Prerequisite for the programme: Offered if commitment for summer internship followed by projects is available for all students from industry and for collaboration with industry in delivering lectures for the subjects in curriculum

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

- To enable graduates to possess skills to develop new innovation in the field of Electronics and Communication Engineering (Industry Integrated) using analytical reasoning and state-of-the-art approaches derived from the Engineering Sciences and Engineering practice.
- To enable graduates to create useful systems, components, or processes through agile, skillful, and innovative analysis and design, while respecting economic, environmental, cultural, and ethical standards or constraints and acquire technical and managerial leadership positions in their chosen fields.
- To enable graduates to engage in lifelong learning, adapt to evolving Technology, work in multidisciplinary research for designing innovative products & solutions and become Entrepreneurs, understand current professional issues and apply latest technologies for the betterment of the nation and society.

PROGRAMME OUTCOMES (POs)

Engineering Graduates will be able to:

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

13. The program will have Core courses, Elective courses and Project works. The project may also have seminar practical/Industrial training summer project.

Contribution 1: Reasonable 2: Significant 3: Strong
MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVES WITH PROGRAMME OUTCOMES

A broad relation between the Programme Objectives and the outcomes is given in the following table.

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MAPPING OF PROGRAMME SPECIFIC OUTCOMES WITH PROGRAMME OUTCOMES

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Tentative
## M.E. ELECTRONICS AND COMMUNICATION ENGINEERING (INDUSTRY INTEGRATED)
### SEMESTER COURSE WISE PO MAPPING

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<th>Year/ Semester</th>
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### SEMESTER I

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The above table represents the course structure for Semester I and Semester II of the M.E. Electronics and Communication Engineering program at Anna University, Chennai. It includes course codes, titles, categories, and contact periods for both theoretical and practical courses.
### SEMESTER III

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### PROFESSIONAL ELECTIVES (PE)

### SEMESTER II

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### SEMESTER III

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### FOUNDATION COURSES (FC)

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EMPLOYABILITY ENHANCEMENT COURSE (EEC)

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MA5152  APPLIED MATHEMATICS FOR ELECTRONICS ENGINEERS  L  T  P  C
4  0  0  4

OBJECTIVES:
The main objective of this course is to demonstrate various analytical skills in applied mathematics
and extensive experience with the tactics of problem solving and logical thinking applicable in
electronics engineering. This course also will help the students to identify, formulate, abstract, and
solve problems in electrical engineering using mathematical tools from a variety of mathematical
areas, including fuzzy logic, matrix theory, probability, dynamic programming and queuing theory.

UNIT I  FUZZY LOGIC  12
Classical logic – Multivalued logics – Fuzzy propositions – Fuzzy quantifiers.

UNIT II  MATRIX THEORY  12
Cholesky decomposition - Generalized Eigenvectors - Canonical basis - QR factorization - Least
squares method - Singular value decomposition.

UNIT III  PROBABILITY AND RANDOM VARIABLES  12
Probability – Axioms of probability – Conditional probability – Baye’s theorem - 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  DYNAMIC PROGRAMMING  12
Dynamic programming – Principle of optimality – Forward and backward recursion – Applications of
dynamic programming – Problem of dimensionality.

UNIT V  QUEUEING MODELS  12
Poisson Process – Markovian queues – Single and multi server models – Little’s formula - Machine
interference model – Steady state analysis – Self service queue.

TOTAL: 60 PERIODS

OUTCOMES:
After completing this course, students should demonstrate competency in the following
skills:
- Concepts of fuzzy sets, knowledge representation using fuzzy rules, fuzzy logic, fuzzy
prepositions and fuzzy quantifiers and applications of fuzzy logic.
- Apply various methods in matrix theory to solve system of linear equations.
- Computation of probability and moments, standard distributions of discrete and continuous
random variables and functions of a random variable.
- Conceptualize the principle of optimality and sub-optimization, formulation and
computational procedure of dynamic programming
- Exposing the basic characteristic features of a queuing system and acquire skills in analyzing
queuing models.
- Using discrete time Markov chains to model computer systems.
REFERENCES:

AP5152 ADVANCED DIGITAL SIGNAL PROCESSING L T P C
3 2 0 4

OBJECTIVES:
- The student comprehends mathematical description and modelling of discrete time random signals.
- The student is conversant with important theorems and random signal processing algorithms.
- The student learns relevant figures of merit such as power, energy, bias and consistency.
- The student is familiar with estimation, prediction, filtering, multi rate concepts and techniques.

UNIT I DISCRETE RANDOM SIGNAL PROCESSING 9+6

UNIT II SPECTRUM ESTIMATION 9+6

UNIT III SIGNAL MODELING AND OPTIMUM FILTERS 9+6

UNIT IV ADAPTIVE FILTERS 9+6
UNIT V MULTIRATE SIGNAL PROCESSING 9+6
Decimation - Interpolation – Sampling Rate conversion by a rational factor I/D – Multistage implementation of sampling rate conversion – Polyphase filter structures – Applications of multirate signal processing.

TOTAL: 45+30: 75 PERIODS

OUTCOMES:

- Formulate time domain and frequency domain description of Wide Sense Stationary process in terms of matrix algebra and relate to linear algebra concepts.
- State W-K theorem, spectral factorization theorem, spectrum estimation, bias and consistency of estimators.
- Wiener filtering, LMS algorithms, Levinson recursion algorithm, applications of adaptive filters
- Decimation, interpolation, Sampling rate conversion, Applications of multirate signal processing

REFERENCES:

II5101 EMBEDDED CONTROLLERS L T P C 3 0 0 3

OBJECTIVES:

- Understand the features of 8,16, 32 bit microcontrollers
- Use microcontroller for interfacing real time applications
- Develop assembly and embedded programs for various real time applications
- Understand RTOS

UNIT I 8051 MICROCONTROLLER AND INTERFACING APPLICATIONS 9
UNIT II  PIC MICROCONTROLLER AND INTERFACING APPLICATIONS  9

UNIT III  MSP430 MICROCONTROLLER AND INTERFACING APPLICATIONS  8

UNIT IV  ARM CONTROLLERS AND INTERFACING APPLICATIONS  9

UNIT V  REAL-TIME OPERATING SYSTEMS  10
Basic concepts of RTOS and its types – Concurrency- Reentrancy –Inter task communication - scheduling, IPC, RPC, CPU Scheduling, scheduling criteria, scheduling algorithms Threads: Multi-threading models, threading issues, thread libraries, synchronization Mutex: creating, deleting, prioritizing mutex, mutex internals Messages, Buffers, mailboxes, queues, semaphores, deadlock, priority in version Process stack management - run-time buffer size - swapping, overlays, block/page management, replacement algorithms - real-time garbage collection- Implementation of RTOS with some case studies

TOTAL: 45 PERIODS

OUTCOMES:
The students will be able to
- Use the features of 8,16, 32 bit microcontrollers for various Industrial Applications
- Develop Industry Application Programs using Embedded Programming
- Apply RTOS principles for real time applications
- Interface microcontrollers with real time applications

REFERENCES:
1. User Manuals of 8051, Arduino, AVR, PIC 16F877A, MSP 430, ARM LPC 2148, and Cortex M4 controllers
5. MSP 430 controller manual
II5102 INDUSTRIAL AUTOMATION AND CONTROL

OBJECTIVES:
The students will be able to
- Understand PLC Instructions
- Develop Ladder Logic for working models
- Use SCADA programming
- Interface various sensors with Arduino for industrial Automation

UNIT I PROGRAMMABLE LOGIC CONTROLLERS
Programmable Logic Controllers (PLCs) – architecture-Types- features -Programming a PLC using ladder/connected Component workbench-Input & Output Modules- Bit Instructions- Timer & Counter Instructions- Comparison & Data Handling Instructions- Program Control Instructions- Sequencing Instructions- PLC Programming- Exercises for Industrial Applications- DOL starter- Star Delta starter- Automatic water level controller- Conveyor-Lift-Bottle filling and process control applications- Analog I/Os -High speed counter-PTO-PWM and RTC

UNIT II SCADA SYSTEM
Evolution of SCADA, Various SCADA architectures, advantages and disadvantages of each system, SCADA System Components: Schemes- Remote Terminal Unit (RTU), Intelligent Electronic Devices (IED), Communication Network, SCADA Server Data acquisition systems, SCADA applications in Automation, SCADA –Memory tag, Device tag, Alarm logging, Data logging, OPC server- HMI Systems –DCS- DCS integration with PLC and Computers - Features of DCS

UNIT III ARDUINO AND SENSORS FOR INDUSTRIAL AUTOMATION AND CONTROL

UNIT IV DATA ACQUISITION SYSTEM
Data acquisition of digital and analog signals (input and output) – Stand alone, LabVIEW compatible, Mat lab compatible, Real time data acquisition and storing using different data acquisition cards. Retrieving the stored data for analysis – High level language programming for using data acquisition system

UNIT V PROCESS CONTROL AND PNEUMATICS
Process control- P, PI, PD,PID–Tuning methods- Statistical Process Control, Model Predictive Control, Fuzzy Logic Based Control, Neural-Network Based Control
Actuators in motor vehicles, power switches, electrical rotary and linear actuators - pneumatic system - Properties of air – Perfect Gas Laws –Components of pneumatic system- ISO symbols for their elements -Control and regulation Elements—Direction, flow and pressure control valves-- Methods of actuation, types, Design of Pneumatic and Electro pneumatic circuit—Simulation of
Pneumatic and Electro pneumatic circuits - Applications using Robotics

TOTAL: 45 PERIODS

OUTCOMES:
The students will be able to
● Program PLC for Industrial Applications
● Interface PLC with working models
● Control Applications using SCADA programming
● Develop industrial Automation using Arduino with various sensors

REFERENCES:

II5103 NETWORK SECURITY TECHNOLOGIES L T P C 3 0 0 3

OBJECTIVES:
● Understand concepts and importance of Network Security
● Comprehend application and network layer security
● Analyze about wireless and mobile security

UNIT I INTRODUCTION 9
Introduction to Security in Networks – Characteristics of Networks – Intrusion Kinds of security breaches – Plan of attack - Points of vulnerability – Methods of defense – Control measures – Effectiveness of controls

UNIT II APPLICATION LAYER SECURITY 9
Layer Security

UNIT III NETWORK LAYER SECURITY 9

UNIT IV WIRELESS NETWORK SECURITY 9

UNIT V SECURITY IN MOBILE AND IoT 9

TOTAL: 45 PERIODS

OUTCOMES:
The students will be able to
● Develop attack detection model
● Apply basic security features in wire and wireless applications
● Incorporate security aspects in IoT

REFERENCES:

II5104 VIRTUAL INSTRUMENTATION L T P C
3 0 0 3

OBJECTIVES:
The students will be able to
● understand the basics of Virtual Instrumentation
- differentiate analog and digital I/Os
- use LabVIEW for experiments
- analyze tools and applications in VI

UNIT I  REVIEW OF DIGITAL INSTRUMENTATION  8
Representation of Analog signals in the Digital domain – Review of quantization in amplitude and time axis, sample and hold, sampling theorem, ADC and DAC types.

UNIT II  FUNDAMENTALS OF VIRTUAL INSTRUMENTATION  10
Concept of virtual instrumentation – PC based data acquisition – Typical on board DAQ card, Resolution and sampling frequency - Multiplexing of analog inputs – Single-ended and differential inputs – Different strategies for sampling of multi-channel analog inputs. Concept of universal DAQ card - Use of timer-counter and analog outputs on the universal DAQ card.

UNIT III  CLUSTER OF INSTRUMENTS IN VI SYSTEM  10

UNIT IV  GRAPHICAL PROGRAMMING ENVIRONMENT IN VI  10
Concepts of graphical programming language LabVIEW – Concept of VIs and sub VI – Graphs & charts – Dataflow programming - Loops – Case and sequence structures - Types of data – Arrays & clusters – Formula nodes –math script integration - Local and global variables – String and file I/O – Building executables and installers – Web publishing tools

UNIT V  ANALYSIS TOOLS AND SIMPLE APPLICATIONS IN VI  7
Build virtual instruments like oscilloscope, FFT analyzer – Windowing and filtering tools – Introduction of Electrical power measurement suite - Simple temperature ON/OFF controller – P-I-D controller design - Simulation of a simple second order system - Building autonomous embedded system using FPGA target

TOTAL: 45 PERIODS

OUTCOMES:
The students will be able to
- use VI basics for Industrial Applications
- develop Virtual Instrumentation using LabVIEW
- use DAQ for Real Time Applications

REFERENCES:
1. Jovitha Jerome, Virtual Instrumentation using LabVIEW, PHI publications, 2010
OBJECTIVES:
The students will be able to
● Understand concepts of Embedded Systems Programming

LIST OF EXPERIMENTS:

Programs using 8051 microcontroller (To list specific experiments)
Programs using PIC microcontroller
Programs using MSP430 microcontroller
Programs using LPC 2148 microcontroller
List of experiments to be carried out using above four controllers are:
1. Write a program to ON and OFF a LED
2. Interface switches with LEDs
3. Use timers to introduce delays
4. Use counters to count switching events
5. Increment bar graph using switches
6. Use external and internal interrupts
7. Apply Serial Communication peripherals to transmit and receive the data
8. Interface Seven Segment Display
9. Interface LCD
10. Interface Key pad
11. Interface Stepper and DC motors

Programs using Arduino/AVR microcontrollers
12. Interface various Analog and Digital Sensors using Arduino micro controller

Programs using RTOS
13. Write a program to ON and OFF a LED
14. Interface switches with LEDs
15. Use timers to introduce delays

TOTAL: 60 PERIODS

OUTCOMES:
The students will be able to
● Develop Embedded Systems Programming for Real Time Applications

OBJECTIVES:
The students will be able to
● study the design flow of different types of ASIC.
● familiarize the different types of programming technologies and logic devices.
● learn the architecture of different types of FPGA.
- gain knowledge about partitioning, floor planning, placement and routing including circuit extraction of ASIC

UNIT I OVERVIEW OF ASIC AND PLD
9
Types of ASICs - Design flow – CAD tools used in ASIC Design – Programming Technologies: Antifuse – static RAM – EPROM and EEPROM technology, Programmable Logic Devices: ROMs and EPROMs – PLA – PAL. Gate Arrays – CPLDs and FPGAs

UNIT II ASIC PHYSICAL DESIGN
9
System partition - partitioning - partitioning methods – interconnect delay models and measurement of delay - floor planning - placement – Routing: global routing - detailed routing - special routing - circuit extraction - DRC

UNIT III LOGIC SYNTHESIS, SIMULATION AND TESTING
9

UNIT IV FIELD PROGRAMMABLE GATE ARRAYS
9

UNIT V SOC DESIGN
9

OUTCOMES:
The students will be able to
- analyze the synthesis, Simulation and testing of systems.
- apply different high performance algorithms in ASICs.
- discuss the design issues of SOC.

REFERENCES:

TOTAL: 45 PERIODS
OBJECTIVES:

- To understand the characteristics of wireless channels and the fundamental limits on the capacity of wireless channels
- Understand various types of local area networks, WiMax and wide area networks.
- Understand various wireless networking standards such as 3G and 4G.
- To interwork between WLAN and WWAN.
- To have a good understanding of emerging wireless networks such as Adhoc, Sensor networks and cooperative wireless networks.

UNIT I  THE WIRELESS CHANNEL

Overview of wireless systems – Physical modeling for wireless channels – Time and Frequency coherence – Statistical channel models – Capacity of wireless Channel- Capacity of Flat Fading Channel – Channel Distribution Information known – Channel Side Information at Receiver – Channel Side Information at Transmitter and Receiver – Capacity with Receiver diversity – Capacity comparisons – Capacity of Frequency Selective Fading channels.

UNIT II  3G EVOLUTIONS


UNIT III  4G AND BEYOND

Introduction to LTE-A – Requirements and Challenges, network architectures – EPC, E-UTRAN architecture - mobility management, resource management, services, channel - logical and transport channel mapping, downlink/uplink data transfer, MAC control element, PDU packet formats, scheduling services, random access procedure.

UNIT IV  ADHOC & SENSOR NETWORKS

Introduction to WLAN – IEEE 802.11 and HIPERLAN, Bluetooth, WiMAX. Characteristics of MANETs, Table-driven and Source-initiated On Demand routing protocols, Hybrid protocols, Wireless Sensor networks- Classification, MAC and Routing protocols.

UNIT V  INTERWORKING CONCEPTS AND COOPERATIVE WIRELESS NETWORKS

Interworking objectives and requirements, Schemes to connect WLANs and 3GNetworks, Session Mobility, Interworking Architectures for WLAN and GPRS. Introduction to User cooperation and cognitive systems- Relay channels- A general three node relay channel- Wireless relay channel- User cooperation in wireless networks- Two user cooperative network
TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, student will be able to

- Understand the concepts of wireless LAN, WAN and various wireless standards.
- Work with different wireless networks.
- Familiarize with advanced wireless networks such as Adhoc, Sensor networks and cooperative wireless networks.

REFERENCES:

II5201 CYBERPHYSICAL SYSTEMS  LT P C

OBJECTIVES:
The students will be able to

- Understand Cyber Physical System
- Analyse Intelligent CPS
- Apply modern tools to develop CPS applications

UNIT I CYBER PHYSICAL SYSTEMS
Cyber-Physical Systems (CPS) in the real world - Basic principles of design and validation of CPS - models of physical process, finite state machines, computation, converters between physical and cyber variables, and digital networks - Industry 4.0 – Auto SAR - IIOT implications - Building Automation - Medical CPS

UNIT II CPS - PLATFORM COMPONENTS
CPS HW platforms - Processors, Sensors, Actuators - mCPS Network – Wireless Hart, CAN, Automotive Ethernet - CPS Sw stack - RTOS - Scheduling Real Time control tasks

UNIT III PRINCIPLES OF AUTOMATED CONTROL DESIGN
Dynamical Systems and Stability - Controller Design Techniques - Stability Analysis: CLFs, MLFs, stability under slow switching - Performance under Packet drop and Noise - Tutorial: Matlab
Features to software components - Mapping software components to ECUs - CPS Performance Analysis - effect of scheduling, bus latency, sense and actuation faults on control performance, network congestion

UNIT IV INTELLIGENT CPS
Safe Reinforcement Learning - Robot motion control - Autonomous Vehicle control - Gaussian Process Learning - Smart Grid Demand Response - Building Automation

UNIT V SECURE DEPLOYMENT OF CPS& APPLICATIONS OF CPS Secure Task mapping and Partitioning - State estimation for attack detection - Automotive Case study: Vehicle ABS hacking - Power Distribution Case study: Attacks on Smart Grids – Virtual Instrumentation – Applications of CPS. TOTAL: 45 PERIODS

OUTCOMES:
The students will be able to
• Develop CPS real time Applications
• Use Modern tools for CPS applications
• Solve Security issues in CPS

REFERENCES:

II5211 IoT and CYBER PHYSICAL SYSTEMS LABORATORY LT P C 0 0 4 2

OBJECTIVES:
The students will be able to
• Understand concepts of IoT and Cyber Physical Systems

LIST OF EXPERIMENTS:
• Programming using LabVIEW – Virtual Instrumentation
• Programming using MATLAB for Industrial Applications
• Raspberry Pi – GPIO and Cloud
• Arduino – I/O and Sensor Interfacing
• Applications using FPGA
• Electromechanical modelling of QUBE Servo Inertia Disk system
● Analysis of Physical system with RIO hardware integration (Step response, time domain, stability)
● Mathematical modelling of Second-order system with PID Controller design
● Mathematical modelling of Pendulum system and design a balance control and swing-up control
● Design and Develop Cloud based master and slave systems using Internet
● Development of Machine Learning algorithms in the physical system and validate

OUTCOMES:
The students will be able to
● Develop IoT and Cyber Physical S based Real Time Applications

TOTAL: 60 PERIODS

II5212 RESEARCH METHODOLOGY AND SEMINAR LT P C
0 0 2 1

OBJECTIVES:
The students will be able to
● Understand foundations of research
● Design Research models
● Develop statistical model

UNIT I FOUNDATIONS OF RESEARCH


UNIT II RESEARCH DESIGN
Concept and Importance in Research – Features of a good research design – Exploratory Research Design – concept, types and uses, Descriptive Research Designs – concept, types and uses. Experimental Design: Concept of Independent & Dependent variables.

UNIT III QUALITATIVE AND QUANTITATIVE RESEARCH
Qualitative research – Quantitative research – Concept of measurement, causality, generalization, replication. Merging the two approaches.

UNIT IV MEASUREMENT
Concept of measurement – what is measured? Problems in measurement in research – Validity and Reliability. Levels of measurement – Nominal, Ordinal, Interval, Ratio.

Sampling
Systematic Sample, Stratified Random Sample & Multi-stage sampling. Determining size of the sample – Practical considerations in sampling and sample size.

UNIT V DATA ANALYSIS
Data Preparation – Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis – Cross tabulations and Chi-square test including testing hypothesis of association.


Use of Encyclopedias, Research Guides, Handbook etc., Academic Databases for Computer Science Discipline.

Use of tools / techniques for Research: methods to search required information effectively, Reference Management Software like Zotero/Mendeley, Software for paper formatting like LaTeX/MS Office, Software for detection of Plagiarism

OUTCOMES:
The students will be able to
- Do Literature survey
- Analyse the Research gaps
- Formulate research problem
- Do Qualitative and Quantitative Analysis
- Write research articles

TOTAL: 30 PERIODS

REFERENCES:
2. Business Research Methods – Alan Bryman & Emma Bell, Oxford University Press.
3. Research Methodology – C.R.Kothari
4. Select references from the Internet

CU5097 WIRELESS ADHOC AND SENSOR NETWORKS L T P C
3 0 0 3

OBJECTIVES:
- To understand the basics of Ad-hoc & Sensor Networks.
- To learn various fundamental and emerging protocols of all layers.
- To study about the issues pertaining to major obstacles in establishment and efficient management of Ad-hoc and sensor networks.
- To understand the nature and applications of Ad-hoc and sensor networks.
- To understand various security practices and protocols of Ad-hoc and Sensor Networks.
UNIT I  MAC & TCP IN AD HOC NETWORKS  9
Fundamentals of WLANs – IEEE 802.11 Architecture - Self configuration and Auto configuration-
Based Protocols - TCP over Ad-Hoc networks-TCP protocol overview - TCP and MANETs –
Solutions for TCP over Ad-Hoc Networks.

UNIT II  ROUTING IN AD HOC NETWORKS  9
Routing in Ad-Hoc Networks- Introduction-Topology based versus Position based Approaches-
Proactive, Reactive, Hybrid Routing Approach-Principles and issues – Location services - DREAM
– Quorums based location service – Grid – Forwarding strategies – Greedy packet forwarding –
Restricted directional flooding- Hierarchical Routing- Issues and Challenges in providing QoS.

UNIT III  MAC, ROUTING & QOS IN WIRELESS SENSOR NETWORKS  9
Introduction – Architecture - Single node architecture – Sensor network design considerations –
Energy Efficient Design principles for WSNs – Protocols for WSN – Physical Layer : Transceiver
Design considerations – MAC Layer Protocols – IEEE 802.15.4 Zigbee – Link Layer and Error
Control issues - Routing Protocols – Mobile Nodes and Mobile Robots - Data Centric & Contention
Based Networking – Transport Protocols & QOS – Congestion Control issues – Application Layer
support.

UNIT IV  SENSOR MANAGEMENT  9
Sensor Management - Topology Control Protocols and Sensing Mode Selection Protocols - Time
synchronization - Localization and positioning – Operating systems and Sensor Network
programming – Sensor Network Simulators.

UNIT V  SECURITY IN AD HOC AND SENSOR NETWORKS  9
Anti-tamper techniques – water marking techniques – Defense against routing attacks - Secure
Adhoc routing protocols – Broadcast authentication WSN protocols – TESLA – Biba – Sensor
Network Security Protocols – SPINS.

TOTAL : 45 PERIODS

OUTCOMES:
Upon Completion of the course, the students should be able to:

- Identify different issues in wireless ad hoc and sensor networks.
- To analyze protocols developed for ad hoc and sensor networks.
- To identify and address the security threats in ad hoc and sensor networks.
- Establish a Sensor network environment for different type of applications.

REFERENCES:

CP5292 INTERNET OF THINGS L T P C 3 0 0 3

OBJECTIVES:
- To understand the fundamentals of Internet of Things
- To learn about the basics of IOT protocols
- To build a small low cost embedded system using Raspberry Pi.
- To apply the concept of Internet of Things in the real world scenario.

UNIT I INTRODUCTION TO IoT
Internet of Things - Physical Design- Logical Design- IoT Enabling Technologies - IoT Levels & Deployment Templates - Domain Specific IoTs - IoT and M2M - IoT System Management with NETCONF-YANG- IoT Platforms Design Methodology

UNIT II IoT ARCHITECTURE
M2M high-level ETSI architecture - IETF architecture for IoT - OGC architecture - IoT reference model - Domain model - information model - functional model - communication model - IoT reference architecture

UNIT III IoT PROTOCOLS

UNIT IV BUILDING IoT WITH RASPBERRY PI & ARDUINO

UNIT V CASE STUDIES AND REAL-WORLD APPLICATIONS
Outcomes: Upon completion of this course, the students should be able to:

- Analyze various protocols for IoT
- Develop web services to access/control IoT devices.
- Design a portable IoT using Raspberry Pi
- Deploy an IoT application and connect to the cloud.
- Analyze applications of IoT in real time scenario

References:


Objectives:

- To know the basics of artificial neural networks
- To provide adequate knowledge about feed forward /feedback neural networks
- To apply the concept of fuzzy logic in various systems.
- To have the idea about genetic algorithm
- To provide adequate knowledge about the applications of Soft Computing.

Unit I: Artificial Neural Network

UNIT II  
FUZZY LOGIC  
9


UNIT III  
NEURO-FUZZY MODELLING  
9

ANFIS Architecture-Classification and Regression Trees-Data Clustering algorithms-Rulebase Structure Identification.

UNIT IV  
GENETIC ALGORITHMS  
9


UNIT V  
APPLICATIONS OF SOFTCOMPUTING  
9


TOTAL : 45 PERIODS

OUTCOMES:

- Knowledge on concepts of soft computational techniques.
- Able to apply soft computational techniques to solve various problems.
- Motivate to solve research oriented problems.

REFERENCES:

   Pearson Education India, 2006.
   Pearson Education India, 2006.
OBJECTIVES:
The students should be made to understand:
- Optical system components like optical amplifiers, wavelength converters.
- Up-to-date survey of development in Optical Network Architectures.
- Packet switching.
- Network design perspectives.
- Different Optical Network management techniques and functions.

UNIT I

UNIT II

UNIT III

UNIT IV

UNITY
Network topologies and protection schemes: Robust networks, Line and path protection switching, Types of topology, Point to point topology, bi-directional line-switched ring (BLSR), meshed topology, Passive optical networks, Metro optical networks 28 MPLS and Optical Networks: IS label switching, Forwarding equivalence class (FEC), Types of MPLS nodes, Label distribution and binding, label swapping and traffic forwarding, MPLS support of Virtual Private Networks (VPN), MPLS traffic engineering, Multi protocol Lambda switching (MPLS).
OUTCOMES:
At the end of the course, the student should be able to:
● Design and Analyze Network Components
● Assess and Evaluate optical networks

REFERENCES:
2. Optical Networks, Third Generation Transport Systems, Uyless Black, Pearson

CP5095 COMPUTER VISION L T P C
3 0 0 3

OBJECTIVES:
The students should be made to:
• To review image processing techniques for computer vision.
• To understand shape and region analysis.
• To understand Hough Transform and its applications to detect lines, circles, ellipses.
• To understand three-dimensional image analysis techniques.
• To understand motion analysis.
• To study some applications of computer vision algorithms

UNIT I IMAGE PROCESSING FOUNDATIONS

UNIT II SHAPES AND REGIONS

UNIT III HOUGH TRANSFORM

UNIT IV 3D VISION AND MOTION

UNIT V APPLICATIONS


TOTAL : 45 PERIODS

OUTCOMES:
Upon completion of this course, the students should be able to

• Implement fundamental image processing techniques required for computer vision.
• Perform shape analysis.
• Implement boundary tracking techniques.
• Apply chain codes and other region descriptors.
• Apply Hough Transform for line, circle, and ellipse detections.
• Apply 3D vision techniques.
• Implement motion related techniques.
• Develop applications using computer vision techniques.

REFERENCES:


II5001 INDUSTRY 4.0

OBJECTIVES:
The students will be able to

• understand Industry 4.0
- apply IoT and IIoT for Industry 4.0
- understand CPS for Industry 4.0

UNIT I  
9
Introduction to Industry 4.0 - The Various Industrial Revolutions - Digitalisation and the Networked Economy - Drivers, Enablers, Compelling Forces and Challenges for Industry 4.0 - Comparison of Industry 4.0 Factory and Today's Factory - Trends of Industrial Big Data and Predictive Analytics for Smart Business Transformation

UNIT II  
9
Road to Industry 4.0 - Internet of Things (IoT) & Industrial Internet of Things (IIoT) & Internet of Services - Smart Manufacturing - Smart Devices and Products - Smart Logistics - Smart Cities - Predictive Analytics

UNIT III  
9

UNIT IV  
9
Role of data, information, knowledge and collaboration in future organizations - Resource-based view of a firm - Data as a new resource for organizations - Harnessing and sharing knowledge in organizations - Cloud Computing Basics - Cloud Computing and Industry 4.0

UNIT V  
9
Industry 4.0 IIoT case studies - Opportunities and Challenges - Future of Works and Skills for Workers in the Industry 4.0 Era - Strategies for competing in an Industry 4.0 world - Society 5.0

OUTCOMES:
The students will be able to
- use Industry 4.0 for Industrial Applications
- use IoT and IIoT for Industry 4.0
- apply smart devices Industrial Applications

REFERENCES:
1. Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things

EL5071  
BROADBAND ACCESS TECHNOLOGIES  
3 0 0 3

OBJECTIVES:
- To give fundamental concepts related to broadband access technologies.
- To understand the current and emerging wired and wireless access technologies.
- To acquire knowledge about cable modems and fiber access technologies.
To have an exposure to different systems standards for next generation broadband access networks.

UNIT I REVIEW OF ACCESS TECHNOLOGIES

Phone-Line modem, cable-access, ISDN, Emerging Broad band Technologies, Cable DSL, Fiber and Wireless, Standards for access network.

UNIT II DIGITAL SUBSCRIBER LINES

Asymmetric Digital subscriber lines (ADSL) – Rate Adaptive subscriber line (RADSL)-ISDN Digital subscriber line (IDSL) - High bit rate DSL (HDSL)-Single line DSL (SDSL) - very high bit rate DSL (VDSL) - Standards for XDSL & Comparison.

UNIT III CABLE MODEM


UNIT IV FIBER ACCESS TECHNOLOGIES

Optical Fiber in access networks, Architecture and Technologies- Hybrid fiber – Coax (HFC) system, Switched Digital Video (SDV) – Passive optical networks (PON) – FTTX (FTTH, FTTB, FTTC, FTT cab) comparison, Broadband PON , Gigabit-Capable PON.

UNIT V BROAD BAND WIRELESS

Fixed Wireless, Direct Broadcast Satellite (DBS), Multi channel multi point distribution services (MMDS), Local multi point distribution services (LMDS), and Wideband integrated Digital Interactive Services (WIDIS), Mobile Wireless 3G – IMT 2000, Introduction to LTE-A.

TOTAL: 45 PERIODS

OUTCOMES:

- To able to design systems meeting out the requirements of the recent standards.
- To meet out the industry requirements for man power in next generation networks.
- To be able to contribute towards the enhancement of the existing wireless technologies.

REFERENCES:


II5002 AUTOMOTIVE ELECTRONICS L T P C

C 3 0 0 3

OBJECTIVES

● In Automobiles the electrical systems are important. It has number of subsystems like starting system, Charging system etc. Also most of the control systems are being converted from mechanical to electronics. In this course the function and construction of various electrical components and electronic components and system are described.

UNIT I BATTERIES AND CHARGING SYSTEM

Principle and construction of lead acid battery, characteristics of battery, rating capacity and efficiency of batteries, various tests on batteries, maintenance and charging. Lighting system: insulated and earth return system, details of head light and side light, LED lighting system, head light dazzling and preventive methods—Horn, wiper system and trafficator.

Generation of direct current, shunt generator characteristics, armature reaction, third brush regulation, cutout. Voltage and current regulators, compensated voltage regulator, alternators principle and constructional aspects and bridge rectifiers, new developments

UNIT II STARTING SYSTEM

Condition at starting, behavior of starter during starting, series motor and its characteristics, principle and construction of starter motor, working of different starter drive units, care and maintenances of starter motor, starter switches.

UNIT III FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS

Current trends in automotive electronic engine management system, electromagnetic interference suppression, electromagnetic compatibility, electronic dashboard instruments, onboard diagnostic system, security and warning system.

UNIT IV INFOTAINMENT & NAVIGATION SYSTEMS

UNIT V  SENSORS AND ACTUATORS

Types of sensors: sensor for speed, throttle position, exhaust oxygen level, manifold pressure, crankshaft position, coolant temperature, exhaust temperature, air mass flow for engine application. Solenoids, stepper motors, relay.

TOTAL: 45 PERIODS

OUTCOMES:
The students will be able to
● use Electronics for automotive industries
● use sensors for automation
● apply smart devices for infotainment

REFERENCES

EL5004  SMART ANTENNAS

OBJECTIVES:
● To understand smart antenna environments
● To learn channel models
● To learn algorithms for Multi target decision

UNIT I

UNIT II

UNIT III

UNIT IV
Optimal spatial filtering – adaptive algorithms for CDMA. Multi target decision – directed algorithm.
UNIT V
DOA estimation – conventional and subspace methods. ML estimation techniques. Estimation of the number of sources using eigen decomposition. Direction finding and true ranging PL systems. Elliptic and hyperbolic PL systems. TDOA estimation techniques.

OUTCOMES:
- To compare algorithms for target decision
- To explain DOA estimation techniques

REFERENCES:

UNIT I  
BASIC THEORY
Introduction to EMI and EMC, Intra and inter system EMI, Elements of Interference, Sources and Victims of EMI, Conducted and Radiated EMI emission and susceptibility, Case Histories, Radiation hazards to humans, Various issues of EMC, EMC Testing categories EMC Engineering Application.

UNIT II  
COUPLING MECHANISM
Electromagnetic field sources and Coupling paths, Coupling via the supply network, Common mode coupling, Differential mode coupling, Impedance coupling, Inductive and Capacitive coupling, Radioactive coupling, Ground loop coupling, Cable related emissions and coupling, Transient sources, Automotive transients.

UNIT III  
EMI MITIGATION TECHNIQUES
Working principle of Shielding and Murphy's Law, LF Magnetic shielding, Apertures and shielding effectiveness, Choice of Materials for H, E, and free space fields, Gasketting and sealing, PCB Level
shielding, Principle of Grounding, Isolated grounds, Grounding strategies for Large systems, Grounding for mixed signal systems, Filter types and operation, Surge protection devices, Transient Protection.

UNIT IV  STANDARD AND REGULATION
9

UNIT V  EMI TEST METHODS AND INSTRUMENTATION
9
Fundamental considerations, EMI Shielding effectiveness tests, Open field test, TEM cell for immunity test, Shielded chamber, Shielded anechoic chamber, EMI test receivers, Spectrum analyzer, EMI test wave simulators, EMI coupling networks, Line impedance stabilization networks, Feed through capacitors, Antennas, Current probes, MIL -STD test methods, Civilian STD test methods.

TOTAL : 45 PERIODS

OUTCOMES:
At the end of this course, the student should be able to:
- Identify Standards
- Compare EMI test methods
- Discuss EMI mitigation techniques

REFERENCES:
5. Electromagnetic Compatibility by Norman Violette Published by Springer, 2013
II5003 SYSTEM ON CHIP L T P C 3 0 0 3

OBJECTIVES:
● To introduce architecture and design concepts underlying system on chips.
● Students can gain knowledge of designing SoCs.
● To impart knowledge about the hardware-software design of a modest complexity chip all the way from specifications, modeling, synthesis and physical design.

UNIT I SYSTEM ARCHITECTURE: OVERVIEW 9
Components of the system – Processor architectures – Memory and addressing – system level interconnection – SoC design requirements and specifications – design integration – design complexity – cycle time, die area and cost, ideal and practical scaling, area-time-power tradeoff in processor design, Configurability.

UNIT II PROCESSOR SELECTION FOR SOC 9

UNIT III MEMORY DESIGN 9

UNIT IV INTERCONNECT ARCHITECTURES AND SOC CUSTOMIZATION 9

UNIT V FPGA BASED EMBEDDED PROCESSOR 9

TOTAL: 45 PERIODS

OUTCOMES:
Upon successful completion of the program the students shall
● Explain all important components of a System-on-Chip and an embedded system, i.e.
● digital hardware and embedded software;
● Outline the major design flows for digital hardware and embedded software;
● Discuss the major architectures and trade-offs concerning performance, cost and power
● consumption of single chip and embedded systems;
REFERENCES:

II5004 SOFTWARE DEFINED NETWORKS LT P C 3003

OBJECTIVES:
- To learn about what software defined networks are
- To understand the separation of the data plane and the control plane
- To learn about the use of SDN in data centers
- To learn about different applications of SDN

UNIT I INTRODUCTION
History of Software Defined Networking (SDN) – Modern Data Center – Traditional Switch Architecture – Why SDN – Evolution of SDN – How SDN Works – Centralized and Distributed Control and Date Planes

UNIT II OPEN FLOW & SDN CONTROLLERS
Open Flow Specification – Drawbacks of Open SDN, SDN via APIs, SDN via Hypervisor Based Overlays – SDN via Opening up the Device – SDN Controllers – General Concepts

UNIT III DATA CENTERS
Multitenant and Virtualized Multitenant Data Center – SDN Solutions for the Data Center Network – VLANs – EVPN – VxLAN – NVGRE

UNIT IV SDN PROGRAMMING
Programming SDNs: Northbound Application Programming Interface, Current Languages and Tools, Composition of SDNs – Network Functions Virtualization (NFV) and Software Defined Networks: Concepts, Implementation and Applications.

UNIT V SDN
Juniper SDN Framework – IETF SDN Framework – Open Daylight Controller – Floodlight Controller – Bandwidth Calendaring – Data Center Orchestration

TOTAL :45 PERIODS

OUTCOMES:
Upon completion of the course, the students will be able to:
- Critically analyze and appreciate the evolution of software defined networks
- Point out the various components of SDN and their uses
- Explain the use of SDN in the current networking scenario
- Design and develop various applications of SDN

REFERENCES:
1. Thomas D. Nadeau, Ken Gray, —SDN: Software Defined Networks‖, O’Reilly Media,

II5005 MACHINE LEARNING L T P C 3 0 0 3

OBJECTIVES:
● To introduce students to the basic concepts and techniques of Machine Learning.
● To have a thorough understanding of the Supervised and Unsupervised learning techniques
● To study the various probability based learning techniques
● To understand graphical models of machine learning algorithms

UNIT I INTRODUCTION 9

UNIT II LINEAR MODELS 9

UNIT III TREE AND PROBABILISTIC MODELS 9

UNIT IV DIMENSIONALITY REDUCTION AND EVOLUTIONARY MODELS 9
UNIT V  GRAPHICAL MODELS

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of the course, the students will be able to:

● Distinguish between, supervised, unsupervised and semi-supervised learning
● Apply the apt machine learning strategy for any given problem
● Suggest supervised, unsupervised or semi-supervised learning algorithms for any given problem
● Design systems that uses the appropriate graph models of machine learning
● Modify existing machine learning algorithms to improve classification efficiency

REFERENCES:

MP5291      REAL TIME SYSTEMS      LT PC
30 0 3

OBJECTIVES:
● To learn real time operating system concepts, the associated issues & Techniques.
● To understand design and synchronization problems in Real Time System.
● To explore the concepts of real time databases.
● To understand the evaluation techniques present in Real Time System.

UNIT I  REAL TIME SYSTEM AND SCHEDULING

UNIT II  SOFTWARE REQUIREMENTS ENGINEERING
UNIT III    INTERTASK COMMUNICATION AND MEMORY MANAGEMENT  9
Buffering data – Time relative Buffering – Ring Buffers – Mailboxes – Queues – Critical regions
– Semaphores – other Synchronization mechanisms – deadlock – priority inversion – process
stack management – run time ring buffer – maximum stack size – multiple stack arrangement
– memory management in task control block - swapping – overlays – Block page management
– replacement algorithms – memory locking – working sets – real time garbage collection –
contiguous file systems.

UNIT IV    REAL TIME DATABASES  9
Real time Databases – Basic Definition, Real time Vs General Purpose Databases, Main
Memory Databases, Transaction priorities, Transaction Aborts, Concurrency control issues,
Disk Scheduling Algorithms, Two– phase Approach to improve Predictability – Maintaining

UNIT V    EVALUATION TECHNIQUES AND CLOCK SYNCHRONIZATION  9
Reliability Evaluation Techniques – Obtaining parameter values, Reliability models for
Hardware Redundancy–Software error models. Clock Synchronization–Clock, A Nonfault–
Tolerant Synchronization Algorithm – Impact of faults – Fault Tolerant Synchronization in
Hardware – Fault Tolerant Synchronization in software.

TOTAL:  45 PERIODS

OUTCOMES:
Upon completion of this course, the students should be able to:

●  Apply principles of real time system design techniques to develop real time applications.
●  Make use of database in real time applications.
●  Make use of architectures and behaviour of real time operating systems.
●  Apply evaluation techniques in application.

REFERENCES:
   Editions, 1997
2. Philip.A.Laplante, “Real Time System Design and Analysis”, Prentice Hall of India,
   3rd Edition, 2004
   International, 1999
5. Stuart Bennett, “Real Time Computer Control-An Introduction”, Prentice Hall of India,
   1998
OBJECTIVES

- Study the behavior of photovoltaic solar energy systems, focusing on the behavior of "stand-alone" systems.
- Do a first order, conceptual design of a stand-alone system for a location anywhere in India.
- Introduce the hardware elements and their behavior.
- Select battery for a PV system and battery sizing.
- Simulate standalone and grid tied PV system.

UNIT I INTRODUCTION TO SOLAR POWER

Semiconductor – properties, energy levels - basic equations of semiconductor devices physics - Basic characteristics of sunlight - Solar angles - day length - angle of incidence on tilted surface – Sun path diagrams – Equivalent circuit of PV cell, PV cell characteristics (VI curve, PV curve) - Maximum power point, Vmp, IMP, Voc, ISC – types of PV cell - Block diagram of solar photo voltaic system, PV array sizing.

UNIT II DC-DC CONVERTER


UNIT III MAXIMUM POWER POINT TRACKING


UNIT IV BATTERY

Types of Battery, Battery Capacity – Units of Battery Capacity - impact of charging and discharging rate on battery capacity - Columbic efficiency - Voltage Efficiency, Charging – Charge Efficiency, Charging methods, State of Charge, Charging Rates, Discharging - Depth of discharge - Discharge Methods, Circuits for Battery Management System (BMS), selection of Battery and sizing.

UNIT V PV MODULE & CONVERTERS

Characterization of PV module - VI Plot, PV Plot, finding VMP, IMP, Voc, Isc of PV module, Simulation of DC to DC converter - buck, boost, buck-boost and Cuk converters, standalone and grid tied photo voltaic system.

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to collect solar power characteristics at a given location.
- Ability to design and realize dc-dc converters for solar power utilization.
- Ability to design algorithms for improving solar power utilization.
- Ability to deal with battery issues and selection.
• Ability to design and simulate PV systems to validate its performance.

REFERENCES:

II5007 HEALTHCARE TECHNOLOGIES AND IoMT L T P C
3 0 0 3

OBJECTIVES:
The students will be able to
• know the principles and applications of biomedical devices
• comprehend the basics of healthcare technologies
• understand the applications of computer in medicine
• comprehend the telemedicine technology
• understand the applications of IoT for medical field and IoMT

UNIT I BIOMEDICAL TRANSDUCERS AND AMPLIFIERS 9
Introduction to Anatomy & Physiology of Human Body - Categories and Characteristics of Transducer - Signal conditioning units - Multichannel data acquisition system - various types recorders - necessity for low noise pre amplifiers - Difference amplifier - Chopper amplifier - Different types of electrode and its equivalent circuits.

UNIT II BIOPOTENTIAL RECORDING & MEASUREMENTS 9
ECG, EEG, EMG, PCG, EOG, ERG lead system and recording methods - typical waveform - frequency spectrum - abnormal waveform.

NON ELECTRICAL PARAMETER MEASUREMENTS: Respiration rate - Pulse rate – Temperature - Blood Pressure - $O_2$, $CO_2$ measurements - Respiratory volume measurement - BMR measurement - Plethysmography technique - Impedance technique - Bipolar and Tetrapolar circuits - Detection of various physiological parameters using impedance technique – Blood Flow meter – Biochemical measurements.

UNIT III COMPUTER APPLICATIONS IN MEDICINE 9
UNIT IV TELEMEDICINE APPLICATIONS


UNIT V CONNECTED HEALTH

E-Health –E-health services security and interoperability - Internet of Things (IoT) in Medical Field – Internet of Medical Things (IoMT) - Applications of IoMT – M- Health - Connected Health – Innovations in Healthcare Technologies.

OUTCOMES:

By the completion of this course the student will to

- Identify various functional blocks present in biosignal acquisition system
- Design the data acquisition system.
- Analyze different biopotential characteristics and recording methods of biosignals.
- Develop measurement systems by selecting different types of sensors, signal conditioning circuits for acquiring and recording various physiological parameters.
- Use the Applications of Computers in Medicine
- Differentiate the Protocols behind encryption techniques for secure transmission of data.
- Use the techniques, skills, and tools necessary for Telemedicine
- Apply new knowledge as needed in Connected Health including IoMT in healthcare

REFERENCES:

1. Leslie Cromwell, Fred J. Weibell and Erich A. Pfeiffer’s, Biomedical Instrumentation and Measurements, Biomedical Instrumentation and Measurements, Prentice Hall, 2001
3. Webster J.G Medical Instrumentation application and design, John Wiley and sons New York 3rd edition 1999
OBJECTIVES: The students will be able to
- understand the basics of robotics for industrial needs
- understand how to select robotics according to different applications
- analyse material handling techniques

UNIT I  INTRODUCTION: 7
Types of industrial robots - Load handling capacity - general considerations in Robotic material handling - material transfer - machine loading and unloading - CNC machine tool loading, Robot centered cell- robots for Industrial automation.

UNIT II  ROBOTS FOR INSPECTION: 9

UNIT III  SELECTION OF ROBOT: 10
Factors influencing the choice of a robot - robot performance testing - economics of robotisation - Impact of robot on industry and society.

UNIT IV  MATERIAL HANDLING: 9
Concepts of material handling - principles and considerations in material handling systems design - conventional material handling systems - industrial trucks, monorails, rail guided vehicles, conveyor systems, cranes and hoists - advanced material handling systems - automated guided vehicle systems - automated storage and retrieval systems (ASRS) - bar code technology - radio frequency identification technology.

UNIT V  ROBOTIC MACHINE VISION SYSTEM for INDUSTRY 10
Machine vision components - hardware’s and algorithms - image function and characteristics, segmentation - data reduction - feature extraction - edge detection - image recognition and decisions - application of machine vision such as in inspection of parts, identification, industrial robot control, mobile robot application - Competing technologies - CCD line scan and area scan sensor.

TOTAL: 45 PERIODS

OUTCOMES: The students will be able to
- assemble basic robot for industrial automation
- select robots for industrial applications
- use robots for material handling

REFERENCES:

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<thead>
<tr>
<th>II5009</th>
<th>COGNITIVE RADIO COMMUNICATIONS</th>
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<td>OBJECTIVES:</td>
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<td>● To enable the student to understand the evolving paradigm of cognitive radio communication and the enabling technologies for its implementation.</td>
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<td>● To enable the student to understand the essential functionalities and requirements in designing software defined radios and their usage for cognitive communication.</td>
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<td>● To expose the student to the evolving next generation wireless networks and their associated challenges.</td>
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**UNIT I** INTRODUCTION TO SDR

Definitions and potential benefits - software radio architecture evolution – foundations, technology tradeoffs and architecture implications - Antenna for Cognitive Radio.

**UNIT II** SDR ARCHITECTURE

Essential functions of the software radio - architecture goals - quantifying degrees of programmability - top level component topology - computational properties of functional components - interface topologies among plug and play modules, architecture partitions.

**UNIT III** INTRODUCTION TO COGNITIVE RADIOS

Marking radio self-aware, the cognition cycle - organization of cognition tasks - structuring knowledge for cognition tasks - Enabling location and environment awareness in cognitive radios – concepts, architecture, design considerations.

**UNIT IV** COGNITIVE RADIO ARCHITECTURE

Primary Cognitive Radio functions, Behaviors, Components, A–Priori Knowledge taxonomy, observe – phase data structures, Radio procedure knowledge encapsulation - components of orient, plan, decide phases, act phase knowledge representation, design rules.

**UNIT V** NEXT GENERATION WIRELESS NETWORKS

The XG Network architecture - spectrum sensing - spectrum management - spectrum mobility, spectrum sharing - upper layer issues - cross – layer design.

**TOTAL**: 45 PERIODS

**OUTCOMES:**

- The student would be able to appreciate the motivation and the necessity for cognitive radiocommunication strategies.
- The student would be able to evolve new techniques and demonstrate their feasibility using mathematical validations and simulation tools.
- The student would be able to demonstrate the impact of the evolved solutions in future wireless
network design.

REFERENCES:

II5010 MICRO AND NANO ELECTROMECHANICAL SYSTEMS L T P C 3 0 0 3

OBJECTIVES:
● To introducing the concepts of micro electro mechanical devices.
● To know the fabrication process of Microsystems.
● To know the design concepts of micro sensors and micro actuators.
● To introducing concepts of quantum mechanics and nano systems.

UNIT I OVERVIEW AND INTRODUCTION 9
New trends in Engineering and Science: Micro and Nanoscale systems Introduction to Design of MEMS and NEMS - Overview of Nano and Microelectromechanical Systems - Applications of Micro and Nanoelectromechanical systems - Microelectromechanical systems, devices and structures Definitions - Materials for MEMS: Silicon, silicon compounds, polymers, metals

UNIT II MEMS FABRICATION TECHNOLOGIES 9

UNIT III MICRO SENSORS 9
MEMS Sensors: Design of Acoustic wave sensors, resonant sensor - Vibratory gyroscope - Capacitive and Piezo Resistive Pressure sensors - engineering mechanics behind these Microsensors. Case study: Piezo-resistive pressure sensor

UNIT IV MICRO ACTUATORS 9
Design of Actuators: Actuation using thermal forces - Actuation using shape memory Alloys -
Actuation using piezoelectric crystals - Actuation using Electrostatic forces (Parallel plate, Torsion bar, Comb drive actuators) - Micromechanical Motors and pumps. Case study: Comb drive actuators

UNIT V NANOSYSTEMS AND QUANTUM MECHANICS 9
Atomic Structures and Quantum Mechanics - Molecular and Nanostructure Dynamics: Shrodinger Equation and Wavefunction Theory - Density Functional Theory - Nanostructures and Molecular Dynamics - Electromagnetic Fields and their quantization - Molecular Wires and Molecular Circuits

TOTAL: 45 PERIODS

OUTCOMES:
The students will be able to
- use the principles of MEMS and NEMS
- use micro sensors and actuators for the required field
- analyse the quantum machines for industrial applications

REFERENCES:
4. Chang Liu, “Foundations of MEMS”, Pearson education India limited, 2006,

II5011 QUANTUM COMPUTING L T P C
3 0 0 3

OBJECTIVES:
The students will be able to
- understand the principles of quantum computing
- learn algorithms using quantum computing
- know the procedures for estimating computation complexity

UNIT I FOUNDATION 9

UNIT II QUBIT SAND QUANTUM MODEL OF COMPUTATION 9

UNIT III QUANTUM ALGORITHMS – I 9
Superdense coding – quantum teleportation – applications of teleportation – probabilistic versus quantum algorithms – phase kick-back – the Deutsch algorithm – the Deutsch-

UNIT IV QUANTUM ALGORITHMS – II 9

UNIT V QUANTUM COMPUTATIONAL COMPLEXITY AND ERROR CORRECTION 9

TOTAL: 45 PERIODS

OUTCOMES:
The students will be able to
● use the principles of quantum computing
● develop quantum computing algorithms
● estimate Computational complexity

REFERENCES:

II5012 DEEP LEARNING TECHNIQUES L T P C 3 0 0 3

OBJECTIVES:
The students will be able to
● understand deep learning techniques
● study deep learning models
● understand the algorithms using deep learning technique

UNIT I MACHINE LEARNING FUNDAMENTALS 9

UNIT II DEEP LEARNING FUNDAMENTALS 9
Convolutional neural networks - Fundamentals, architectures, pooling, visualization - Recurrent and recursive neural networks - Deep learning for spatial localization Transposed convolution, efficient pooling, object detection, semantic segmentation. Deep learning applications with a focus on the
ones that have achieved superhuman performance (in face recognition, object recognition, speech recognition, natural language processing (machine translation)

UNIT III DEEP LEARNING MODELS

UNIT IV LEARNING TECHNIQUES IN DEEP LEARNING
Reinforcement learning framework - Dynamic programming algorithms for reinforcement learning - Monte Carlo methods for reinforcement learning - Temporal-difference learning and n-step bootstrapping algorithms for reinforcement learning Deep reinforcement learning • Policy gradient methods, Q-Learning

UNIT V APPLICATIONS OF DEEP LEARNING
Function approximation algorithms for reinforcement learning - Case studies of reinforcement learning applications that have achieved superhuman performance - Active research topics in deep and reinforcement learning Q-learning for wire less sensor networks.

OUTCOMES:
The students will be able to
- use deep learning basics for industrial applications
- develop deep learning algorithms
- develop deep learning model based applications

REFERENCES:
5. Deep Learning for Natural Language Processing: Applications of Deep Neural Networks to Machine Learning Tasks by Pearson Learn IT
6. Advanced Deep Learning with Keras by Rowel Atienza

CP5092 CLOUD COMPUTING TECHNOLOGIES LT P C 3 0 0 3

OBJECTIVES:
- To understand the concepts of virtualization and virtual machines
- To gain expertise in server, network and storage virtualization.
- To understand and deploy practical virtualization solutions and enterprise solutions
- To gain knowledge on the concept of virtualization that is fundamental to cloud
To understand the various issues in cloud computing
To be able to set up a private cloud
To understand the security issues in the grid and the cloud environment

UNIT I  VIRTUALIZATION  

UNIT II  VIRTUALIZATION INFRASTRUCTURE  

UNIT III  CLOUD PLATFORM ARCHITECTURE  

UNIT IV  PROGRAMMING MODEL  
Introduction to Hadoop Framework - Mapreduce, Input splitting, map and reduce functions, specifying input and output parameters, configuring and running a job – Developing Map Reduce Applications - Design of Hadoop file system – Setting up Hadoop Cluster - Cloud Software Environments - Eucalyptus, Open Nebula, Open Stack, Nimbus

UNIT V  CLOUD SECURITY  
Cloud Infrastructure security: network, host and application level – aspects of data security, provider data and its security, Identity and access management architecture, IAM practices in the cloud, SaaS, PaaS, IaaS availability in the cloud - Key privacy issues in the cloud – Cloud Security and Trust Management

TOTAL : 45 PERIODS

OUTCOMES:
Upon completion of this course, the students should be able to:
- Employ the concepts of storage virtualization, network virtualization and its management
- Apply the concept of virtualization in the cloud computing
- Identify the architecture, infrastructure and delivery models of cloud computing
- Develop services using Cloud computing
- Apply the security models in the cloud environment
REFERENCES:

II5013 RENEWABLE ENERGY RESOURCES LT P C 3 0 0 3

OBJECTIVES:
● To get exposure on solar radiation and its environmental impact to power.
● To know about the various collectors used for storing solar energy.
● To know about the various applications in solar energy.
● To learn about the wind energy and biomass and its economic aspects.
● To know about geothermal energy with other energy sources.

UNIT I PRINCIPLES OF SOLAR RADIATION 10
Role and potential of new and renewable source - the solar energy option - Environmental impact of solar power - physics of the sun - the solar constant - extraterrestrial and terrestrial solar radiation - solar radiation on titled surface - instruments for measuring solar radiation and sun shine, solar radiation data.

UNIT II SOLAR ENERGY COLLECTION 8
Flat plate and concentrating collectors - classification of concentrating collectors - orientation and thermal analysis - advanced collectors.

UNIT III SOLAR ENERGY STORAGE AND APPLICATIONS 8
Different methods - Sensible, latent heat and stratified storage - solar ponds - Solar Applications - solar heating/cooling technique - solar distillation and drying - photovoltaic energy conversion.

UNIT IV WIND ENERGY 10
UNIT V  GEOTHERMAL ENERGY

Resources - types of wells, methods of harnessing the energy - potential in India - OCEAN ENERGY: OTEC, Principles utilization - setting of OTEC plants - thermodynamic cycles - Tidal and wave energy: Potential and conversion techniques - mini-hydel power plants and their economics - DIRECT ENERGY CONVERSION: Need for DEC - Carnot cycle, limitations, principles of DEC.

TOTAL: 45 PERIODS

OUTCOMES:
- Understanding the physics of solar radiation.
- Ability to classify the solar energy collectors and methodologies of storing solar energy.
- Knowledge in applying solar energy in a useful way.
- Knowledge in wind energy and biomass with its economic aspects.
- Knowledge in capturing and applying other forms of energy sources like wind, biogas and geothermal energies.

REFERENCES:

II5014  E - VEHICLE TECHNOLOGIES  L T P C
                                                  3 0 0 3

OBJECTIVES: The students will be able to
- understand need for E-Vehicles
- understand electric drives for EVs
- know the need for battery management systems in EVs
- study EV infrastructure

UNIT I  ELECTRIC VEHICLES (EV)


UNIT II  ELECTRIC DRIVES FOR EV

Setup of an electric drive- Electromagnetism- Maxwell's equations- Magnetic Circuits- Application of Governing laws- Magnetic Force/Torque Production - Fundamentals, Performance and Control of
PMBLDC Motor - Synchronous Machines Wound-field, Permanent Magnet- Reluctance Machines-Switched Reluctance- Synchronous Reluctance- Flux Modulating Machines.

UNIT III BATTERIES FOR ELECTRIC VEHICLE SYSTEM AND BATTERY MANAGEMENT SYSTEM

UNIT IV POWER ELECTRONICS IN ELECTRIC VEHICLES
Gate driver Rectifiers - Buck convertor - Bidirectional DC-DC converters - PEV configurations - Voltage source inverter - Current source inverter - Power management problems - Control of the Electric Drive

UNIT V EV CHARGING TECHNOLOGY & INFRASTRUCTURE
Types of EV Charging- Design of charging systems with case studies-Charging Infrastructure Requirements - Safety Guidelines for Design of EV Charging Equipment’s.-Power Quality Issues and Design Requirements.

TOTAL: 45 PERIODS

OUTCOMES:
The students will be able to
- use electric drives for EV
- use power electronics for EV
- develop components for EV
- develop EV infrastructure

REFERENCES:
3. Toyota Prius Power Split Device animation
4. TheElectropaedia, a site on battery and energy technologies
7. Evaluation of the 2010 Toyota Prius Hybrid Electric Drive System, Oak Ridge National Lab
OBJECTIVES
- Understand the concepts related to ITS technologies and industry applications of the field.
- Conduct a comprehensive independent research project, on topics related to ITS

UNIT I  INTRODUCTION
Introduction to Intelligent Transportation Systems (ITS) - Advanced Transportation Management Systems (ATMS) - Advanced Traveler Information Systems (ATIS) - Federal ITS Programs

UNIT II  ITS ENVIRONMENT AND SAFETY
ITS Highway Safety Perspective - Environmental Aspects of ITS

UNIT III  ITS STANDARDS
Connected Vehicle Technology and Applications - ITS Standards and Architecture - ITS Telecommunications - Travel Information Systems

UNIT IV  ITS APPLICATIONS
Interactive Voice Recognition (IVR) - Mobile Applications - Economics of ITS – Revenue Generation Models - Case Studies

UNIT V  ITS SECURITY and POLICY
ITS and Security - ITS Policy Issues - International ITS Programs - Careers in the ITS Field

OUTCOMES:
The students will be able to:
- Use the ITS principles to develop ITS
- Develop ITS applications
- Analyze ITS security

REFERENCES:
OBJECTIVE:
- To give an idea about IPR, registration and its enforcement.

UNIT I INTRODUCTION 9
Introduction to IPRs, Basic concepts and need for Intellectual Property – Patents, Copyrights, Geographical Indications, IPR in India and Abroad – Genesis and Development – the way from WTO to WIPO –TRIPS, Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations – Important examples of IPR.

UNIT II REGISTRATION OF IPRs 10
Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad

UNIT III AGREEMENTS AND LEGISLATIONS 10

UNIT IV DIGITAL PRODUCTS AND LAW 9

UNIT V ENFORCEMENT OF IPRs 7
Infringement of IPRs, Enforcement Measures, Emerging issues – Case Studies.

TOTAL: 45 PERIODS

OUTCOME:
- Ability to manage Intellectual Property portfolio to enhance the value of the firm.

REFERENCES: