogeneration.

UNIT I  GENERAL ASPECTS OF ENERGY MANAGEMENT AND ENERGY AUDIT    12

UNIT II  MATERIAL AND ENERGY BALANCE    12
Methods for preparing process flow - material and energy balance diagrams - Energy policy purpose - location of energy management - roles and responsibilities of energy manager – employees training and planning- Financial Management:financial analysis techniques, simple payback period, return on investment, net present value, internal rate of return – Case Study.

UNIT III  ENERGY EFFICIENCY IN THERMAL UTILITIES    12

UNIT IV  ENERGY EFFICIENCY IN COMPRESSED AIR SYSTEM    12

UNIT V   ENERGY EFFICIENCY IN ELECTRICAL UTILITIES
12

TOTAL: 60 PERIODS

COURSE OUTCOMES:
CO1: Students able to acquire knowledge in the field of energy management and auditing process.
CO2: Learned the about basic concepts of economic analysis and load management.
CO3: Able to design the effective thermal utility system.
CO4: Able to improve the efficiency in compressed air system.
CO5: Acquired the design concepts in the field of lighting systems, light sources and various forms of cogeneration.

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PW5072 ENERGY EFFICIENT BUILDINGS

COURSE OBJECTIVES:
- To understand the different climate zones and modelling methods
- To understand about the principle of energy conscious building design.
• To understand about the concept of passive solar heating and efficient technologies in electrical system.
• To provide knowledge about the energy conservation techniques in buildings.
• To provide knowledge about energy efficient technologies.

UNIT I  CLIMATE AND SHELTER

UNIT II  PRINCIPLES OF ENERGY CONSCIOUS BUILDING DESIGN

UNIT III  PASSIVE SOLAR HEATING

UNIT IV  ENERGY CONSERVATION IN BUILDING

UNIT V  EFFICIENT TECHNOLOGIES IN ELECTRICAL SYSTEMS
Maximum demand controllers, automatic power factor controllers, energy efficient motors, and soft starters – Energy efficient Lighting and Transformers.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: Able to understand the different climate zones and modelling methods
CO2: Able to design energy conscious building design.
CO3: Able to understand about the concept of passive solar heating and efficient technologies in electrical system.
CO4: Able to gain knowledge about the energy conservation techniques in buildings.
CO5: Know about different energy efficient technologies.

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REFERENCES

PS5076 WIND ENERGYCONVERSION SYSTEM LT P C
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COURSE OBJECTIVES

- To learn about the basic concepts of wind energy conversion system
- To learn the design and control principles of Wind turbine.
- To understand the concepts of fixed speed wind energy conversion systems.
- To understand the concepts of 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 WINDTurbINES
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 FIXEDSPEEDSYSTEMS
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 VARIABLESSPEED SYSTEMS
Need of variable speed systems-Power-wind speed characteristics-Variable speed constant frequency systems synchronous generator- DFIG- PMSG -Variable speed generators modelling - Variable speed variable frequency schemes.

UNIT V GRIDCONNECTED 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.

COURSE OUTCOMES

Students will be able to:

CO1: Attain knowledge on the basic concepts of Wind energy conversion system.
CO2: Attain the knowledge of the mathematical modelling and control of the Wind turbine
CO3: Develop more understanding on the design of Fixed speed system
CO4: Study about the need of Variable speed system and its modelling.
CO5: Learn about Grid integration issues and current practices of wind interconnections with power system.
REFERENCES


COURSE OBJECTIVES

Students will be able to:
- Understand concept of smart grid and its advantages over conventional grid
- Know smart metering techniques
- Learn wide area measurement techniques
- Understanding the problems associated with integration of distributed generation & its solution through 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, National and International Initiatives in Smart Grid.

UNIT II         SMART GRID TECHNOLOGIES (Transmission)
Technology Drivers, Smart energy resources, Smart substations, Substation Automation, Feeder Automation, Transmission systems: EMS, FACTS and HVDC, Wide area monitoring, Protection and control

UNIT III        SMART GRID TECHNOLOGIES (Distribution)
DMS, Volt/VAr control, Fault Detection, Isolation and service restoration, Outage management, High-Efficiency Distribution Transformers, Phase Shifting Transformers, and Plug in Hybrid Electric Vehicles (PHEV).

UNIT IV         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 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, Computing algorithms for Smart grid, IOT, Cyber Security for Smart Grid.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Students will be able to:

CO1: Understand on the concepts of Smart Grid and its present developments.
CO2: Analyze about different Smart Grid transmission technologies.
CO3: Analyze about different Smart Grid distribution technologies.
CO4: Acquire knowledge about different smart meters and advanced metering infrastructure.
CO5: Develop more understanding on LAN, WAN and Cloud Computing for Smart Grid applications.

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REFERENCES

4. Xi Fang, Satyajayant Misra, Guoliang Xue, and Dejun Yang “Smart Grid – The New and Improved Power Grid: A Survey”, IEEE Transaction on Smart Grid

PS5072  APPLICATION OF DSP TO POWER SYSTEM PROTECTION

COURSE OBJECTIVES:

- To expose the students to learn about DFT and Wavelet transforms.
- To provide an in-depth knowledge on the components used for the implementation of digital protection.
- To impart knowledge on different algorithms for digital protection of power system components.
- To implement digital protection for transformer.
- To understand different decision making methodologies in protective relays.
UNIT I  DIGITAL SIGNAL PROCESSING TECHNIQUES 9

UNIT II  DIGITAL PROTECTION 9

UNIT III  ALGORITHMIC TECHNIQUES 9
Finite difference techniques- Interpolation-Numerical differentiation-curve fitting and smoothing. Sinusoidal wave based algorithms -First and second derivative method -two and three sample technique .Walsh function analysis- least squares based methods-differential equation based techniques -Travelling wave protective schemes.FIR based algorithms-Least square curve fitting algorithm.

UNIT IV  DIGITAL PROTECTION TECHNIQUES 9

UNIT V  DIGITAL PROTECTIVE RELAYS 9

TOTAL: 45 PERIODS

COURSE OUTCOMES

CO1: The students will be able to apply DSP techniques for digital protection.
CO2: The students will be capable of decision making algorithm suitable for digital relaying applications.
CO3: The students will be able to employ FIR based algorithms for digital relaying.
CO4: The students will be able to do transformer protection using digital techniques.
CO5: The students will be able to perform coordinated operation of relays for specific purposes.

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OBJECTIVES:

- To develop the ability to apply the concepts of Matrix theory in Electrical Engineering problems.
- To familiarize the students in the concept of calculus of variations.
- To achieve an understanding of the basic concepts of one dimensional random variables and apply in electrical engineering problems.
- To formulate and solve linear programming problems.
- To solve engineering problems using Fourier series.

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

UNIT II  CALCULUS OF VARIATIONS
Concept of variation and its properties – Euler’s equation – Functionals dependant on first and higher order derivatives – Functionals dependant on functions of several independent variables – Variational problems with moving boundaries - Direct methods: Ritz and Kantorovich methods

UNIT III  ONE DIMENSIONAL RANDOM VARIABLES
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
Formulation – Graphical solution – Simplex method – Two phase method - Transportation and Assignment Models

UNIT V  FOURIER SERIES
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

TOTAL: 60 PERIODS

OUTCOMES:
At the end of the course, students will be able to
CO1: Apply the concepts of Matrix theory in Electrical Engineering problems.
CO2: Use calculus of variation techniques to solve various engineering problems.
CO3: Solve electrical engineering problems involving one-dimensional random variables.
CO4: Formulate and solve linear programming problems in electrical engineering.
CO5: To solve engineering problems using Fourier series techniques.
REFERENCES:

UNIT I  INTRODUCTION TO INTERNET OF THINGS
Overview, Hardware and software requirements for IOT, Sensor and actuators, Technology drivers, Business drivers, Typical IoT applications, Trends and implications.
UNIT II  IOT ARCHITECTURE  9

UNIT III  9
PROTOCOLS : NFC, SCADA and RFID, Zigbee MIPI, M-PHY, UniPro, SPMI, SPI, M-PCle GSM, CDMA, LTE, GPRS, small cell.

Wireless technologies for IoT: WiFi (IEEE 802.11), Bluetooth/Bluetooth Smart, ZigBee/ZigBee Smart, UWB (IEEE 802.15.4), 6LoWPAN, Proprietary systems-Recent trends.

UNIT IV  9
Services/Attributes: Big-Data Analytics for IOT, Dependability, Interoperability, Security, Maintainability.

Embedded processors for IOT : Introduction to Python programming -Building IOT with RASPERRY PI and Arduino.

UNIT V  CASE STUDIES  9
Industrial IoT, Home Automation, smart cities, Smart Grid, connected vehicles, electric vehicle charging, Environment, Agriculture, Productivity Applications, IOT Defense

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: Students will have a clear understanding on the concepts of IoT and its present developments.
CO2: Able to analyze different IoT technologies
CO3: Able to use different platforms and infrastructures available for IoT
CO4: Able to understand the big data analytic and its importance
CO5: Able to implement IoT solutions for smart applications

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

ET5014 UNMANNED AERIAL VEHICLE LT P C 3 0 0 3

COURSE OBJECTIVES:

- To make the students to understand the basic concepts and components of UAV systems.
- To teach the UAV design concepts
- To provide an insight about the hardware structure for UAVs
- To emphasis the communication protocol requirements and control strategy for UAVs.
- To highlight the need and the role of UAVs for real time applications and development of real time UAVs

UNIT I INTRODUCTION TO UAV
Overview and background - History of UAV –classification – societal impact and future outlook
Unmanned Aerial System (UAS) components --models and prototypes – System Composition-applications

UNIT II THE DESIGN OF UAV SYSTEMS

UNIT III HARDWAREs for UAVs
Real time Embedded processors for UAVs - sensors-servos-accelerometer –gyros-actuators-
power supply- integration, installation, configuration, and testing –MEMS/NEMS sensors and actuators for UAVs- Autopilot – AGL.
UNIT IV COMMUNICATION PAYLOADS AND CONTROLS
Payloads–Telemetry-tracking-Aerial photography-controls-PID feedback-radio control frequency range–modems-memory system-simulation-ground test-analysis-trouble shooting

UNIT V THE DEVELOPMENT OF UAV SYSTEMS

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: Ability to identify different hardware for UAV
CO2: Prepare preliminary design requirements for an unmanned aerial vehicle.
CO3: Ability to design UAV system
CO4: Integrate various systems of unmanned aerial vehicle.
CO5: Design micro aerial vehicle systems by considering practical limitations.

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REFERENCES:
OPEN ELECTIVE COURSES (OEC)

OE5091 BUSINESS DATA ANALYTICS LT P C 3 0 0 3

OBJECTIVES:
- To understand the basics of business analytics and its life cycle.
- To gain knowledge about fundamental business analytics.
- To learn modeling for uncertainty and statistical inference.
- To understand analytics using Hadoop and Map Reduce frameworks.
- To acquire insight on other analytical frameworks.

UNIT I OVERVIEW OF BUSINESS ANALYTICS

Suggested Activities:
- Case studies on applications involving business analytics.
- Converting real time decision making problems into hypothesis.
- Group discussion on entrepreneurial opportunities in Business Analytics.

Suggested Evaluation Methods:
- Assignment on business scenario and business analytical life cycle process.
- Group presentation on big data applications with societal need.
- Quiz on case studies.

UNIT II ESSENTIALS OF BUSINESS ANALYTICS

Suggested Activities:
- Solve numerical problems on basic statistics.
- Explore chart wizard in MS Excel Case using sample real time data for data visualization.
- Use R tool for data visualization.

Suggested Evaluation Methods:
- Assignment on descriptive analytics using benchmark data.
- Quiz on data visualization for univariate, bivariate data.

UNIT III MODELING UNCERTAINTY AND STATISTICAL INFERENCE

Suggested Activities:
- Solving numerical problems in sampling, probability, probability distributions and hypothesis testing.

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• Converting real time decision making problems into hypothesis.

**Suggested Evaluation Methods:**
- Assignments on hypothesis testing.
- Group presentation on real time applications involving data sampling and hypothesis testing.
- Quizzes on topics like sampling and probability.

**UNIT IV  ANALYTICS USING HADOOP AND MAPREDUCE FRAMEWORK**


**Suggested Activities:**
- Practical – Install and configure Hadoop.
- Practical – Use web based tools to monitor Hadoop setup.
- Practical – Design and develop MapReduce tasks for word count, searching involving text corpus etc.

**Suggested Evaluation Methods:**
- Evaluation of the practical implementations.
- Quizzes on topics like HDFS and extensions to MapReduce.

**UNIT V  OTHER DATA ANALYTICAL FRAMEWORKS**

Overview of Application development Languages for Hadoop – PigLatin – Hive – Hive Query Language (HQL) – Introduction to Pentaho, JAQL – Introduction to Apache: Sqoop, Drill and Spark, Cloudera Impala – Introduction to NoSQL Databases – Hbase and MongoDB.

**Suggested Activities:**
- Practical – Installation of NoSQL database like MongoDB.
- Practical – Demonstration on Sharding in MongoDB.
- Practical – Install and run Pig
- Practical – Write PigLatin scripts to sort, group, join, project, and filter data.
- Design and develop algorithms to be executed in MapReduce involving numerical methods for analytics.

**Suggested Evaluation Methods:**
- Mini Project (Group) – Real time data collection, saving in NoSQL, implement analytical techniques using Map-Reduce Tasks and Result Projection.

**OUTCOMES:**
On completion of the course, the student will be able to:
- Identify the real world business problems and model with analytical solutions.
- Solve analytical problem with relevant mathematics background knowledge.
- Convert any real world decision making problem to hypothesis and apply suitable statistical testing.
- Write and Demonstrate simple applications involving analytics using Hadoop and MapReduce
- Use open source frameworks for modeling and storing data.
- Apply suitable visualization technique using R for visualizing voluminous data.

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OE5092  INDUSTRIAL SAFETY  LT P C
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OBJECTIVES:
- Summarize basics of industrial safety
- Describe fundamentals of maintenance engineering
- Explain wear and corrosion
- Illustrate fault tracing
- Identify preventive and periodic maintenance

UNIT I  INTRODUCTION
Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT II  FUNDAMENTALS OF MAINTENANCE ENGINEERING
Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT III  WEAR AND CORROSION AND THEIR PREVENTION
UNIT IV FAULT TRACING
Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment’s like, i. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT V PERIODIC AND PREVENTIVE MAINTENANCE
Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: i. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

TOTAL: 45 PERIODS

OUTCOMES:
CO1: Ability to summarize basics of industrial safety
CO2: Ability to describe fundamentals of maintenance engineering
CO3: Ability to explain wear and corrosion
CO4: Ability to illustrate fault tracing
CO5: Ability to identify preventive and periodic maintenance

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REFERENCES:

OE5093 OPERATIONS RESEARCH

OBJECTIVES:
- Solve linear programming problem and solve using graphical method.
- Solve LPP using simplex method
- Solve transportation, assignment problems
- Solve project management problems
- Solve scheduling problems
UNIT I  LINEAR PROGRAMMING  
Introduction to Operations Research – assumptions of linear programming problems - Formulations of linear programming problem – Graphical method

UNIT II  ADVANCES IN LINEAR PROGRAMMING  
Solutions to LPP using simplex algorithm- Revised simplex method - primal dual relationships – Dual simplex algorithm - Sensitivity analysis

UNIT III  NETWORK ANALYSIS – I  
Transportation problems -Northwest corner rule, least cost method,Voges’s approximation method - Assignment problem -Hungarian algorithm

UNIT IV  NETWORK ANALYSIS – II  
Shortest path problem: Dijkstra’s algorithms, Floyds algorithm, systematic method -CPM/PERT

UNIT V  NETWORK ANALYSIS – III  
Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models

TOTAL: 45 PERIODS

OUTCOMES: 
CO1: To formulate linear programming problem and solve using graphical method. 
CO2: To solve LPP using simplex method 
CO3: To formulate and solve transportation, assignment problems 
CO4: To solve project management problems 
CO5: To solve scheduling problems

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OE5094  COST MANAGEMENTOF ENGINEERING PROJECTS  
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OBJECTIVES: 
• Summarize the costing concepts and their role in decision making 
• Infer the project management concepts and their various aspects in selection 
• Interpret costing concepts with project execution 
• Develop knowledge of costing techniques in service sector and various budgetary control techniques 
• Illustrate with quantitative techniques in cost management
UNIT I  INTRODUCTION TO COSTING CONCEPTS
Objectives of a Costing System; Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost; Creation of a Database for operational control.

UNIT II  INTRODUCTION TO PROJECT MANAGEMENT
Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities, Detailed Engineering activities, Pre project execution main clearances and documents, Project team: Role of each member, Importance Project site: Data required with significance, Project contracts.

UNIT III  PROJECT EXECUTION AND COSTING CONCEPTS
Project execution Project cost control, Bar charts and Network diagram, Project commissioning: mechanical and process, Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis, Various decision-making problems, Pricing strategies: Pareto Analysis, Target costing, Life Cycle Costing.

UNIT IV  COSTING OF SERVICE SECTOR AND BUDGETERY CONTROL
Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis, Budgetary Control: Flexible Budgets; Performance budgets; Zero-based budgets.

UNIT V  QUANTITATIVE TECHNIQUES FOR COST MANAGEMENT
Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Learning Curve Theory.

OUTCOMES
CO1 – Understand the costing concepts and their role in decision making
CO2–Understand the project management concepts and their various aspects in selection
CO3–Interpret costing concepts with project execution
CO4–Gain knowledge of costing techniques in service sector and various budgetary control techniques
CO5 - Become familiar with quantitative techniques in cost management

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2. Charles T. Horngren and George Foster, Advanced Management Accounting, 1988
OBJECTIVES:
- Summarize the characteristics of composite materials and effect of reinforcement in composite materials.
- Identify the various reinforcements used in composite materials.
- Compare the manufacturing process of metal matrix composites.
- Understand the manufacturing processes of polymer matrix composites.
- Analyze the strength of composite materials.

UNIT I INTRODUCTION
Definition – Classification and characteristics of Composite materials - Advantages and application of composites - Functional requirements of reinforcement and matrix - Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT II REINFORCEMENTS
Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers - Properties and applications of whiskers, particle reinforcements - Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures - Isostrain and Isostress conditions.

UNIT III MANUFACTURING OF METAL MATRIX COMPOSITES

UNIT IV MANUFACTURING OF POLYMER MATRIX COMPOSITES

UNIT V STRENGTH
Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TOTAL: 45 PERIODS

OUTCOMES:
- CO1 - Know the characteristics of composite materials and effect of reinforcement in composite materials.
- CO2 – Know the various reinforcements used in composite materials.
- CO3 – Understand the manufacturing processes of metal matrix composites.
- CO4 – Understand the manufacturing processes of polymer matrix composites.
- CO5 – Analyze the strength of composite materials.

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OBJECTIVES:
- Interpret the various types of wastes from which energy can be generated
- Develop knowledge on biomass pyrolysis process and its applications
- Develop knowledge on various types of biomass gasifiers and their operations
- Invent knowledge on biomass combustors and its applications on generating energy
- Summarize the principles of bio-energy systems and their features

UNIT I INTRODUCTION TO EXTRACTION OF ENERGY FROM WASTE
Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

UNIT II BIOMASS PYROLYSIS
Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT III BIOMASS GASIFICATION

UNIT IV BIOMASS COMBUSTION
Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNIT V BIO ENERGY
Properties of biogas (Calorific value and composition), Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

TOTAL: 45 PERIODS

OUTCOMES:
CO1 – Understand the various types of wastes from which energy can be generated
CO2 – Gain knowledge on biomass pyrolysis process and its applications
CO3 – Develop knowledge on various types of biomass gasifiers and their operations
CO4 – Gain knowledge on biomass combustors and its applications on generating energy
CO5 – Understand the principles of bio-energy systems and their features

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AUDIT COURSES (AC)  
AX5091  
ENGLISH FOR RESEARCH PAPER WRITING  
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OBJECTIVES
- Teach how to improve writing skills and level of readability
- Tell about what to write in each section
- Summarize the skills needed when writing a Title
- Infer the skills needed when writing the Conclusion
- Ensure the quality of paper at very first-time submission

UNIT I  INTRODUCTION TO RESEARCH PAPER WRITING  6
Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT II  PRESENTATION SKILLS  6

UNIT III  TITLE WRITING SKILLS  6
Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check

UNIT IV  RESULT WRITING SKILLS  6
Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT V  VERIFICATION SKILLS  6
Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first-time submission

TOTAL: 30 PERIODS
OUTCOMES
CO1 – Understand that how to improve your writing skills and level of readability
CO2 – Learn about what to write in each section
CO3 – Understand the skills needed when writing a Title
CO4 – Understand the skills needed when writing the Conclusion
CO5 – Ensure the good quality of paper at very first-time submission

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AX5092 DISASTER MANAGEMENT

OBJECTIVES
- Summarize basics of disaster
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Develop the strengths and weaknesses of disaster management approaches

UNIT I INTRODUCTION
Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT II REPERCUSSIONS OF DISASTERS AND HAZARDS

UNIT III DISASTER PRONE AREAS IN INDIA
Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides And Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics

UNIT IV DISASTER PREPAREDNESS AND MANAGEMENT
Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports:
UNIT V  RISK ASSESSMENT

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People’s Participation in Risk Assessment. Strategies for Survival

TOTAL : 30 PERIODS

OUTCOMES

CO1: Ability to summarize basics of disaster
CO2: Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
CO3: Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
CO4: Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
CO5: Ability to develop the strengths and weaknesses of disaster management approaches

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AX5093  SANSKRIT FOR TECNICAL KNOWLEDGE  L T P C
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OBJECTIVES

- Illustrate the basic sanskrit language.
- Recognize sanskrit, the scientific language in the world.
- Appraise learning of sanskrit to improve brain functioning.
- Relate sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power.
- Extract huge knowledge from ancient literature.

UNIT I  ALPHABETS
Alphabets in Sanskrit

UNIT II  TENSES AND SENTENCES
Past/Present/Future Tense - Simple Sentences
UNIT III  ORDER AND ROOTS  6
Order - Introduction of roots

UNIT IV  SANSKRIT LITERATURE  6
Technical information about Sanskrit Literature

UNIT V  TECHNICAL CONCEPTS OF ENGINEERING  6
Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

TOTAL: 30 PERIODS

OUTCOMES
• CO1 - Understanding basic Sanskrit language.
• CO2 - Write sentences.
• CO3 - Know the order and roots of Sanskrit.
• CO4 - Know about technical information about Sanskrit literature.
• CO5 - Understand the technical concepts of Engineering.

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REFERENCES
1. “Abhyaspustakam” – Dr. Vishwas, Samskrita-Bharti Publication, New Delhi
2. “Teach Yourself Sanskrit” Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication

AX5094  VALUE EDUCATION

OBJECTIVES
Students will be able to
• Understand value of education and self-development
• Imbibe good values in students
• Let the should know about the importance of character

UNIT I

UNIT II

UNIT III
Universal brother hood and religious tolerance. True friendship. Happiness Vs suffering, love for

UNIT IV

TOTAL: 30 PERIODS

OUTCOMES
Students will be able to
- Knowledge of self-development.
- Learn the importance of Human values.
- Developing the overall personality.

Suggested reading

AX5095 CONSTITUTION OF INDIA L T P C
2 0 0 0

OBJECTIVES
Students will be able to:
- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals’ constitutional role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

UNIT I HISTORY OF MAKING OF THE INDIAN CONSTITUTION:
History, Drafting Committee, (Composition & Working)

UNIT II PHILOSOPHY OF THE INDIAN CONSTITUTION:
Preamble, Salient Features

UNIT III CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES:

UNIT IV ORGANS OF GOVERNANCE:
Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT V LOCAL ADMINISTRATION:
UNIT VI  ELECTION COMMISSION:
Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.

TOTAL: 30 PERIODS

OUTCOMES
Students will be able to:
- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization 
of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party[CSP] 
under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct 
elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

Suggested reading
1. The Constitution of India, 1950(Bare Act), Government Publication.

AX5096   PEDAGOGY STUDIES   L T P C
2 0 0 0

OBJECTIVES
Students will be able to:
- Review existing evidence on there view topic to inform programme design and policy
- Making under taken by the DFID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

UNIT I   INTRODUCTION AND METHODOLOGY:
Aims and rationale, Policy background, Conceptual framework and terminology - Theories of 
learning, Curriculum, Teacher education - Conceptual framework, Research questions - Overview 
of methodology and Searching.

UNIT II   THEMATIC OVERVIEW
Pedagogical practices are being used by teachers in formal and informal classrooms in developing 
countries - Curriculum, Teacher education.

UNIT III   EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES
Methodology for the in depth stage: quality assessment of included studies - How can teacher 
education (curriculum and practicum) and the school curriculum and guidance materials best 
support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for 
effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers’ 
attitudes and beliefs and Pedagogic strategies.
UNIT IV  PROFESSIONAL DEVELOPMENT
Professional development: alignment with classroom practices and follow up support - Peer support - Support from the head teacher and the community - Curriculum and assessment - Barriers to learning: limited resources and large class sizes

UNIT V  RESEARCH GAPS AND FUTURE DIRECTIONS
Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.

OUTCOMES
Students will be able to understand:
- What pedagogical practices are being used by teachers informal and informal classrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

Suggested reading

AX5097  STRESS MANAGEMENT BY YOGA

OBJECTIVES
- To achieve overall health of body and mind
- To overcome stress

UNIT I
Definitions of Eight parts of yoga.(Ashtanga)

UNIT II
Yam and Niyam - Do’s and Don’t’s in life - i) Ahinsa, satya, astheya, bramhacharya and aparigraha, ii) Ahinsa, satya, astheya, bramhacharya and aparigraha.

UNIT III
Asan and Pranayam - Various yog poses and their benefits for mind & body - Regularization of breathing techniques and its effects-Types of pranayam

TOTAL: 30 PERIODS
OUTCOMES
Students will be able to:
- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

SUGGESTED READING
1. ‘Yogic Asanas for Group Tarining-Part-I”:Janardan Swami Yoga bhyasi Mandal, Nagpur
2. “Rajayoga or conquering the Internal Nature” by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

AX5098 PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

OBJECTIVES
- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

UNIT I
Neetisatakam-holistic development of personality - Verses- 19,20,21,22 (wisdom) - Verses- 29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue) - Verses- 52,53,59 (don’ts) - Verses- 71,73,75,78 (do’s)

UNIT II
Approach to day to day work and duties - Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter 6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48.

UNIT III
Statements of basic knowledge - Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter 12 -Verses 13, 14, 15, 16,17, 18 - Personality of role model - shrimad bhagwad geeta - Chapter2-Verses 17, Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63

TOTAL: 30 PERIODS

OUTCOMES
Students will be able to
- Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
- The person who has studied Geeta will lead the nation and man kind to peace and prosperity
- Study of Neet is hatakam will help in developing versatile personality of students.

Suggested reading
1. Gopinath, Rashtriya Sanskrit Sansthanam P, Bhartrihari’s Three Satakam, Niti-sringar-vairagya, New Delhi,2010