1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):
   - To enable graduates to develop solutions to real world problems in the frontier areas of Applied Electronics.
   - To enable the graduates to adapt to the latest trends in technology through self-learning and to pursue research to meet out the demands in industries and Academia.
   - To enable the graduates to exhibit leadership skills and enhance their abilities through lifelong learning.
   - To become entrepreneurs to develop indigenous solutions.

2. PROGRAM OUTCOMES (POs)
   1. An ability to independently carry out research/investigation and development work to solve practical problems
   2. An ability to write and present a substantial technical report/document
   3. Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program
   4. To critically evaluate the design and provide optimal solutions to problem areas in advanced signal processing, Consumer and automotive systems, embedded systems and VLSI design.
   5. To enhance and develop electronic systems, protocols between circuits using modern engineering hardware and software tools.
   6. To acquire knowledge of fundamentals of power electronics, power management, wireless, power supply circuits, RF circuits and FPGA circuits
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## ANNA UNIVERSITY, CHENNAI
### NON - AUTONOMOUS COLLEGES AFFILIATED ANNA UNIVERSITY
### M.E. APPLIED ELECTRONICS
### REGULATIONS – 2021
### CHOICE BASED CREDIT SYSTEM
### I TO IV SEMESTERS CURRICULA AND SYLLABI

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### AUDIT COURSES (AC)

Registration for any of these courses is optional to students

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### LIST OF OPEN ELECTIVES FOR PG PROGRAMMES

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### SUMMARY

**NAME OF THE PROGRAMME: M.E. APPLIED ELECTRONICS**

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COURSE OBJECTIVES:
- To introduce the fundamentals of fuzzy logic.
- To understand the basics of random variables with emphasis on the standard discrete and continuous distributions.
- To understand the basic probability concepts with respect to two dimensional random variables.
- To make students understand the notion of a Markov chain, and how simple ideas of conditional probability and matrices can be used to give a thorough and effective account of discrete – time Markov chains.
- To provide the required fundamental concepts in queueing models and apply these techniques in networks, image processing.

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

UNIT II  PROBABILITY AND RANDOM VARIABLES  12

UNIT III  TWO DIMENSIONAL RANDOM VARIABLES  12
Joint distributions – Marginal and conditional distributions – Functions of two dimensional random variables – Regression curve – Correlation.

UNIT IV  RANDOM PROCESSES  12

UNIT V  QUEUEING MODELS  12

COURSE OUTCOMES:
At the end of the course, students will be able to
- apply the concepts of fuzzy sets, fuzzy logic, fuzzy propositions and fuzzy quantifiers and in relate.
- analyze the performance in terms of probabilities and distributions achieved by the determined solutions.
- use some of the commonly encountered two dimensional random variables and extend to multivariate analysis.
- classify various random processes and solve problems involving stochastic processes.
- use queueing models to solve practical problems.

TOTAL : 60 PERIODS
REFERENCES:

RM4151 RESEARCH METHODOLOGY AND IPR L T P C
2 0 0 2

UNIT I RESEARCH DESIGN
Overview of research process and design, Use of Secondary and exploratory data to answer the research question, Qualitative research, Observation studies, Experiments and Surveys.

UNIT II DATA COLLECTION AND SOURCES
Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods.
Data - Preparing, Exploring, examining and displaying.

UNIT III DATA ANALYSIS AND REPORTING
Overview of Multivariate analysis, Hypotheses testing and Measures of Association.
Presenting Insights and findings using written reports and oral presentation.

UNIT IV INTELLECTUAL PROPERTY RIGHTS

UNIT V PATENTS

TOTAL:30 PERIODS

REFERENCES
COURSE OBJECTIVES:

- To describe fundamental concepts of DSP and Discrete Transforms
- To design digital filters design
- To estimate power spectrum using non-parametric and parametric methods
- To analyze the Multirate Signal processing by decimation and interpolation.
- To apply the concept of multirate signal processing for various applications

UNIT I  DIGITAL SIGNAL PROCESSING
Sampling of analog signals - Selection of sampling frequency - Frequency response - Transfer functions - Filter structures - Fast Fourier Transform (FFT) Algorithms - Image coding - DCT.

UNIT II  DIGITAL FILTER DESIGN

UNIT III ESTIMATION OF POWER SPECTRUM

UNIT IV MULTIRATE SIGNAL PROCESSING
Decimation by a factor D - Interpolation by a factor I - Sampling rate conversion by a rational factor I/D, Multistage Implementation of Sampling Rate Conversion, Filter design and Implementation for sampling rate conversion. Up-sampling using All Pass Filter.

UNIT V APPLICATIONS OF MULTIRATE SIGNAL PROCESSING AND DSP INTEGRATED CIRCUITS

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
CO1: Describe the basics of Digital Signal Processing and Discrete Time Transforms.
CO2. Design and implement FIR/IIR digital filters using various structures
CO3. Estimate power spectrum using appropriate parametric/non-parametric method.
CO4: Analyze discrete time system at different sampling frequencies using the concept of Multirate signal processing
CO5: Design discrete time system for the given application using Multi rate signal processing

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AP4152 ADVANCED DIGITAL SYSTEM DESIGN

COURSE OBJECTIVES:
- To design asynchronous sequential circuits.
- To learn about hazards in asynchronous sequential circuits.
- To study the fault testing procedure for digital circuits.
- To understand the architecture of programmable devices.
- To design and implement digital circuits using programming tools.

UNIT I SEQUENTIAL CIRCUIT DESIGN
Analysis of Clocked Synchronous Sequential Circuits and Modelling- State Diagram, State Table, State Table Assignment and Reduction-Design of Synchronous Sequential Circuits Design of Iterative Circuits-ASM Chart and Realization using ASM.

UNIT II ASYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN
Analysis of Asynchronous Sequential Circuit – Flow Table Reduction-Races-State Assignment-Transition Table and Problems in Transition Table- Design of Asynchronous Sequential Circuit - Static, Dynamic and Essential hazards – Mixed Operating Mode Asynchronous Circuits – Designing Vending Machine Controller.
UNIT III  FAULT DIAGNOSIS AND TESTABILITY ALGORITHMS  

UNIT IV  SYNCHRONOUS DESIGN USING PROGRAMMABLE DEVICES  

UNIT V  SYSTEM DESIGN USING VERILOG  

SUGGESTED ACTIVITIES:  
1: Design asynchronous sequential circuits.  
2: Design synchronous sequential circuits using PLA/PAL.  
3: Simulation of digital circuits in FPGA.  
4: Design digital systems with System Verilog.

PRACTICAL EXERCISES:  
1. Design of Registers by Verilog HDL.  
2. Design of Counters by Verilog HDL.  
3. Design of Sequential Machines by Verilog HDL.  
4. Design of Serial Adders , Multiplier and Divider by Verilog HDL.  
5. Design of a simple Microprocessor by Verilog HDL.

COURSE OUTCOMES:  
At the end of this course, the students will be able to:

CO1: Analyse and design synchronous sequential circuits.  
CO2: Analyse hazards and design asynchronous sequential circuits.  
CO3: Knowledge on the testing procedure for combinational circuit and PLA.  
CO4: Able to design PLD and ROM.  
CO5: Design and use programming tools for implementing digital circuits of industry standards.

REFERENCES  
2. M.D.Ciletti , Modeling, Synthesis and Rapid Prototyping with the Verilog HDL, Prentice Hall, 1999  

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AP4153 SEMICONDUCTOR DEVICES AND MODELING

COURSE OBJECTIVES:
- To acquire the fundamental knowledge and to expose to the field of semiconductor theory and devices and their applications.
- To gain adequate understanding of semiconductor device modeling aspects, designing devices for electronic applications
- To acquire the fundamental knowledge of different semiconductor device modeling aspects.

UNIT I MOS CAPACITORS
Surface Potential: Accumulation, Depletion, and Inversion, Electrostatic Potential and Charge Distribution in Silicon, Capacitances in an MOS Structure, Polysilicon-Gate Work Function and Depletion Effects, MOS under Nonequilibrium and Gated Diodes, Charge in Silicon Dioxide and at the Silicon–Oxide Interface, Effect of Interface Traps and Oxide Charge on Device Characteristics, High-Field Effects, Impact Ionization and Avalanche Breakdown, Band-to-Band Tunneling, Tunneling into and through Silicon Dioxide, Injection of Hot Carriers from Silicon into Silicon Dioxide, High-Field Effects in Gated Diodes, Dielectric Breakdown.

UNIT II MOSFET DEVICES
Long-Channel MOSFETs, Drain-Current Model, MOSFET I–V Characteristics, Subthreshold Characteristics, Substrate Bias and Temperature Dependence of Threshold Voltage, MOSFET Channel Mobility, MOSFET Capacitances and Inversion-Layer Capacitance Effect, Short-Channel MOSFETs, Short-Channel Effect, Velocity Saturation and High-Field Transport Channel Length Modulation, Source–Drain Series Resistance, MOSFET Degradation and Breakdown at High Fields

UNIT III CMOS DEVICE DESIGN
CMOS Scaling, Constant-Field Scaling, Generalized Scaling, Nonscaling Effects, Threshold Voltage, Threshold-Voltage Requirement, Channel Profile Design, Nonuniform Doping, Quantum Effect on Threshold Voltage, Discrete Dopant Effects on Threshold Voltage, MOSFET Channel Length, Various Definitions of Channel Length, Extraction of the Effective Channel Length,
UNIT IV  BIPOLAR DEVICES

UNIT V  MATHEMATICAL TECHNIQUES FOR DEVICE SIMULATIONS
Poisson equation, continuity equation, drift-diffusion equation, Schrödinger equation, hydrodynamic equations, trap rate, finite difference solutions to these equations in 1D and 2D space, grid generation.

COURSE OUTCOMES:
Upon completion of this course, the students will be able to
CO1: Explore the properties of MOS capacitors.
CO2: Analyze the various characteristics of MOSFET devices.
CO3: Describe the various CMOS design parameters and their impact on performance of the device.
CO4: Discuss the device level characteristics of BJT transistors.
CO5: Identify the suitable mathematical technique for simulation.

REFERENCES:
4. Trond Ytterdal, Yuhua Cheng and Tor A. Fjeldly Wayne Wolf, "Device Modeling for Analog and RF CMOS Circuit Design", John Wiley & Sons Ltd, 2004

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COURSE OBJECTIVES:
- To introduce the transistor level design of all digital building blocks common to all cmos microprocessors, network processors, digital backend of all wireless systems etc.
- To introduce the principles and design methodology in terms of the dominant circuit choices, constraints and performance measures
- To learn all important issues related to size, speed and power consumption

UNIT I MOS TRANSISTOR PRINCIPLES AND CMOS INVERTER 12
MOSFET characteristic under static and dynamic conditions, MOSFET secondary effects, elmore constant, CMOS inverter-static characteristic, dynamic characteristic, power, energy, and energy delay parameters, stick diagram and layout diagrams.

UNIT II COMBINATIONAL LOGIC CIRCUITS 9
Static CMOS design, different styles of logic circuits, logical effort of complex gates, static and dynamic properties of complex gates, interconnect delay, dynamic logic gates.

UNIT III SEQUENTIAL LOGIC CIRCUITS 9
Static latches and registers, dynamic latches and registers, timing issues, pipelines, clocking strategies, nonbistable sequential circuits.

UNIT IV ARITHMETIC BUILDING BLOCKS 9
Data path circuits, architectures for adders, accumulators, multipliers, barrel shifters, speed, power and area tradeoffs.

UNIT V MEMORY ARCHITECTURES 6
Memory architectures and Memory control circuits: Read-Only Memories, ROM cells, Read-Write Memories (RAM), dynamic memory design, 6 Transistor SRAM cell, sense amplifiers.

COURSE OUTCOMES:
At the end of this course, the students will be able to:
CO1: Use mathematical methods and circuit analysis models in analysis of CMOS digital circuits
CO2: Create models of moderately sized static CMOS combinational circuits that realize specified digital functions and to optimize combinational circuit delay using RC delay models and logical effort
CO3: Design sequential logic at the transistor level and compare the tradeoffs of sequencing elements including flip-flops, transparent latches
CO4: Understand design methodology of arithmetic building blocks
CO5: Design functional units including ROM and SRAM

REFERENCES:

CO-PO Mapping

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AP4111 ELECTRONICS SYSTEM DESIGN LABORATORY L T P C 0 0 3 1.5

COURSE OBJECTIVES:
- Design of instrumentation amplifier and voltage regulator
- Design of PCB layout
- Write a Verilog HDL coding of various combinational circuits
- Verify the design functionality for various memory modules
- Design of PLL circuits

LIST OF EXPERIMENTS:

1. Design of a 4-20 mA transmitter for a bridge type transducer.

Design the Instrumentation amplifier with the bridge type transducer (Thermistor or any resistance variation transducers) and convert the amplified voltage from the instrumentation amplifier to 4 – 20 mA current using op-amp. Plot the variation of the temperature Vs output current.

2. Design of AC/DC voltage regulator using SCR

Design a phase controlled voltage regulator using full wave rectifier and SCR, vary the conduction angle and plot the output voltage.
3. PCB layout design using CAD

Drawing the schematic of simple electronic circuit and design of PCB layout using CAD

4. HDL based design entry and simulation of Parameterizable cores of Counters, Shift registers, State machines, 8-bit Parallel adders and 8 – Bit multipliers.

5. HDL based design entry and simulation of Parameterizable cores on the simple Distributed Arithmetic system. Test vector generation and timing analysis.

6. HDL based design entry and simulation of Parameterizable cores on memory design and 4 – bit ALU. Synthesis, P&R and post P&R simulation, Critical paths and static timing analysis results to be identified. FPGA real time programming and I/O interfacing.

7. Interfacing with Memory modules in FPGA Boards. Verifying design functionality by probing internal signals.

8. Realization of Discrete Fourier transform/Fast Fourier Transform algorithm in HDL and observing the spectrum in simulation.

9. Invoke PLL module and demonstrate the use of the PLL for clock generation in FPGAs. Verify design functionality implemented in FPGA by capturing the signal in Oscilloscope

COURSE OUTCOMES:
CO1: Design an instrumentation amplifier and voltage regulator
CO2: Design a PCB layout using CAD tool
CO3: Write a Verilog code for various combinational and sequential circuits
CO4: Develop a memory module with FPGA
CO5: Design an PLL circuit

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AP4112  SIGNAL PROCESSING LABORATORY  L T P C  0 0 3 1.5

COURSE OBJECTIVES:

- To provide the student with the basic understanding of audio signal analysis using filters
- To provide the students with the understanding of the working of statistical method based approaches
- To impart the students with the design of filters
- To demonstrate the working of algorithms for different applications
- To provide knowledge of analyzing the images and video

LIST OF EXPERIMENTS:

1. Design of Adaptive channel equalizer
2. Realization of sub band filter using linear convolution
3. Realization of STFT using FFT
4. Demonstration of Bayes technique
5. Demonstration of Min-max technique
6. Realization of FIR Wiener filter
7. Generation of Multivariate Gaussian generated data with desired mean vector and the required co-variance matrix.
8. Design and Realization of the adaptive filter using LMS algorithm (solved using steepest-descent algorithm)
9. Representation of the 2D image signal as the linear combinations of PCA (Eigen faces)
10. Image compression using Discrete cosine transformation (DCT).
11. Multiple-input Multiple output (MIMO)
13. LMS filtering implementation using TMS320C6x processor
14. Face detection and tracking in video using OpenCV

TOTAL :45 PERIODS

COURSE OUTCOMES:

CO1: Obtain the ability to apply knowledge of linear algebra, random process and multirate signal processing in various signal processing applications.

CO2: Develop the student’s ability on conducting engineering experiments, analyze experimental observations scientifically

CO3: Become familiar to fundamental principles of linear algebra

CO4: Familiarize the basic operations of filter banks through simulations

CO5: Apply the principles of random process in practical applications
REFERENCES
3. V. Siahaan, R.H. Sianipar, Signal and Image processing with python GUI, Balige Publishing, 2021

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AP4201  ANALOG AND MIXED SIGNAL IC DESIGN  L T P C
9 3 0 0 3

COURSE OBJECTIVES:
- To study the concepts of MOS large signal model and small signal model
- To provide in-depth understanding of the analog integrated circuit and building blocks
- To learn the Analog and Digital layout design for mixed signal circuits
- To understand the methodologies for analysis and design of fundamental CMOS Analog and Mixed signal Circuits like Data Converters and filters.
- To study the integrated circuits like oscillators and PLLs.

UNIT I  INTRODUCTION AND BASIC MOS DEVICES
9
Challenges in analog design-Mixed signal layout issues- MOS FET structures and characteristics- large signal model – small signal model- single stage Amplifier-Source follower-Common gate stage – Cascode Stage

UNIT II  SUBMICRON CIRCUIT DESIGN
9

UNIT III  DATA CONVERTERS
9
Characteristics of Sample and Hold- Digital to Analog Converters- architecture-Differential Non linearity-Integral Non linearity- Voltage Scaling-Cyclic DAC-Pipeline DAC-Analog to Digital Converters- architecture – Flash ADC-Pipeline ADC-Differential Non linearity-Integral Non linearity.
Overview of SNR of Data Converters- Clock Jitters- Improving Using Averaging – Decimating Filters for ADC- Band pass and High Pass Sinc Filters- Interpolating Filters for DAC

UNIT IV ANALOG AND DIGITAL LAYOUT DESIGN FOR MIXED SIGNAL


UNIT V OSCILLATORS AND PLL

LC oscillators, Voltage Controlled Oscillators. Simple PLL, Charge pumps PLLs, Non ideal effects in PLLs, Delay Locked Loops. Applications of PLL.frequency multiplication and synthesis. Introduction to RF IC Design, building blocks, applications.

SUGGESTED ACTIVITIES:

ICT/MOOCs Reference :
https://nptel.ac.in/courses/117/101/117101105/

COURSE OUTCOMES:
At the end of this course the students will be able to:
CO1: Carry out research and development in the area of analog and mixed signal IC design.
CO2: Well versed with the MOS fundamentals, small signal models and analysis of MOSFET based circuits.
CO3 Analyse and model data converters architecture
CO4: Understand and Design different mixed signal circuits for various applications as per the user specifications.
CO5: Analyze and design mixed signal circuits such as Comparator, ADCs, DACs, PLL.

REFERENCES

COURSE 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 IoT
- To apply the concept of IoT in the real world scenario

UNIT I  INTRODUCTION AND ARCHITECTURE OF IoT  9

UNIT II  INDUSTRIAL IoT  9

UNIT III  IIOT ANALYTICS  9
Big Data Analytics and Software Defined Networks, Machine Learning and Data Science, Julia Programming, Data Management with Hadoop

UNIT IV  IOT SECURITY  9

UNIT V  CASE STUDY  9
Industrial IOT- Application Domains: Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Real case studies: Milk Processing and Packaging Industries, Manufacturing Industries

TOTAL : 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, student will be able to
CO1: Understand the basic concepts and Architectures of Internet of Things.
CO2: Understand various IoT Layers and their relative importance.
CO3: Realize the importance of Data Analytics in IoT.
CO4: Study various IoT platforms and Security
CO5: Understand the concepts of Design Thinking.

REFERENCE BOOKS
1. Industry 4.0: The Industrial Internet of Things”, by Alasdair Gilchrist (Apress), 2017
3. Hands-On Industrial Internet of Things: Create a powerful Industrial IoT by Giacomo Veneri, Antonio Capasso, Packt, 2018.

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AP4202 POWER CONVERSION CIRCUITS FOR ELECTRONICS

COURSE OBJECTIVE:
- To provide the students a deep insight into the working of different switching devices with respect to their characteristics
- To analyze different converters with their applications.
- To study advanced converters and switching techniques implemented in recent technology

UNIT I POWER ELECTRONIC DEVICES AND SEMICONDUCTOR SWITCHES
9

UNIT II SCR PERFORMANCE AND APPLICATIONS
9
Turn on circuits for SCR – triggering with single pulse and train of pulses synchronizing with supply – Thyristor turn off methods, natural and forced commutation, self-commutation series and parallel operations of SCRs. Rectifiers: Single phase and three phase controlled Rectifiers with inductive loads, RL load. Construction & Working of Opto- Isolators, Opto-TRIAC, Opto-SCR.

UNIT III INVERTERS AND VOLTAGE CONTROLLERS
9
Voltage and current source inverters, resonant, Series inverter, PWM inverter. AC and DC choppers – DC to DC converters – Buck, boost and buck – boost.
Single phase and three phase Cyclo-converters, Power factor control and Matrix Converters. Industrial applications DC and AC Drives DC Motor Speed control Induction Motor Speed Control.

UNIT IV  
TIMERS & DELAY ELEMENTS, HIGH FREQUENCY POWER HEATING, SENSOR AND ACTUATORS  

UNIT V  
AUTOMATION AND CONTROL  
Data Communications for Industrial Electronics, Telemetry, SCADA & Automation, AC & DC Drives, Voltage & Power Factor Control through Solid State Devices, Soft Switching, Industrial Robots.

TOTAL :45 CREDITS

COURSE OUTCOMES:  
At the end of this course students will be able to:  
CO1: Describe the characteristics, operation of power switching devices and identify their ratings and applications.  
CO2: Understand the requirements SCR Protection, Describe the Functioning of SCR their Construction and Performance.  
CO3: Analyze and Design the Converter Based on SCR for various Industrial Applications.  
CO4: Demonstrate ability to understand High Frequency, Heating Systems, Timers, Relevant Sensors & Actuator and their Application in Industrial Setting.  
CO5: Demonstrate the ability to understand and apply Data Communication, Telemetry & SCADA System in Industrial Applications.

REFERENCES:  
5. M.S. Jamil Asghar, “Power Electronics” Prentice Hall of India Ltd., 2004  
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### COURSE OBJECTIVES:
- Learn Embedded design challenges and design methodologies
- Study general and single purpose processor
- Understand bus structures
- Design a state machine and concurrent process models
- Know about Embedded software development tools and RTOS.

### UNIT I

**EMBEDDED SYSTEM OVERVIEW**

Embedded System Overview, Design Challenges – Optimizing Design Metrics, Design Methodology, RT-Level Combinational and Sequential Components, Optimizing Custom Single-Purpose Processors.

### UNIT II

**GENERAL AND SINGLE PURPOSE PROCESSOR**

Basic Architecture, Pipelining, Superscalar and VLIW architectures, Programmer’s view, Development Environment, Application-Specific Instruction-Set Processors (ASIPs) Microcontrollers, Timers, Counters and watchdog Timer, UART, LCD Controllers and Analog-to-Digital Converters, Memory Concepts.

### UNIT III

**BUS STRUCTURES**


### UNIT IV

**STATE MACHINE AND CONCURRENT PROCESS MODELS**

UNIT V EMBEDDED SOFTWARE DEVELOPMENT TOOLS AND RTOS

Compilation Process – Libraries – Porting kernels – C extensions for embedded systems –
emulation and debugging techniques – RTOS – System design using RTOS.

TOTAL : 45 PERIODS

SUGGESTED ACTIVITIES:

1: Insist students to write a requirements form for a smart phone
2: Compare the use of different Microcontrollers for a particular ESD.
3: Application of a protocol for a specified application.
4: Write a Embedded C code for a given task.
5: design an embedded system for any type of real time application

PRACTICAL LIST:

Exercise – 1
Comparative study of software development tools and design steps with respect to FPGA
based and Non – FPGA based (defined logic) embedded system development.
(For Example: consider any Spartan FPGA board for FPGA based Embedded System Consider
any cortex- M based board for Non – FPGA based Embedded system)

Exercise – 2
Implement adder and decoder logic blocks in any one of the FPGA chip based
development board.

Exercise – 3
Design and development of UART protocol logic block in any one of FPGA chip based
development board.

Exercise – 4
Consider on board LEDs ( any four) and timer logic block of cortex- M board. Write a
program which enables LEDs to glow in different timing.

Exercise – 5
Consider on board switches and (2x16) LCD display develop a program which displays the
status of switch activation.

Exercise – 6
Demonstrate GPIO based I/O interfacing by considering LM 35 temperature sensor and
cortex- M board.

Exercise – 7
Development of one interfacing scheme which transmits data from one cortex- M board to
another cortex- M board using on chip CAN logic blocks.

Exercise – 8
Consider on board EPROM IC of Cortex- M board by utilizing on chip I2c logic block transmit
data to EPROM IC and receive stored data from EPROM IC.

Exercise – 9
Consider on board LEDs (4 Nos) of Cortex - M board. Demonstrate time management
service concept of RTOS for glowing all four LEDS in different timings.

Exercise – 10
Consider two ultrasonic sensors which are interfaced with cortex- M board. Both are
located some distance ( 2 meters) apart vertically so that the system can identify the movement of
object in term of distance. consider data reception and display of each sensor as two different
tasks by RTOS. Establish a RTOS based system to recognize the height of moving object.
Objective:

a. Able to understand embedded system design flow in FPGA chip based and Non – FPGA chip based embedded development boards.
b. Able to create simple logic blocks in FPGA chip based boards.
c. Able to understand interfacing scheme for Non – FPGA board scheme for Non – FPGA board
d. Able to utilize RTOS functions for interfacing practice

HARDWARE AND SOFTWARE REQUIREMENTS

1. Cortex- M board and simulation tools
2. FPGA EVM Board and simulation tools
3. Ultrasonic sensor
4. Any portable open source RTOS

COURSE OUTCOMES:
At the end of the course the student will be:

CO1: Able to design an Embedded system
CO2: Understand a general and single purpose processor
CO3: Explain different protocols
CO4: Discuss state machine and design process models
CO5: Outline embedded software development tools and RTOS

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TOTAL: 45+30 = 75 PERIODS
COURSE OBJECTIVE:
- Familiarize with different FPGA boards
- Analyze digital design using Front end Tools
- Analyze the CMOS circuits using CAD tools
- Analyze the interfacing of I/O devices with Arduino Boards using Embedded C

PRACTICAL EXPERIMENTS:
1. Synthesize and implement Combinational and Sequential Circuits in VERILOG / VHDL
2. Synthesize and implement MAC unit and GCD unit in Verilog /VHDL
3. Implementation of sampling of input signal and display in FPGA Synthesize and implement FIR filter and IIR filter Verilog /VHDL
4. Synthesize and implement 8 bit general purpose processor in Verilog/VHDL
5. Synthesize and implement UART and USART
6. Simulation and Analysis of CMOS combinational and sequential logic circuits using CAD tools

TOTAL : 60 PERIODS

COURSE OUTCOME:
At the end of the course, the students will be able to
CO1: Program in Verilog/VHDL for combinational and sequential circuits and implement the program in FPGA
CO2: Implement FIR and IIR filters in FPGA
CO3: Implement data path design and interfaces
CO4: Handle CAD tools to draw/edit, and analyze the CMOS circuits.
CO5: Program and interface the Arduino Boards using Embedded C

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AP4001 APPLICATIONS SPECIFIC INTEGRATED CIRCUITS

COURSE OBJECTIVE:
- To prepare the student to be an entry-level industrial standard ASIC or FPGA designer.
- To analyze the issues and tools related to ASIC/FPGA design and implementation.
- To understand basics of System on Chip and Platform based design.

UNIT I  INTRODUCTION TO ASICS, CMOS LOGIC AND ASIC LIBRARY DESIGN  9
Types of ASICs - Design flow - CMOS transistors - Combinational Logic Cell – Sequential logic cell -Data path logic cell - Transistors as Resistors - Transistor Parasitic Capacitance- Logical effort.

UNIT II  PROGRAMMABLE ASICS, PROGRAMMABLE ASIC LOGIC CELLS AND PROGRAMMABLE ASIC I/O CELLS  9
Anti-fuse - static RAM - EPROM and EEPROM technology - Actel ACT - Xilinx LCA –Altera FLEX - Altera MAX DC & AC inputs and outputs - Clock & Power inputs - Xilinx I/O blocks.

UNIT III  PROGRAMMABLE ASIC ARCHITECTURE  9

UNIT IV  LOGIC SYNTHESIS, PLACEMENT AND ROUTING  9
Logic synthesis - ASIC floor planning- placement and routing – power and clocking strategies.

UNIT V  HIGH PERFORMANCE ALGORITHMS FOR ASICs/ SOCs. SOC CASE STUDIES  9

TOTAL:45 PERIODS

COURSE OUTCOMES:
At the end of this course students will be able:

CO1: To architect ASIC library design
CO2: To develop programmable ASIC logic cells
CO3: To design I/O cells and interconnects
CO4: To understand logic synthesis, placement and routing
CO5: To identify new developments in SOC and low power design

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AP4071 COMPUTER ARCHITECTURE AND PARALLEL PROCESSING  L T P C 3 0 0 3

COURSE OBJECTIVES:
- Discuss the basic concepts and structure of computers.
- Explain the concepts of number representation and arithmetic operations.
- Explain different types of Memory architectures.
- Describe various parallel processing schemes and vector architecture.
- Summarize the Instruction execution stages and Memory hierarchy.

UNIT I  INTRODUCTION TO COMPUTER ORGANIZATION  9

UNIT II  DATA REPRESENTATION  9
Signed number representation, fixed and floating point representations, character representation. Computer arithmetic - integer addition and subtraction, ripple carry adder, carry look-ahead adder - multiplication - shift-and-add, Booth multiplier, carry save multiplier - Division - non-restoring and restoring techniques, floating point arithmetic.

UNIT III  PROCESSOR ARCHITECTURE AND CONTROL UNIT  9

UNIT IV  PARALLEL PROCESSING  9
Parallel processing challenges – Flynn's classification – Single Instruction Single Data (SISD), Multiple Instruction Multiple Data (MIMD), Single Instruction Multiple Data (SIMD), Single Program Multiple Data (SPMD), and Vector Architectures - Hardware multithreading – Multi-core processors and other Shared Memory Multiprocessors - Introduction to Graphics Processing Units, Clusters, Warehouse Scale Computers and other Message-Passing Multiprocessors.

UNIT V  MEMORY & I/O SYSTEMS  9

TOTAL: 45 PERIODS
COURSE OUTCOMES
Upon completion of this course, the student will be able to
CO1: Understand the basic organization of computer and different instruction formats and addressing modes. (K2)
CO2: Interpret the representation and manipulation of data on the computer. (K3)
CO3: Illustrate about implementation schemes of control unit and pipeline performance. (K2)
CO4: Summarize the various types of parallelism architectures. (K2)
CO5: Compare the various memory hierarchy and I/O systems. (K2)

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AP4091 AUTOMOTIVE ELECTRONICS L T P C
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COURSE OBJECTIVES:
- To explain the principle of electronic management system and different sensors used in the systems.
- To know the concepts and develop basic skills necessary to diagnose automotive electronic problems.
- To know Starting, and charging, lighting systems, advanced automotive electrical systems.
- To include electronic accessories and basic computer control.
- To explore practically about the components present in an Automotive electrical and electronics system.
UNIT I FUNDAMENTALS

Components for electronic engine management system, open and closed loop control strategies, PID control, Look up tables, introduction to modern control strategies like Fuzzy logic and adaptive control. Switches, active resistors, Transistors, Current mirrors/amplifiers, Voltage and current references, Comparator, Multiplier. Amplifier, filters, A/D and D/A converters.

UNIT II MODERN SENSORS

Film sensors, micro-scale sensors, Particle measuring systems, Vibration Sensors, SMART sensors, Machine Vision, Multi-sensor systems Applications of Sensors: Applications and case studies of Sensors in Automobile Engineering, Aeronautics, Machine tools and Manufacturing processes.

UNIT III CHARGING SYSTEM


UNIT IV AUTOMOTIVE TRANSMISSION CONTROL SYSTEMS


UNIT V ELECTRONICS SYSTEMS


TOTAL : 45 PERIODS

SUGGESTED ACTIVITIES:

1. Testing of battery, starting systems, charging systems, ignition systems and body controller systems
2. Study of various sensors and actuators used in two wheelers and four wheelers for electronic control.

COURSE OUTCOMES:

At the end of this course the students will be able to:

CO1: Explain the fundamentals, operation, function of various sensors and actuators in engine management systems.

CO2: Explain the Automotive Transmission Control Systems.

CO3: Enumerate the principles, application, construction and specification of different sensors and actuators usable in typical automobile by suitable testing.

CO4: List out the principles and characteristics of charging system components and demonstrate their working with suitable tools.
CO5: Describe the principles and architecture of electronics systems and its components present in an automobile related to instrumentation, control, security and warning systems.

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AP4094 ROBOTICS L T P C 3 0 0 3

COURSE OBJECTIVES:
- To Introduce the concepts of Robotic systems
- To understand the concepts of Instrumentation and control related to Robotics
- To understand the kinematics and dynamics of robotics
- To explore robotics in Industrial applications

UNIT I INTRODUCTION TO ROBOTICS 9
Robotics -History - Classification and Structure of Robotic Systems - Basic components - Degrees of freedom - Robot joints coordinates- Reference frames - workspace- Robot languages- Robotic sensors- proximity and range sensors, ultrasonic sensor, touch and slip sensor.

UNIT II ROBOT KINEMATICS AND DYNAMICS 9
UNIT III ROBOTICS CONTROL 9
Control of robot manipulator - state equations - constant solutions - linear feedback systems, single-axis PID control - PD gravity control - computed torque control, variable structure control and impedance control.

UNIT IV ROBOT INTELLIGENCE AND TASK PLANNING 9
Artificial Intelligence - techniques - search problem reduction - predicate logic means and end analysis - problem solving - robot learning - task planning - basic problems in task planning - AI in robotics and Knowledge Based Expert System in robotics.

UNIT-V INDUSTRIAL ROBOTICS 9
Robot cell design and control - cell layouts - multiple robots and machine interference - work cell design - work cell control - interlocks - error detection deduction and recovery - work cell controller - robot cycle time analysis. Safety in robotics, Applications of robot and future scope.

TOTAL : 45 PERIODS

COURSE OUTCOMES:
At the end of the course the student will be able to
CO1: Describe the fundamentals of robotics
CO2: Understand the concept of kinematics and dynamics in robotics.
CO3: Discuss the robot control techniques
CO4: Explain the basis of intelligence in robotics and task planning
CO5: Discuss the industrial applications of robotics

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COURSE OBJECTIVE:

- To classify various soft computing frameworks.
- To be familiar with the design of neural networks, fuzzy logic, and fuzzy systems.
- To learn mathematical background for optimized genetic programming.
- Be exposed to neuro-fuzzy hybrid systems and its applications.
- To understand the various evolutionary optimization techniques.

UNIT I  Fuzzy Logic:  
Introduction to Fuzzy logic - Fuzzy sets and membership functions- Operations on Fuzzy sets- Fuzzy relations, rules, propositions, implications, and inferences- Defuzzification techniques- Fuzzy logic controller design- Some applications of Fuzzy logic.

UNIT II  Artificial Neural Networks:  

UNIT III  Genetic Algorithm:  

UNIT IV  Neuro-Fuzzy Modeling  

UNIT V  Conventional Optimization Techniques  

TOTAL :45 PERIODS

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

CO1: Develop application on different soft computing techniques like Fuzzy, GA and Neural network
CO3: Implement machine learning through Neural networks.
CO4: Model Neuro Fuzzy system for clustering and classification.
CO5: Able to use the optimization techniques to solve the real world problems
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CU4251 RF SYSTEM DESIGN

COURSE OBJECTIVES:
- Be familiar with RF transceiver system design for wireless communications
- Be exposed to design methods of receivers and transmitters used in communication systems
- Design RF circuits and systems using an advanced design tool.
- Exemplify different synchronization methods circuits and describe their block schematic and design criteria
- Measure RF circuits and systems with a spectrum analyzer.

UNIT I BASICS OF RADIO FREQUENCY SYSTEM DESIGN
Definitions and models of Linear systems and Non-linear system. Specification parameters: Gain, noise figure, SNR, Characteristic impedance, S-parameters, Impedance matching and Decibels. Elements of digital base band signalling: complex envelope of band pass signals, Average value, RMS value, Crest factor, Sampling, jitter, modulation techniques, filters, pulse shaping, EVM, BER,
sensitivity, selectivity, dynamic range and, adjacent and alternate channel power leakages

UNIT II   RADIO ARCHITECTURES AND DESIGN CONSIDERATIONS  

UNIT III   AMPLIFIER MODELING AND ANALYSIS  

UNIT IV   MIXER AND OSCILLATOR MODELING AND ANALYSIS  
Mixers: Frequency translation mechanisms, frequency inversion, image frequencies, spurious calculations, principles of mixer realizations. Oscillators: phase noise and its effects, effects of oscillator spurious components, frequency accuracy, oscillator realizations: Frequency synthesizers, NCO.

UNIT V   APPLICATIONS OF SYSTEMS DESIGN  
Multimode and multiband Superheterodyne transceiver: selection of frequency plan, receiver system and transmitter system design – Direct conversion transceiver: receiver system and transmitter system design.

TOTAL : 45 PERIODS

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

CO1: understand the specifications of transceiver modules
CO2: understand pros and cons of transceiver architectures and their associated design considerations
CO3: understand the impact of noise and amplifier non-linearity of amplification modules and also will learn the resultant effect during cascade connections
CO4: get exposure about spurs and generation principles during signal generation and frequency translations
CO5: understand the case study of transceiver systems and aid to select specification parameters

REFERENCES
### Course Objectives:

- To gain broad conceptual understanding of the various aspects of electromagnetic (EM) interference and compatibility
- To develop a theoretical understanding of electromagnetic shielding effectiveness
- To understand ways of mitigating EMI by using shielding, grounding and filtering
- To understand the need for standards and to appreciate measurement methods
- To understand how EMI impacts wireless and broadband technologies

### Unit I - Introduction & Sources of EM Interference

- Introduction
- Classification of sources
- Natural sources
- Man-made sources
- Survey of the electromagnetic environment

### Unit II - EM Shielding

- Introduction
- Shielding effectiveness
- Far-field sources
- Near-field sources
- Low-frequency, magnetic field shielding
- Effects of apertures

### Unit III - Interference Control Techniques

- Equipment screening
- Cable screening
- Grounding
- Power-line filters
- Isolation
- Balancing
- Signal-line filters
- Nonlinear protective devices

### Unit IV - EMC Standards, Measurements and Testing

- Need for standards
- The international framework
- Human exposure limits to EM fields
- EMC measurement techniques
- Measurement tools
- Test environments

### Unit V - EMC Considerations in Wireless and Broadband Technologies

- Efficient use of frequency spectrum
- EMC, interoperability and coexistence
- Specifications and alliances
- Transmission of high-frequency signals over telephone and power networks
- EMC and digital subscriber lines
- EMC and power line telecommunications
SUGGESTED ACTIVITIES:
1. Investigate various case studies related to EMIC. Example: Chernobyl Disaster in 1986.
2. Develop some understanding about the design of EM shields in electronic system design and packaging.

COURSE OUTCOMES:
Upon completion of this course, the student will be able to
CO1: Demonstrate knowledge of the various sources of electromagnetic interference
CO2: Display an understanding of the effect of how electromagnetic fields couple through apertures, and solve simple problems based on that understanding
CO3: Explain the EMI mitigation techniques of shielding and grounding
CO4: Explain the need for standards and EMC measurement methods
CO5: Discuss the impact of EMC on wireless and broadband technologies

TOTAL: 45 PERIODS

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AP4003 VLSI DESIGN TECHNIQUES
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COURSE OBJECTIVES:
- To understand the basics I-V characteristics of MOS transistor
- To introduce the VLSI design flow
- To Design combinational and sequential circuits
- To introduce testing of VLSI circuits
- To explore system design using Verilog HDL
Unit I  CMOS TECHNOLOGY

Unit II  CIRCUIT DELAY,POWER, INTERCONNECT AND VERILOG HDL
Verilog: Procedural assignments –conditional statements – Design of combinational and sequential circuits using different types of modeling –Test benches.

Unit III  COMBINATIONAL AND SEQUENTIAL CIRCUIT DESIGN
Circuit families –Circuit Pitfalls – Sequencing static circuits, Max-min delay constraints, Time borrowing, Clock Skew – circuit design of latches and flip flops – synchronizers, Metastability, communication between asynchronous clock domains.

Unit IV  CMOS TESTING

UNIT V  SYSTEM DESIGN USING VERILOG HDL
Basic concepts- identifiers- gate primitives- gate delays- operators timing controls- procedural assignments-conditional statements- Design of combinational and sequential circuits using Data flow- structural gate level- switch level modeling and Behavioral modeling-Test benches.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
After the completion of the course the students will be able to,
CO1: Analyze the characteristics of CMOS transistor
CO2: Identify the methods to distribute clock and reduce power dissipation in CMOS circuits.
CO3: Design combinational and sequential circuits
CO4: Analyze the methods to test the CMOS circuits
CO5: Synthesize the combinational and sequential circuits using Verilog HDL

REFERENCES:
COURSE OBJECTIVES:
- To introduce the basics of nano electronics
- To understand the basics of semiconductor materials
- To understand the basics of MOSFETS and its application in nano electronics
- To learn the advanced nanoscale devices
- To explore about Biosensors

UNIT I  INTRODUCTION TO NANOELECTRONICS 9

UNIT II  MATERIALS FOR NANOELECTRONICS 9

UNIT III  SHRINK-DOWN APPROACHES 9
Moore’s Law- Technology Scaling and Reliability Challenges. Basic MOS Transistor- Types, Modes of operation, n-MOS operation, Drain Current, Threshold Voltage, Energy band diagram of MOSFET, nanoscale MOSFET, SCEs- limits to scaling, system integration limits.

UNIT IV  ADVANCED NANOSCALE DEVICES 9
Double Gate MOSFETs, Tri-Gate MOSFETs, Tunnel FETs-Multi-Gate TFETs and Heterojunction TFETs- Graphene and Carbon Nanotube Transistors.

UNIT V  FET BASED BIOSENSORS 9
Principles- Components of biosensor-Classification of Biosensors based on transducers, FET based Biosensor- ion-sensitive field effect transistor-operation and fabrication-Characteristics and Performance.

TOTAL: 45 PERIODS
COURSE OUTCOMES:
Upon completion of this course, the students will be able to

CO1: Understand the basic concepts of nano electronics and various aspects of nano electronics. (K2)

CO2: Summarize the basic knowledge of Semiconductor materials and carbon nano tubes. (K2)

CO3: Understand the basic concepts of MOS scaling. (K2)

CO4: understand the advanced nanoscale devices (K3)

CO5: Understand the Bio sensor devices. (K2)

REFERENCES
1. G.W. Hanson, Fundamentals of Nanoelectronics, Pearson, 2009.

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VL4252

VLSI TESTING

COURSE OBJECTIVES:
- to introduce the VLSI testing.
- to introduce logic and fault simulation and testability measures
- to study the test generation for combinational and sequential circuits
- to study the design for testability.
- to study the fault diagnosis

UNIT I  INTRODUCTION TO TESTING  9

UNIT II  LOGIC & FAULT SIMULATION & TESTABILITY MEASURES  9
UNIT III TEST GENERATION FOR COMBINATIONAL AND SEQUENTIAL CIRCUITS

UNIT IV DESIGN FOR TESTABILITY

UNIT V FAULT DIAGNOSIS
Introduction and Basic Definitions – Fault Models for Diagnosis – Generation of Vectors for Diagnosis – Combinational Logic Diagnosis - Scan Chain Diagnosis – Logic BIST Diagnosis.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of this course, the students will be able to:
CO1: Understand VLSI Testing Process
CO2: Develop Logic Simulation and Fault Simulation
CO3: Develop Test for Combinational and Sequential Circuits
CO4: Understand the Design for Testability
CO5: Perform Fault Diagnosis.

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AP4092 EDGE ANALYTICS AND INTERNET OF THINGS

COURSE OBJECTIVES:
- To Understand the basis for intersection of IOT and Edge Analytics
- To Understand the IOT protocols and standards
• To comprehend the use of Machine Learning in Edge Analytics
• To gain understanding on the use of Deep Learning techniques for analytics
• To gain insight into edge analytics models and deployment

UNIT I INTRODUCTION TO IOT
Importance and Need for IoT - Application and Use cases of IoT - Overview of Industrial IoT - Intersection of IoT and Edge Analytics.

UNIT II IOT PROTOCOLS AND SYSTEMS
IoT protocols and standards - Cloud IoT Infrastructure - Setup and program IoT device- Data Collection from IoT device.

UNIT III MACHINE LEARNING AND ARTIFICIAL INTELLIGENCE
Introduction to Machine Learning and Artificial Intelligence - Overview of Deep Learning and Neural Networks- Introduction to Convolution Neural Networks.

UNIT IV AUTO ENCODERS AND ITS PROGRAMMING
Introduction to Recurrent Neural Networks- Introduction to Auto Encoders- Programming Practice: Build Image Classifier, Build Anomaly Detector

UNIT V EDGE ANALYTICS
Challenges with Edge Devices and Deployment - Need for Model Quantization Quantization Aware Training- Post Model Quantization- Programming Practice: Model quantization, Deploying model on Edge Devices

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, student will be able to
CO 1: Use the foundational concepts in Edge Analytics for application design and development
CO 2: Use IOT protocols in cloud environments.
CO 3: Implement and use Machine Learning and Artificial Intelligence algorithms and tools
CO 4: implement and use Deep Learning techniques for applications
CO 5: Analyze Edge devices analytics models and and its challenges

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AP4093 QUANTUM COMPUTING  
L T P C 3 0 0 3

COURSE OBJECTIVES:
- To introduce the building blocks of Quantum computers and highlight the paradigm change between conventional computing and quantum computing
- To understand the Quantum state transformations and the algorithms
- To understand entangled quantum subsystems and properties of entangled states
- To explore the applications of quantum computing

UNIT I QUANTUM BUILDING BLOCKS 9
The Quantum Mechanics of Photon Polarization, Single-Qubit Quantum Systems, Quantum State Spaces, Entangled States, Multiple-Qubit Systems, Measurement of Multiple-Qubit States, EPR Paradox and Bell's Theorem, Bloch sphere

UNIT II QUANTUM STATE TRANSFORMATIONS 9
Unitary Transformations, Quantum Gates, Unitary Transformations as Quantum Circuits, Reversible Classical Computations to Quantum Computations, Language for Quantum Implementations.

UNIT III QUANTUM ALGORITHMS 9
Computing with Superpositions, Quantum Subroutines, Quantum Fourier Transformations, Shor's Algorithm and Generalizations, Grover's Algorithm and Generalizations

UNIT IV ENTANGLED SUBSYSTEMS AND ROBUST QUANTUM COMPUTATION 9
Quantum Subsystems, Properties of Entangled States, Quantum Error Correction, Graph states and codes, CSS Codes, Stabilizer Codes, Fault Tolerance and Robust Quantum Computing

UNIT V QUANTUM INFORMATION PROCESSING 9

TOTAL : 45 PERIODS

COURSE OUTCOMES:
At the end of the course, the student will be able to
CO1: Understand the basic principles of quantum computing.
CO2: Gain knowledge of the fundamental differences between conventional computing and quantum computing.
CO3: Understand several basic quantum computing algorithms.
CO4: Understand the classes of problems that can be expected to be solved well by quantum computers.

CO5: Simulate and analyze the characteristics of Quantum Computing Systems.

REFERENCES:
1. John Gribbin, Computing with Quantum Cats: From Colossus to Qubits, 2021
2. William (Chuck) Easttom, Quantum Computing Fundamentals, 2021
3. Parag Lala, Quantum Computing, 2019

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CU4076 VLSI FOR WIRELESS COMMUNICATION

COURSE OBJECTIVES:
- To understand the concepts of basic wireless communication concepts.
- To study the parameters in receiver and low noise amplifier design.
- To study the various types of mixers designed for wireless communication.
- To study and design PLL and VCO.
- To understand the concepts of transmitters and power amplifiers in wireless communication.

UNIT I COMMUNICATION CONCEPTS

UNIT II RECEIVER ARCHITECTURE & LOW NOISE AMPLIFIERS
Receiver front end – Filter design – Non-idealities – Design parameters – Noise figure & Input intercept point. LNA Introduction – Wideband LNA design – Narrow band LNA design: Impedance matching & Core amplifier.
UNIT III  MIXERS

UNIT IV  FREQUENCY SYNTHESIZERS
PLL – Phase detector – Dividers – Voltage Controlled Oscillators – LC oscillators – Ring Oscillators – Phase noise – Loop filters & design approaches – A complete synthesizer design example (DECT) – Frequency synthesizer with fractional divider.

UNIT V  TRANSMITTER ARCHITECTURES & POWER AMPLIFIERS
Transmitter back end design – Quadrature LO generator – Power amplifier design.

COURSE OUTCOMES:
At the end of this course, the student should be able to
CO1: Able to recollect basic wireless communication concepts.
CO2: To understand the parameters in receiver and design a low noise amplifier
CO3: In a position to apply his knowledge on various types of mixers designed for wireless communication.
CO4: Design PLL and VCO
CO5: Understand the concepts of transmitters and utilize the power amplifiers in wireless communication.

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COURSE OBJECTIVES:
- To understand the operation of sensors and actuators
- To understand the operation of major classes of MEMS devices/systems
- To give the fundamentals of standard micro fabrication techniques and processes
- To understand the unique demands, environments and applications of MEMS devices
- To understand RF MEMS, Bio MEMS and MOEMS

UNIT I  INTRODUCTION TO MEMS

UNIT II  SENSORS AND ACTUATORS

UNIT III  MICROMACHINING

UNIT IV  POLYMER AND OPTICAL MEMS

UNIT V  OVERVIEW OF MEMS AREAS
Bonding techniques for MEMS : Surface bonding , Anodic bonding , Silicon - on - Insulator , wire bonding , Sealing – Assembly of micro systems- RF MEMS - switches, active and passive components, Bio MEMS - Microfluidics, Digital Micro fluidics, Ink jet printer,- MOEMS - optical switch, optical cross-connect, tunable VCSEL, micro bolometers.

TOTAL : 45 PERIODS

SUGGESTED ACTIVITIES:
1. Expose the students to occupational environment related to semiconductor devices and MEMS
2. Create opportunity for acquiring practical skills of various field instruments in the area of
MEMS devices
3. Manage the issues arising during the execution of projects related to MEMS.

COURSE OUTCOMES:
At the end of the course the student will be able to:

CO1: Understand the working principles of micro sensors and actuators
CO2: Understand the application of scaling laws in the design of micro systems
CO3: Understand the typical materials used for fabrication of micro machines
CO4: Understand the principles of standard micro fabrication techniques
CO5: Appreciate the challenges in the design and fabrication of RF, Bio, and MOEMS systems

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AP4006 HARDWARE SECURE COMPUTING

COURSE OBJECTIVES
- Describe the fundamental principles in Data security
- Discuss the watermarking algorithms and its usage
- Explain the physical attacks and Modular arithmetic security methods
- Describe the memory based attacks and vulnerabilities using deceptive mechanisms
- Discuss the methods of FPGA implementation of cryptographic algorithms
UNIT I  INTRODUCTION TO CRYPTO ALGORITHMS  
Cryptography basics, Cryptographic algorithms - Symmetric Key algorithms, Public Key algorithms and Hash Algorithms, Data Encryption Standards, Advanced Encryption Standards, RSA, BowFish.

UNIT II  DESIGN INTELLECTUAL PROPERTY PROTECTION  

UNIT III  PHYSICAL ATTACKS AND MODULAR EXPONENTIATION  
Physical Attacks (PA) Basics, Physical Attacks and Countermeasures, Building Secure Systems, Modular Exponentiation (ME) Basics, ME in Cryptography, ME Implementation and Vulnerability, Montgomery Reduction.

UNIT IV  ATTACKS AND COUNTER MEASURES  
Introduction to Side Channel Attacks, Memory Vulnerabilities and Cache Attacks, Power Analysis, More Attacks and Countermeasures, Modified Modular Exponentiation, Hardware Trojan (HT) and Trusted IC, Hardware Trojan Taxonomy, Hardware Trojan Detection Overview, Hardware Trojan Detection Methods, Trusted IC Design with HT Prevention.

UNIT V  EMERGING TECHNOLOGIES  
FPGA Implementation of Crypto algorithms, Vulnerabilities and Countermeasures in FPGA Systems, Role of Hardware in Security and Trust, Physical Unclonable Functions (PUF) Basics, Reliability, Trust Platform Modules

TOTAL : 45 PERIODS

COURSE OUTCOMES

Upon completion the students will be able to

CO1: Understand the basics of Cryptography (K2)
CO2: Identify the mechanism of Data Integrity protection mechanisms (K2)
CO3: Analyse the counter measures for physical attacks and the use of Modular exponentiation (K2)
CO4: Study side channel attacks and Trojan-based attacks (K2)
CO5: Challenges in Realisation using VLSI implementations (K2)

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COURSE OBJECTIVES:
- to introduce the VLSI design methodologies and design methods.
- to introduce data structures and algorithms required for VLSI design.
- to study algorithms for partitioning and placement.
- to study algorithms for floor planning and routing.
- to study algorithms for modelling, simulation and synthesis.

UNIT I INTRODUCTION

UNIT II DATA STRUCTURES AND BASIC ALGORITHMS

UNIT III ALGORITHMS FOR PARTITIONING AND PLACEMENT

UNIT IV ALGORITHMS FOR FLOORPLANNING AND ROUTING

UNIT V MODELLING, SIMULATION AND SYNTHESIS

TOTAL: 45 PERIODS
COURSE OUTCOMES:
At the end of this course, the students should be able to:
CO1: use various VLSI design methodologies
CO2: understand different data structures and algorithms required for VLSI design.
CO3: develop algorithms for partitioning and placement.
CO4: develop algorithms for floorplanning and routing.
CO5: design algorithms for modelling, simulation and synthesis.

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AP4073 SENSORS AND ACTUATORS L T P C 3 0 0 3

COURSE OBJECTIVES:
- Understand static and dynamic characteristics of measurement systems.
- Study various types of sensors.
- Study different types of actuators and their usage.
- Study State-of-the-art digital and semiconductor sensors.

UNIT I INTRODUCTION TO MEASUREMENT SYSTEMS
Introduction to measurement systems: general concepts and terminology, measurement systems, sensor classification, general input-output configuration, methods of correction, performance characteristics: static and dynamic characteristics of measurement systems, zero-order, first-order, and second-order measurement systems and response.
UNIT II
RESISTIVE AND REACTIVE SENSORS
9
Resistive sensors: potentiometers, strain gages, resistive temperature detectors, magneto resistors, light-dependent resistors, Signal conditioning for resistive sensors: Wheatstone bridge, sensor bridge calibration and compensation, Instrumentation amplifiers, sources of interference and interference reduction, Reactance variation and electromagnetic sensors, capacitive sensors, differential, inductive sensors, linear variable differential transformers (LVDT), magneto elastic sensors, hall effect sensors, Signal conditioning for reactance-based sensors & application to LVDT.

UNIT III
SELF-GENERATING SENSORS
9

UNIT IV
ACTUATORS DRIVE CHARACTERISTICS AND APPLICATIONS
9
Relays, Solenoid drive, Stepper Motors, Voice-Coil actuators, Servo Motors, DC motors and motor control, 4-to-20 mA Drive, Hydraulic actuators, variable transformers: synchros, resolvers, Inductosyn, resolver-to-digital and digital-to-resolver converters.

UNIT V
DIGITAL SENSORS AND SEMICONDUCTOR DEVICE SENSORS
9
Digital sensors: position encoders, variable frequency sensors – quartz digital thermometer, vibrating wire strain gages, vibrating cylinder sensors, Sensors based on semiconductor junctions: thermometers based on semiconductor junctions, magneto diodes and magneto transistors, MOSFET transistors, CCD imaging sensors, ultrasonic sensors, fiber-optic sensors.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of the course the student will be able to:
CO1: Compare Actuators with various drive characteristics.
CO2: Evaluate digital sensors and semiconductor device sensors performance metrics.
CO3: Characterize the performance of Self-generating sensors.
CO4: Analyze the performance of self-generating Sensors.
CO5: Analyze the performance of resistive and reactive sensors.

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**AP4095**  
**SIGNAL INTEGRITY FOR HIGH SPEED DESIGN**  
LTPC  
3 0 0 3

**COURSE OBJECTIVES:**

- To identify sources affecting the speed of digital circuits.
- To introduce methods to improve the signal transmission characteristics

**UNIT I**  
**SIGNAL PROPAGATION ON TRANSMISSION LINES**  
9
Transmission line equations, wave solution, wave vs. circuits, initial wave, delay time, Characteristic impedance, wave propagation, reflection, and bounce diagrams Reactive terminations – L, C , static field maps of micro strip and strip line cross-sections, per unit length parameters, PCB layer stackups and layer/Cu thicknesses, cross-sectional analysis tools, Zo and Td equations for microstrip and stripline Reflection and terminations for logic gates, fan-out, logic switching, input impedance into a transmission-line section, reflection coefficient, skin-effect, dispersion.

**UNIT II**  
**MULTI-CONDUCTOR TRANSMISSION LINES AND CROSS-TALK**  
9
Multi-conductor transmission-lines, coupling physics, per unit length parameters, Near and far-end cross-talk, minimizing cross-talk (stripline and microstrip) Differential signalling, termination, balanced circuits, S-parameters, Lossy and Lossless models.

**UNIT III**  
**NON-IDEAL EFFECTS**  
9
Non-ideal signal return paths – gaps, BGA fields, via transitions, Parasitic inductance and capacitance, Transmission line losses – Rs, tanδ, routing parasitic, Common-mode current, differential-mode current, Connectors.

**UNIT IV**  
**POWER CONSIDERATIONS AND SYSTEM DESIGN**  
9
SSN/SSO, DC power bus design, layer stack up, SMT decoupling, Logic families, power consumption, and system power delivery, Logic families and speed Package types and parasitic
SPICE, IBIS models, Bit streams, PRBS and filtering functions of link-path components, Eye diagrams, jitter, inter-symbol interference Bit-error rate, Timing analysis.

UNIT V  CLOCK DISTRIBUTION AND CLOCK OSCILLATORS
Timing margin, Clock slew, low impedance drivers, terminations, Delay Adjustments, canceling parasitic capacitance, Clock jitter.

TOTAL : 45 PERIODS

COURSE OUTCOMES:
At the end of the course the student will be able to
CO1: identify sources affecting the speed of digital circuits.
CO2: identify methods to improve the signal transmission characteristics
CO3: characterise and model multiconductor transmission line
CO4: analyse clock distribution system and understand its design parameters
CO5: analyse nonideal effects of transmission line

REFERENCES

TOOLS REQUIRED
1. SPICE, source - http://www-cad.eecs.berkeley.edu/Software/software.html
3. SPECTRAQUEST from Cadence, http://www.specctraquest.com or any equivalent open source tool

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COURSE OBJECTIVES:
- To acquaint the students with the construction, theory and operation of the basic electronic devices such as PN junction diode, Bipolar and Field Effect Transistors, Power control devices etc.,
- To know about the working principle of LED, LCD and other Opto-electronic devices.
- To introduce the concept of Sensors and voice controls.
- To provide the knowledge on Smart home devices.
- To gain knowledge on current communication technology.

UNIT I  CONSUMER ELECTRONICS FUNDAMENTALS  9

UNIT II  ENTERTAINMENT ELECTRONICS  9

UNIT III  SMART HOME - SENSORS  9

UNIT IV  HOME APPLIANCES  9
Home Enablement Systems: RFID Home, Lighting control, Automatic Cleaning Robots, Washing Machines, Kitchen Electronics- Microwave, Dishwasher, Induction Stoves, Smart Refrigerators, Smart alarms, Smart toilet, Smart floor, Smart locks.

UNIT V  INTRODUCTION TO SMART OS AND COMMUNICATION  9
Introduction to Smart OS- Android and iOS. Video Conferencing Systems- Web/IP Camera, Video security, Internet Enabled Systems, Wi-Fi, IoT, Li-Fi, GPS and Tracking Systems. Cordless Telephones, Fax Machines, PDAs- Tablets, Smart Phones and Smart Watches.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon successful completion of this course students will be able to

CO1: Explain the V-I characteristic of diode, UJT and SCR. Describe the equivalence circuits of transistors.
CO2: Operate the basic electronic devices such as PN junction diode, Bipolar and Field Effect Transistors, Power control devices, LED, LCD and other Opto-electronic devices.
CO3: Gain knowledge on sensors and controls.
CO4: Emphasize the need for communication systems.
CO5: Explore the current technology and apply on home applications.
REFERENCES:
5. Nick Vandome, Smart homes in easy steps, - Master smart technology for your home 2018.

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AP4008 ADVANCED MICROPROCESSORS AND MICROCONTROLLERS L T P C
ARCHITECTURES 3 0 0 3

COURSE OBJECTIVES:
- To expose the students to the fundamentals of microprocessor architecture.
- To explore the high performance features in CISC architecture
- To familiarize the high performance features in RISC architecture
- To introduce the basic features in Motorola microcontrollers.
- To enable the students to understand PIC Microcontroller

UNIT I MICROPROCESSOR ARCHITECTURE

UNIT II HIGH PERFORMANCE CISC ARCHITECTURE – PENTIUM

UNIT III HIGH PERFORMANCE RISC ARCHITECTURE – ARM
Organization of CPU – Bus architecture – Memory management unit - ARM instruction set- Thumb Instruction set- addressing modes – Programming the ARM processor.
UNIT IV   MSP430 16-BIT MICROCONTROLLER

UNIT V   PIC MICROCONTROLLER

COURSE OUTCOMES:
At the end of the course the student will be able to
CO1: To understand the fundamentals of microprocessor architecture.
CO2: To know and appreciate the high performance features in CISC architecture.
CO3: To know and appreciate the high performance features in RISC architecture.
CO4: To perceive the basic features in Motorola microcontrollers.
CO5: To interpret and understand PIC Microcontroller.

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TOTAL: 45 PERIODS
COURSE OBJECTIVES:

- Describe the properties and suitable models of biomedical signals
- Introduce the basic signal processing techniques in analyzing biomedical signals
- Develop computational skills in filtering of biomedical signals
- Develop an understanding on ECG signal compression algorithms
- Develop an understanding on feature extraction of biomedical signals

UNIT I INTRODUCTION TO BIOMEDICAL SIGNALS

Introduction to Biomedical Signals: The nature of Biomedical Signals, Examples of Biomedical Signals, Objectives and difficulties in Biomedical analysis. Electrocardiography: Basic electrocardiography, ECG lead systems, ECG signal characteristics. Signal Conversion: Simple signal conversion systems, Conversion requirements for biomedical signals, Signal conversion circuits.

UNIT II SIGNAL AVERAGING

Signal Averaging: Basics of signal averaging, signal averaging as a digital filter, a typical averager, software for signal averaging, limitations of signal averaging. Adaptive Noise Cancelling: Principal noise canceller model, 60-Hz adaptive cancelling using a sine wave model, other applications of adaptive filtering.

UNIT III DATA COMPRESSION TECHNIQUES

Data Compression Techniques: Turning point algorithm, AZTEC algorithm, Fan algorithm, Huffman coding, data reduction algorithms The Fourier transform, Correlation, Convolution, Power spectrum estimation, Frequency domain analysis of the ECG.

UNIT IV CARDIOLOGICAL SIGNAL PROCESSING

Cardiological signal processing: Basic Electrocardiography, ECG data acquisition, ECG lead system, ECG signal characteristics (parameters and their estimation), Analog filters, ECG amplifier, and QRS detector, Power spectrum of the ECG, Bandpass filtering techniques, Differentiation techniques, Template matching techniques, A QRS detection algorithm, Realtime ECG processing algorithm, ECG interpretation, ST segment analyzer, Portable arrhythmia monitor.

UNIT V NEUROLOGICAL SIGNAL PROCESSING

Neurological signal processing: The brain and its potentials, The electrophysiological origin of brain waves, The EEG signal and its characteristics (EEG rhythms, waves, and transients), Correlation. Analysis of EEG channels: Detection of EEG rhythms, Template matching for EEG, spike and wave detection.

COURSE OUTCOMES:

At the end of this course the student will be able to

CO1: Possess skills necessary to analyze ECG and EEG Signals
CO2: Apply classical and modern filtering techniques for ECG and EEG Signals
CO3: Apply classical and modern compression techniques for ECG and EEG Signals
CO4: Develop an understanding on ECG feature extraction
CO5: Develop an understanding on EEG feature extraction

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AP4010 MODELING AND SYNTHESIS WITH HDL

COURSE OBJECTIVES:
- To know the basic language features of Verilog HDL and its role in digital logic design.
- To know the behavioural modeling of combinational and sequential circuits.
- To know the behavioural modeling of algorithmic state machines.
- To know the synthesis of combinational and sequential descriptions.
- To know the architectural features of programmable logic devices.

UNIT I INTRODUCTION TO LOGIC DESIGN WITH VERILOG

Overview of Digital Design with Verilog HDL - Hierarchical Modeling Concepts: Top-down and bottom-up design methodology, differences between modules and module instances, parts of a simulation, design block, stimulus block - Basic Concept- Modules and Ports: Module definition, port declaration, connecting ports, hierarchical name referencing. Tasks and Functions
UNIT II  LEVELS OF MODELING

Gate-Level Modeling: Modeling using basic Verilog gate primitives, description of and/or and but/not type gates, rise, fall and turn-off delays, min, max, and typical delays. Dataflow Modeling: Continuous assignments, delay specification, expressions, operators, operands, operator types. Behavioral Modeling: Structured procedures, initial and always, blocking and nonblocking statements, delay control, generate statement, event control, conditional statements, multiway branching, loops, sequential and parallel blocks.

UNIT III  DESIGN OF DIGITAL LOGIC USING HDL

Design of combinational logic: adders, multiplexers, de-multiplexers, encoders and decoders, comparators, multipliers - Design of Sequential logic: Flip-flops, synchronous and asynchronous counters, shift registers, Universal shift register, FSM and LFSR. (Using various Levels of Modeling)

UNIT IV  LOGIC SYNTHESIS AND DESIGN FLOW

Logic Synthesis with verilog HDL-Synthesis Design flow, RTL and Test Bench Modeling Techniques and Timing and Path Delay Modeling, Timing Checks, Switch Level Modeling

UNIT V  PROGRAMMABLE LOGIC DEVICES

Programmable logic devices, storage devices, programmable logic array programmable array logic, programmability of PLDs CPLDs.

PRACTICAL EXERCISES: 30 PERIODS

1. Design Entry Using VHDL Or Verilog Using HDL Languages of
   I. Combinational Circuits Namely 8:1 Mux/Demux, Full Adder, 8-Bit Magnitude Comparator, Encoder/Decoder, Priority Encoder.
   II. Sequential Circuits Namely D-FF, 4-Bit Shift Registers (SISO, SIPO, PISO, Bidirectional), 3-Bit Synchronous Counters.
2. Test Vector Generation And Timing Analysis of Sequential And Combinational Logic Design for exercise (1) above.
3. FPGA Implementation of PCI Bus & Arbiter.

   Verifying Design Functionality Using Either Chipscope Feature (Xilinx) / the Signal Tap Feature (Altera)/ Other Equivalent Feature. Invoke the PLL And Demonstrate the Use of the PLL Module for Clock Generation in FPGAs.

COURSE OUTCOMES:

After successful completion of the course, the students are able to

CO1: demonstrate knowledge on HDL design flow and digital circuits design.
CO2: design and develop the combinational and sequential circuits using various modeling
CO3: solving algorithmic state machines using hardware description language
CO4: analyze the process of synthesizing the combinational and sequential descriptions
CO5: know the advantages of programmable logic devices and their description in Verilog

TOTAL: 45 +30=75 PERIODS
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IF4071 DEEP LEARNING L T P C 3 0 2 4

COURSE OBJECTIVES:
- Develop and Train Deep Neural Networks.
- Develop a CNN, R-CNN, Fast R-CNN, Faster-R-CNN, Mask-RCNN for detection and recognition
- Build and train RNNs, work with NLP and Word Embeddings
- The internal structure of LSTM and GRU and the differences between them
- The Auto Encoders for Image Processing

UNIT I DEEP LEARNING CONCEPTS 6

UNIT II NEURAL NETWORKS 9

UNIT III CONVOLUTIONAL NEURAL NETWORK 10

UNIT VI  NATURAL LANGUAGE PROCESSING USING RNN

UNIT V  DEEP REINFORCEMENT & UNSUPERVISED LEARNING

LIST OF EXPERIMENTS:
1: Feature Selection from Video and Image Data
2: Image and video recognition
3: Image Colorization
4: Aspect Oriented Topic Detection & Sentiment Analysis
5: Object Detection using Autoencoder

COURSE OUTCOMES:
CO1: Feature Extraction from Image and Video Data
CO2: Implement Image Segmentation and Instance Segmentation in Images
CO3: Implement image recognition and image classification using a pretrained network (Transfer Learning)
CO4: Traffic Information analysis using Twitter Data
CO5: Autoencoder for Classification & Feature Extraction

TOTAL : 45+30=75 PERIODS

REFERENCES
1. Deep Learning A Practitioner’s Approach Josh Patterson and Adam Gibson O'Reilly Media, Inc.2017
2. Learn Keras for Deep Neural Networks, Jojo Moolayil, Apress,2018
4. Deep Learning with Python, FRANÇOIS CHOLLET, MANNING SHELTER ISLAND, 2017

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AP4011 ADVANCED DIGITAL IMAGE PROCESSING L T P C 3 0 2 4

COURSE OBJECTIVES:

- To understand the image fundamentals and mathematical transforms necessary for image processing and to study the image enhancement techniques.
- To understand the image segmentation and representation techniques.
- To understand how image are analyzed to extract features of interest.
- To introduce the concepts of image registration and image fusion.
- To analyze the constraints in image processing when dealing with 3D data sets.

UNIT I FUNDAMENTALS OF DIGITAL IMAGE PROCESSING 9

Elements of visual perception, brightness, contrast, hue, saturation, mach band effect, 2D image transforms-DFT, DCT, KLT, and SVD. Image enhancement in spatial and frequency domain, Morphological image processing.

UNIT II SEGMENTATION 9

Edge detection, Thresholding, Region growing, Fuzzy clustering, Watershed algorithm, Active contour methods, Texture feature-based segmentation, Model based segmentation, Atlas based segmentation, Wavelet based Segmentation methods.

UNIT III FEATURE EXTRACTION 9

First and second order edge detection operators, Phase congruency, Localized feature extraction-detecting image curvature, shape features Hough transform, shape skeletonization, Boundary descriptors, Moments, Texture descriptors- Autocorrelation, Co-occurrence features, Run length features, Fractal model-based features, Gabor filter, wavelet features.

UNIT IV REGISTRATION AND IMAGE FUSION 9

Registration- Pre-processing, Feature selection-points, lines, regions and templates Feature Correspondence-Point pattern matching, Line matching, region matching Template matching. Transformation functions-Similarity transformation and Affine Transformation. Resampling- Nearest Neighbour and Cubic Splines Image Fusion-Overview of image fusion, pixel fusion, Multiresolution based fusion discrete wavelet transforms, Curvelet transform. Region based fusion.
UNIT V  3D IMAGE VISUALIZATION

Sources of 3D Data sets, Slicing the Data set, Arbitrary section planes, The use of color, Volumetric display, Stereo Viewing, Ray tracing, Reflection, Surfaces, multiply connected surfaces, Image processing in 3D, Measurements on 3D images.

PRACTICALS:
1. Wavelet and DCT based Image Compression
2. Geometrical transformations and Interpolation of Images
3. Edge Detection using Canny edge detector
4. Region based, threshold based and Watershed Segmentation
5. Image filtering using DFT
6. Texture, Gabor and Wavelet Feature Extraction
7. Image fusion using Wavelets
9. Segmentation of Lungs from 3D- Chest Scan.

COURSE OUTCOMES:
Upon Completion of the course, the students will be able to
CO1: To understand image formation and the role of human visual system plays in perception of gray and color image data.
CO2: To apply image processing techniques in both the spatial and frequency (Fourier) domains.
CO3: To design image analysis techniques in the form of image segmentation and to evaluate the methodologies for segmentation.
CO4: To conduct independent study and analysis of feature extraction techniques.
CO5: To understand the concepts of image registration and image fusion.
CO6: To analyze the constraints in image processing when dealing with 3D data sets and to apply image processing algorithms in practical applications.

TOTAL: 45+30=75 PERIODS

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### AP4072 PCB DESIGN L T P C 3 0 2 4

**COURSE OBJECTIVES:**
- Understand the need for PCB Design and steps involved in PCB Design and Fabrication process.
- Familiarize Schematic and layout design flow using Electronic Design Automation (EDA) Tools.
- Understand basic concepts of transmission line, crosstalk and thermal issues.
- Design (schematic and layout) PCB for analog circuits, digital circuits and mixed circuits.
- Schematic creation & interpretation.

**UNIT I** INTRODUCTION TO PRINTED CIRCUIT BOARD 9

**Introduction to Printed circuit board:** fundamental of electronic components, basic electronic circuits, Basics of printed circuit board designing: Layout planning, general rules and parameters, ground conductor considerations, thermal issues, check and inspection of artwork.

**UNIT II** DESIGN RULES FOR PCB 9

**Design rules for PCB**: Design rules for Digital circuit PCBs, Analog circuit PCBs, high frequency and fast pulse applications, Power electronic applications, Microwave applications.

**PCB Technology Trends**: Multilayer PCBs. Multiwire PCB, Flexible PCBs, Surface mount PCBs, Reflow soldering, Introduction to High-Density Interconnection (HDI) Technology.

**UNIT III** INTRODUCTION TO ELECTRONIC DESIGN AUTOMATION(EDA) TOOLS FOR PCB DESIGNING 9

**Introduction to Electronic design automation(EDA) tools for PCB designing**: Brief Introduction of various simulators,SPICE and PSPICE Environment, Selecting the Components Footprints as per design, Making New Footprints, Assigning Footprint to components, Net listing, PCB Layout Designing, Auto routing and manual routing. Assigning specific text (silkscreen) to design, Creating report of design, creating manufacturing data (GERBER) for design.
UNIT IV  INTRODUCTION PRINTED CIRCUIT BOARD PRODUCTION TECHNIQUES

Introduction printed circuit board production techniques: Photo printing, film-master production, reprographic camera, basic process for double sided PCBs photo resists, Screen printing process, plating, relative performance and quality control, Etching machines, Solders alloys, fluxes, soldering techniques, Mechanical operations

UNIT V  PCB DESIGN FOR EMI/EMC

PCB design for EMI/EMC: Subsystem/PCB Placement in an enclosure, Filtering circuit placement, decoupling and bypassing, Electronic discharge protection, Electronic waste; Printed circuit boards Recycling techniques, Introduction to Integrated Circuit Packaging and footprints, NEMA and IPC standards.

SUGGESTED ACTIVITIES:

1. Using any Electronic design automation (EDA) software, Practice following PCB Design steps (Open source EDA Tool KiCad Preferable or equivalent ) Example circuit: Basic RC Circuit  
   Schematic Design: Familiarization of the Schematic Editor, Schematic creation, Annotation, Netlist generation  
   Layout Design: Familiarization of Footprint Editor, Mapping of components, Creation of PCB layout Schematic  
   Create new schematic components  
   Create new component footprints.
2. Fabricate single-sided PCB, mount the components and assemble in a cabinet for any one of the circuits mentioned below.
4. Astable or Monostable multivibrator using IC555
5. RC Phase-shift or Wein-bridge Oscillator using transistor.
6. 4 bit binary /MOD N counter using D-Flip flops.
7. Design a 8051 Development board having  
   Power section consisting of IC7805, capacitor, resistor, headers, LED,Serial communication section consisting of MAX 232, Capacitors,DB9 connector, Jumper, LEDs. Reset & Input/ output sections consisting of89C51 Microcontroller, Electrolytic Capacitor, Resistor, Jumper, Crystal Oscillator, Capacitors.
8. Touch plate switches – transistorized or 555 based
9. Doorbell/cordless bell
10. Clapping switch and IR switch
11. Blinkers
12. Cell charger, battery charger, mobile charger
13. Fire/smoke/intruder alarm
14. Liquid level controller
15. Audio amplifiers

COURSE OUTCOMES:

Upon the completion of this course, students will demonstrate the ability to:
CO1: Appreciate the necessity and evolution of PCB, types and classes of PCB.
CO2: Understand the steps involved in schematic, layout, fabrication and assembly process of PCB design.
CO3: Apply advanced techniques, skills and modern tools for designing and fabrication of PCBs.
CO4: Apply the knowledge and techniques to fabricate Multilayer, SMT and HDI PCB.
CO5: Design (schematic and layout) and fabricate PCB for simple circuits.
TOTAL : 45+30=75 PERIODS

REFERENCES

1. Printed circuit board design, fabrication assembly and testing By R. S. Khandpur, Tata McGraw Hill 2006
5. EMC and Printed circuit board ,Design theory and layout, Mark I Montrose IEEE compatibility society
10. PCB Fabrication at home(video): https://www.youtube.com/watch?v=mv7Y0A9YeUc
11. https://www.youtube.com/watch?v=imQTCW1yWkg

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AUDIT COURSES

AX4091 ENGLISH FOR RESEARCH PAPER WRITING

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COURSE 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

COURSE 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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CO-PO Mapping
**COURSE 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: Governmental and Community Preparedness.

**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

**COURSE 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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AX4093

CONSTITUTION OF INDIA

COURSE 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 nationhood 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.

COURSE 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.

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TOTAL: 30 PERIODS
UNIT I

1. தமிழின் துவக்க நூல் - எழுத்து, தொல், தபொருள்
2. அகநூறு (82)

UNIT II

1. அறதநறி
2. பிற அறநூல்கள
3. புறநூறு (95, 195)

UNIT III

1. கணணகியின் புரட்சி - சிலப்பதிகொரவழக்குகரகொத்த
2. மூக்கவிளக்கியிலக்கியம்

UNIT IV

1. சிறுபொணொற்றுப்பகட - பொரி முல்கலக்குத்தகொடுத்தது, பபகன் மயிலுக்குப் பபொர்கவதகொடுத்தது, அதியமொன் ஒளகவக்குத்தகொடுத்தது, அர ர் பணபுகள்
2. நற்றிகண (4)
3. நற்றிகண (11)
4. புறநொனூறு (4094)
UNIT V INTEGRATED WATER RESOURCES MANAGEMENT

1. Conceptual Framework of IWRM,
   - Definition of IWRM within the broader context of development,
   - Key elements of IWRM - Principles - Paradigm shift in water management - Complexity of the IWRM process - UN World Water Assessment - SDGs.

2. Water as a global issue: key challenges
3. Complexity of the IWRM process
4. UN World Water Assessment
5. Principles of IWRM
6. Paradigm shift in water management
7. Complexity of the IWRM process

TOTAL: 30 PERIODS

OPEN ELECTIVES

OCE431 INTEGRATED WATER RESOURCES MANAGEMENT

OBJECTIVE
- Students will be introduced to the concepts and principles of IWRM, which is inclusive of the economics, public-private partnership, water & health, water & food security and legal & regulatory settings.

UNIT I CONTEXT FOR IWRM
Water as a global issue: key challenges – Definition of IWRM within the broader context of development – Key elements of IWRM - Principles – Paradigm shift in water management - Complexity of the IWRM process – UN World Water Assessment - SDGs.
UNIT II  WATER ECONOMICS  9
Economic view of water issues: economic characteristics of water good and services – Non-market monetary valuation methods – Water economic instruments – Private sector involvement in water resources management: PPP objectives, PPP models, PPP processes, PPP experiences through case studies.

UNIT III  LEGAL AND REGULATORY SETTINGS  9
Basic notion of law and governance: principles of international and national law in the area of water management - Understanding UN law on non-navigable uses of international water courses – International law for groundwater management – World Water Forums – Global Water Partnerships - Development of IWRM in line with legal and regulatory framework.

UNIT IV  WATER AND HEALTH WITHIN THE IWRM CONTEXT  9
Links between water and health: options to include water management interventions for health – Health protection and promotion in the context of IWRM – Global burden of Diseases - Health impact assessment of water resources development projects – Case studies.

UNIT V  AGRICULTURE IN THE CONCEPT OF IWRM  9
Water for food production: ‘blue’ versus ‘green’ water debate – Water foot print - Virtual water trade for achieving global water and food security — Irrigation efficiencies, irrigation methods - current water pricing policy– scope to relook pricing.

TOTAL: 45 PERIODS

OUTCOMES
• On completion of the course, the student is expected to be able to

| CO1 | Describe the context and principles of IWRM; Compare the conventional and integrated ways of water management. |
| CO2 | Select the best economic option among the alternatives; illustrate the pros and cons of PPP through case studies. |
| CO3 | Apply law and governance in the context of IWRM. |
| CO4 | Discuss the linkages between water-health; develop a HIA framework. |
| CO5 | Analyse how the virtual water concept pave way to alternate policy options. |

REFERENCES:
OBJECTIVES:

- Understand the accelerating health impacts due to the present managerial aspects and initiatives in water and sanitation and health sectors in the developing scenario.

UNIT I  FUNDAMENTALS WASH  9
Meanings and Definition: Safe Water- Health, Nexus: Water- Sanitation - Health and Hygiene – Equity issues-Water security - Food Security. Sanitation And Hygiene (WASH) and Integrated Water Resources Management (IWRM) - Need and Importance of WASH.

UNIT II  MANAGERIAL IMPLICATIONS AND IMPACT  9

UNIT III  CHALLENGES IN MANAGEMENT AND DEVELOPMENT  9

UNIT IV  GOVERNANCE  9
Public health -Community Health Assessment and Improvement Planning (CHA/CHIP)- Infrastructure and Investments on Water, (WASH) - Cost Benefit Analysis – Institutional Intervention-Public Private Partnership - Policy Directives - Social Insurance -Political Will vs Participatory Governance -

UNIT V  INITIATIVES  9
Management vs Development -Accelerating Development- Development Indicators -Inclusive Development-Global and Local- Millennium Development Goal (MDG) and Targets - Five Year Plans - Implementation - Capacity Building - Case studies on WASH.

TOTAL: 45 PERIODS

OUTCOMES:

| CO1 | Capture to fundamental concepts and terms which are to be applied and understood all through the study. |
| CO2 | Comprehend the various factors affecting water sanitation and health through the lens of third world scenario. |
| CO3 | Critically analyse and articulate the underlying common challenges in water, sanitation and health. |
| CO4 | Acquire knowledge on the attributes of governance and its say on water sanitation and health. |
| CO5 | Gain an overarching insight into the aspects of sustainable resource management in the absence of a clear level playing field in the developmental aspects. |

REFERENCES


OBJECTIVES:

- To impart knowledge on environmental, social and economic dimensions of sustainability and the principles evolved through landmark events so as to develop an action mindset for sustainable development.

UNIT I SUSTAINABILITY AND DEVELOPMENT CHALLENGES

UNIT II PRINCIPLES AND FRAMEWORK

UNIT III SUSTAINABLE DEVELOPMENT AND WELLBEING

UNIT IV SUSTAINABLE SOCIO-ECONOMIC SYSTEMS
Sustainable Development Goals and Linkage to Sustainable Consumption and Production – Investing in Natural Capital- Agriculture, Forests, Fisheries - Food security and nutrition and sustainable agriculture- Water and sanitation - Biodiversity conservation and Ecosystem integrity –
UNIT V ASSESSING PROGRESS AND WAY FORWARD


TOTAL: 45 PERIODS

OUTCOMES:
- On completion of the course, the student is expected to be able to

| CO1 | Explain and evaluate current challenges to sustainability, including modern world social, environmental, and economic structures and crises. |
| CO2 | Identify and critically analyze the social environmental, and economic dimensions of sustainability in terms of UN Sustainable development goals |
| CO3 | Develop a fair understanding of the social, economic and ecological linkage of Human well being, production and consumption |
| CO4 | Evaluate sustainability issues and solutions using a holistic approach that focuses on connections between complex human and natural systems |
| CO5 | Integrate knowledge from multiple sources and perspectives to understand environmental limits governing human societies and economies and social justice dimensions of sustainability. |

REFERENCES:

OCE434 ENVIRONMENTAL IMPACT ASSESSMENT

OBJECTIVES:
- To make the students to understand environmental clearance, its legal requirements and to provide knowledge on overall methodology of EIA, prediction tools and models, environmental management plan and case studies.

UNIT I INTRODUCTION

Historical development of Environmental Impact Assessment (EIA). Environmental Clearance- EIA

UNIT II IMPACT IDENTIFICATION AND PREDICTION 10

UNIT III SOCIO-ECONOMIC IMPACT ASSESSMENT 8
Socio-economic impact assessment - relationship between social impacts and change in community and institutional arrangements. factors and methodologies- individual and family level impacts. communities in transition-rehabilitation

UNIT IV EIA DOCUMENTATION AND ENVIRONMENTAL MANAGEMENT PLAN 9
Environmental management plan - preparation, implementation and review – mitigation and rehabilitation plans – policy and guidelines for planning and monitoring programmes – post project audit – documentation of EIA findings – ethical and quality aspects of environmental impact assessment

UNIT V CASE STUDIES 9
Mining, power plants, cement plants, highways, petroleum refining industry, storage & handling of hazardous chemicals, common hazardous waste facilities, CETPs, CMSWMF, building and construction projects

TOTAL: 45 PERIODS

OUTCOMES:
- On completion of the course, the student is expected to be able to

| CO1 | Understand need for environmental clearance, its legal procedure, need of EIA, its types, stakeholders and their roles |
| CO2 | Understand various impact identification methodologies, prediction techniques and model of impacts on various environments |
| CO3 | Understand relationship between social impacts and change in community due to development activities and rehabilitation methods |
| CO4 | Document the EIA findings and prepare environmental management and monitoring plan |
| CO5 | Identify, predict and assess impacts of similar projects based on case studies |

REFERENCES:
1. EIA Notification 2006 including recent amendments, by Ministry of Environment, Forest and Climate Change, Government of India
2. Sectoral Guidelines under EIA Notification by Ministry of Environment, Forest and Climate Change, Government of India
5. Lee N. and George C. 2000. Environmental Assessment in Developing and Transitional
OIC431 BLOCKCHAIN TECHNOLOGIES

COURSE OBJECTIVES:
- This course is intended to study the basics of Blockchain technology.
- During this course the learner will explore various aspects of Blockchain technology like application in various domains.
- By implementing, learners will have idea about private and public Blockchain, and smart contract.

UNIT I INTRODUCTION OF CRYPTOGRAPHY AND BLOCKCHAIN
Introduction to Blockchain, Blockchain Technology Mechanisms & Networks, Blockchain Origins, Objective of Blockchain, Blockchain Challenges, Transactions and Blocks, P2P Systems, Keys as Identity, Digital Signatures, Hashing, and public key cryptosystems, private vs. public Blockchain.

UNIT II BITCOIN AND CRYPTOCURRENCY

UNIT III INTRODUCTION TO ETHEREUM
Introduction to Ethereum, Consensus Mechanisms, Metamask Setup, Ethereum Accounts, Transactions, Receiving Ethers, Smart Contracts.

UNIT-IV INTRODUCTION TO HYPERLEADER AND SOLIDITY PROGRAMMING

UNIT V BLOCKCHAIN APPLICATIONS
Internet of Things, Medical Record Management System, Domain Name Service and Future of Blockchain, Alt Coins.

COURSE OUTCOMES:
After the completion of this course, student will be able to
CO1: Understand and explore the working of Blockchain technology
CO2: Analyze the working of Smart Contracts
CO3: Understand and analyze the working of Hyperledger
CO4: Apply the learning of solidity to build de-centralized apps on Ethereum
CO5: Develop applications on Blockchain
REFERENCES:

OIC432 DEEP LEARNING

COURSE OBJECTIVES:
- Develop and Train Deep Neural Networks.
- Develop a CNN, R-CNN, Fast R-CNN, Faster-R-CNN, Mask-RCNN for detection and recognition
- Build and train RNNs, work with NLP and Word Embeddings
- The internal structure of LSTM and GRU and the differences between them
- The Auto Encoders for Image Processing

UNIT I DEEP LEARNING CONCEPTS

UNIT II NEURAL NETWORKS

UNIT III CONVOLUTIONAL NEURAL NETWORK

UNIT IV NATURAL LANGUAGE PROCESSING USING RNN
Representation  GloVe. Backpropagation Through Time. Bidirectional RNNs (BRNN) . Long Short Term Memory (LSTM). Bi-directional LSTM. Sequence-to-Sequence Models (Seq2Seq). Gated recurrent unit GRU.

UNIT V  DEEP REINFORCEMENT & UNSUPERVISED LEARNING  10

COURSE OUTCOMES:
CO1: Feature Extraction from Image and Video Data  
CO2: Implement Image Segmentation and Instance Segmentation in Images  
CO3: Implement image recognition and image classification using a pretrained network (Transfer Learning)  
CO4: Traffic Information analysis using Twitter Data  
CO5: Autoencoder for Classification & Feature Extraction

TOTAL :  45 PERIODS

REFERENCES
1. Deep Learning A Practitioner’s Approach Josh Patterson and Adam Gibson O'Reilly Media, Inc.2017  
2. Learn Keras for Deep Neural Networks, Jojo Moolayil, Apress,2018  
4. Deep Learning with Python, FRANÇOIS CHOLLET, MANNING SHELTER ISLAND,2017  

OME431  VIBRATION AND NOISE CONTROL STRATEGIES  L  T  P  C  3  0  0  3

OBJECTIVES
- To appreciate the basic concepts of vibration in damped and undamped systems
- To appreciate the basic concepts of noise, its effect on hearing and related terminology
- To use the instruments for measuring and analyzing the vibration levels in a body
- To use the instruments for measuring and analyzing the noise levels in a system
- To learn the standards of vibration and noise levels and their control techniques

UNIT- I  BASICS OF VIBRATION  9

UNIT- II  BASICS OF NOISE  9
Introduction - Anatomy of human ear - Mechanism of hearing - Amplitude, frequency, wavelength and sound pressure level - Relationship between sound power, sound intensity and sound pressure level - Addition, subtraction and averaging decibel levels - sound spectra -Types of sound fields - Octave band analysis - Loudness.
UNIT- III INSTRUMENTATION FOR VIBRATION MEASUREMENT

UNIT- IV INSTRUMENTATION FOR NOISE MEASUREMENT AND ANALYSIS
Microphones - Weighting networks - Sound Level meters, its classes and calibration - Noise measurements using sound level meters - Data Loggers - Sound exposure meters - Recording of noise - Spectrum analyser - Intensity meters - Energy density sensors - Sound source localization.

UNIT- V METHODS OF VIBRATION CONTROL, SOURCES OF NOISE AND ITS CONTROL

OUTCOMES:
On Completion of the course the student will be able to
1. apply the basic concepts of vibration in damped and undamped systems
2. apply the basic concepts of noise and to understand its effects on systems
3. select the instruments required for vibration measurement and its analysis
4. select the instruments required for noise measurement and its analysis.
5. recognize the noise sources and to control the vibration levels in a body and to control noise under different strategies.

REFERENCES:
COURSE OBJECTIVES:
1. To learn the present energy scenario and the need for energy conservation.
2. To understand the different measures for energy conservation in utilities.
3. Acquaint students with principle theories, materials, and construction techniques to create energy efficient buildings.
4. To identify the energy demand and bridge the gap with suitable technology for sustainable habitat.
5. To get familiar with the energy technology, current status of research and find the ways to optimize a system as per the user requirement.

UNIT I ENERGY SCENARIO

UNIT II HEATING, VENTILLATION & AIR CONDITIONING

UNIT III LIGHTING, COMPUTER, TV

UNIT IV ENERGY EFFICIENT BUILDINGS

UNIT V ENERGY STORAGE TECHNOLOGIES
Necessity & types of energy storage – Thermal energy storage – Battery energy storage, charging and discharging – Hydrogen energy storage & Super capacitors – energy density and safety issues – Applications.

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Understand technical aspects of energy conservation scenario.
2. Energy audit in any type for domestic buildings and suggest the conservation measures.
3. Perform building load estimates and design the energy efficient landscape system.
4. Gain knowledge to utilize an appliance/device sustainably.
5. Understand the status and current technological advancement in energy storage field.

REFERENCES:
   (Could be downloaded from www.energymanagertraining.com)

OME433 ADDITIVE MANUFACTURING L T P C 3 0 0 3

UNIT I INTRODUCTION 9

UNIT II DESIGN FOR ADDITIVE MANUFACTURING 9

UNIT III VAT POLYMERIZATION 9

UNIT IV MATERIAL EXTRUSION AND SHEET LAMINATION 9

POWDER BASED PROCESS
UNIT V CASE STUDIES AND OPPORTUNITIES ADDITIVE MANUFACTURING PROCESSES


TOTAL: 45 PERIODS

REFERENCES:
UNIT V  DESIGN OF ELECTRIC VEHICLES


TOTAL: 45 PERIODS

REFERENCES:

OME435  NEW PRODUCT DEVELOPMENT  L  T  P  C
435  3  0  0  3

COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
1. Applying the principles of generic development process; and understanding the organization structure for new product design and development.
2. Identifying opportunity and planning for new product design and development.
3. Conducting customer need analysis; and setting product specification for new product design and development.
4. Generating, selecting, and testing the concepts for new product design and development.
5. Applying the principles of Industrial design and prototype for new product design and development.

UNIT I  INTRODUCTION TO PRODUCT DESIGN & DEVELOPMENT

UNIT II  OPPORTUNITY IDENTIFICATION & PRODUCT PLANNING

UNIT III  IDENTIFYING CUSTOMER NEEDS & PRODUCT SPECIFICATIONS
Establishing Target Specifications – Setting the Final Specifications

UNIT IV CONCEPT GENERATION, SELECTION & TESTING 9

UNITV INDUSTRIAL DESIGN & PROTOTYPING 9

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Apply the principles of generic development process; and understand the organization structure for new product design and development.
2. Identify opportunity and plan for new product design and development.
3. Conduct customer need analysis; and set product specification for new product design and development.
4. Generate, select, and test the concepts for new product design and development.
5. Apply the principles of Industrial design and prototype for design and develop new products.

TEXT BOOK:

REFERENCES:
UNIT I  MANAGEMENT OF SUSTAINABILITY  9
Management of sustainability - rationale and political trends: An introduction to sustainability management, International and European policies on sustainable development, theoretical pillars in sustainability management studies.

UNIT II  CORPORATE SUSTAINABILITY AND RESPONSIBILITY  9
Corporate sustainability parameter, corporate sustainability institutional framework, integration of sustainability into strategic planning and regular business practices, fundamentals of stakeholder engagement.

UNIT III  SUSTAINABILITY MANAGEMENT: STRATEGIES AND APPROACHES  9
Corporate sustainability management and competitiveness: Sustainability-oriented corporate strategies, markets and competitiveness, Green Management between theory and practice, Sustainable Consumption and Green Marketing strategies, Environmental regulation and strategic postures; Green Management approaches and tools; Green engineering: clean technologies and innovation processes; Sustainable Supply Chain Management and Procurement.

UNIT IV  SUSTAINABILITY AND INNOVATION  9
Socio-technical transitions and sustainability, Sustainable entrepreneurship, Sustainable pioneers in green market niches, Smart communities and smart specializations.

UNIT V  SUSTAINABLE MANAGEMENT OF RESOURCES, COMMODITIES AND COMMONS  9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: An understanding of sustainability management as an approach to aid in evaluating and minimizing environmental impacts while achieving the expected social impact.
CO2: An understanding of corporate sustainability and responsible Business Practices
CO3: Knowledge and skills to understand, to measure and interpret sustainability performances.
CO4: Knowledge of innovative practices in sustainable business and community management
CO5: Deep understanding of sustainable management of resources and commodities

REFERENCES:
4. Margaret Robertson, Sustainability Principles and Practice, 2014
5. Peter Rogers, An Introduction to Sustainable Development, 2006
COURSE OBJECTIVES

• To familiarize students with the theory and practice of small business management.
• To learn the legal issues faced by small business and how they impact operations.

UNIT I  INTRODUCTION TO SMALL BUSINESS


UNIT II  SCREENING THE BUSINESS OPPORTUNITY AND FORMULATING THE BUSINESS PLAN

Concepts of opportunity recognition; Key factors leading to new venture failure; New venture screening process; Applying new venture screening process to the early stage small firm Role planning in small business – importance of strategy formulation – management skills for small business creation and development.

UNIT III  BUILDING THE RIGHT TEAM AND MARKETING STRATEGY

Management and Leadership – employee assessments – Tuckman’s stages of group development - The entrepreneurial process model - Delegation and team building - Comparison of HR management in small and large firms - Importance of coaching and how to apply a coaching model.

Marketing within the small business - success strategies for small business marketing - customer delight and business generating systems, - market research, - assessing market performance-sales management and strategy - the marketing mix and marketing strategy.

UNIT IV  FINANCING SMALL BUSINESS

Main sources of entrepreneurial capital; Nature of ‘bootstrap’ financing - Difference between cash and profit - Nature of bank financing and equity financing - Funding-equity gap for small firms. Importance of working capital cycle - Calculation of break-even point - Power of gross profit margin- Pricing for profit - Credit policy issues and relating these to cash flow management and profitability.

UNIT V  VALUING SMALL BUSINESS AND CRISIS MANAGEMENT

Causes of small business failure - Danger signals of impending trouble - Characteristics of poorly performing firms - Turnaround strategies - Concept of business valuation - Different valuation measurements - Nature of goodwill and how to measure it - Advantages and disadvantages of buying an established small firm - Process of preparing a business for sale.

TOTAL: 45 PERIODS

COURSE OUTCOMES

CO1. Familiarise the students with the concept of small business
CO2. In depth knowledge on small business opportunities and challenges
CO3. Ability to devise plans for small business by building the right skills and marketing strategies
CO4. Identify the funding source for small start ups
CO5. Business evaluation for buying and selling of small firms

REFERENCES
3. Journal articles on SME’s.

OBA433 INTELLECTUAL PROPERTY RIGHTS

COURSE OBJECTIVE
➢ To understand intellectual property rights and its valuation.

UNIT I INTRODUCTION
Intellectual property rights - Introduction, Basic concepts, Patents, Copyrights, Trademarks, Trade Secrets, Geographic Indicators; Nature of Intellectual Property, Technological Research, Inventions and Innovations, History - the way from WTO to WIPO, TRIPS.

UNIT II PROCESS
New Developments in IPR, Procedure for grant of Patents, TM, GIs, Patenting under Patent Cooperation Treaty, Administration of Patent system in India, Patenting in foreign countries.

UNIT III STATUTES

UNIT IV STRATEGIES IN INTELLECTUAL PROPERTY
Strategies for investing in R&D, Patent Information and databases, IPR strength in India, Traditional Knowledge, Case studies.

UNIT V MODELS
The technologies Know-how, concept of ownership, Significance of IP in Value Creation, IP Valuation and IP Valuation Models, Application of Real Option Model in Strategic Decision Making, Transfer and Licensing.

TOTAL: 45 PERIODS

COURSE OUTCOMES
CO1: Understanding of intellectual property and appreciation of the need to protect it
CO2: Awareness about the process of patenting
CO3: Understanding of the statutes related to IPR
CO4: Ability to apply strategies to protect intellectual property
CO5: Ability to apply models for making strategic decisions related to IPR
REFERENCES
2. Intellectual Property rights and copyrights, EssEss Publications.

OBA434 ETHICAL MANAGEMENT L T P C
COURSE OBJECTIVE
➢ To help students develop knowledge and competence in ethical management and decision making in organizational contexts.

UNIT I ETHICS AND SOCIETY
Ethical Management - Definition, Motivation, Advantages - Practical implications of ethical management. Managerial ethics, professional ethics, and social Responsibility - Role of culture and society’s expectations - Individual and organizational responsibility to society and the community.

UNIT II ETHICAL DECISION MAKING AND MANAGEMENT IN A CRISIS
Managing in an ethical crisis, the nature of a crisis, ethics in crisis management, discuss case studies, analyze real-world scenarios, develop ethical management skills, knowledge, and competencies. Proactive crisis management.

UNIT III STAKEHOLDERS IN ETHICAL MANAGEMENT
Stakeholders in ethical management, identifying internal and external stakeholders, nature of stakeholders, ethical management of various kinds of stakeholders: customers (product and service issues), employees (leadership, fairness, justice, diversity) suppliers, collaborators, business, community, the natural environment (the sustainability imperative, green management, Contemporary issues).

UNIT IV INDIVIDUAL VARIABLES IN ETHICAL MANAGEMENT
Understanding individual variables in ethics, managerial ethics, concepts in ethical psychology - ethical awareness, ethical courage, ethical judgment, ethical foundations, ethical emotions/intuitions/intensity. Utilization of these concepts and competencies for ethical decision-making and management.

UNIT V PRACTICAL FIELD-GUIDE, TECHNIQUES AND SKILLS
Ethical management in practice, development of techniques and skills, navigating challenges and dilemmas, resolving issues and preventing unethical management proactively. Role modelling and creating a culture of ethical management and human flourishing.

COURSE OUTCOMES
CO1: Role modelling and influencing the ethical and cultural context.
CO2: Respond to ethical crises and proactively address potential crises situations.
CO3: Understand and implement stakeholder management decisions.
CO4: Develop the ability, knowledge, and skills for ethical management.
CO5: Develop practical skills to navigate, resolve and thrive in management situations.

REFERENCES

ET4251 IoT FOR SMART SYSTEMS

COURSE OBJECTIVES:
1. To study about Internet of Things technologies and its role in real time applications.
2. To introduce the infrastructure required for IoT
3. To familiarize the accessories and communication techniques for IoT.
4. To provide insight about the embedded processor and sensors required for IoT
5. To familiarize the different platforms and Attributes for IoT

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

UNIT III PROTOCOLS AND WIRELESS TECHNOLOGIES FOR IOT
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 IOT PROCESSORS
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

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of this course, the students will have the ability to
CO1: Analyze the concepts of IoT and its present developments.
CO2: Compare and contrast different platforms and infrastructures available for IoT
CO3: Explain different protocols and communication technologies used in IoT
CO4: Analyze the big data analytic and programming of IoT
CO5: Implement IoT solutions for smart applications

REFERENCES:

ET4072 MACHINE LEARNING AND DEEP LEARNING

COURSE OBJECTIVES:
The course is aimed at
1. Understanding about the learning problem and algorithms
2. Providing insight about neural networks
3. Introducing the machine learning fundamentals and significance
4. Enabling the students to acquire knowledge about pattern recognition.
5. Motivating the students to apply deep learning algorithms for solving real life problems.

UNIT I LEARNING PROBLEMS AND ALGORITHMS 9
Various paradigms of learning problems, Supervised, Semi-supervised and Unsupervised algorithms

UNIT II NEURAL NETWORKS 9

UNIT III MACHINE LEARNING – FUNDAMENTALS & FEATURE SELECTIONS & CLASSIFICATIONS 9
Classifying Samples: The confusion matrix, Accuracy, Precision, Recall, F1- Score, the curse of dimensionality, training, testing, validation, cross validation, overfitting, under-fitting the data, early stopping, regularization, bias and variance. Feature Selection, normalization, dimensionality reduction, Classifiers: KNN, SVM, Decision trees, Naïve Bayes, Binary classification, multi class classification, clustering.

UNIT IV DEEP LEARNING: CONVOLUTIONAL NEURAL NETWORKS 9
Feed forward networks, Activation functions, back propagation in CNN, optimizers, batch normalization, convolution layers, pooling layers, fully connected layers, dropout, Examples of CNNs.

UNIT V DEEP LEARNING: RNNS, AUTOENCODERS AND GANS 9
State, Structure of RNN Cell, LSTM and GRU, Time distributed layers, Generating Text, Autoencoders: Convolutional Autoencoders, Denoising autoencoders, Variational autoencoders, GANs: The discriminator, generator, DCGANs

TOTAL : 45 PERIODS

COURSE OUTCOMES (CO):
At the end of the course the student will be able to
CO1: Illustrate the categorization of machine learning algorithms.
CO2: Compare and contrast the types of neural network architectures, activation functions
CO3: Acquaint with the pattern association using neural networks
CO4: Elaborate various terminologies related with pattern recognition and architectures of convolutional neural networks
CO5: Construct different feature selection and classification techniques and advanced neural network architectures such as RNN, Autoencoders, and GANs.

REFERENCES:
OBJECTIVES:
To impart knowledge on
- Different types of renewable energy technologies
- Standalone operation, grid connected operation of renewable energy systems

UNIT I INTRODUCTION
Classification of energy sources – Co2 Emission - Features of Renewable energy - Renewable energy scenario in India -Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment Per Capital Consumption - CO2 Emission - importance of renewable energy sources, Potentials – Achievements– Applications.

UNIT II SOLAR PHOTOVOLTAICS

UNIT III PHOTOVOLTAIC SYSTEM DESIGN
Block diagram of solar photo voltaic system : Line commutated converters (inversion mode) - Boost and buck-boost converters - selection of inverter, battery sizing, array sizing - PV systems classification- standalone PV systems - Grid tied and grid interactive inverters- grid connection issues.

UNIT IV WIND ENERGY CONVERSION SYSTEMS

UNIT V OTHER RENEWABLE ENERGY SOURCES
Qualitative study of different renewable energy resources: ocean, Biomass, Hydrogen energy systems, Fuel cells, Ocean Thermal Energy Conversion (OTEC), Tidal and wave energy, Geothermal Energy Resources.

TOTAL : 45 PERIODS

OUTCOMES:
After completion of this course, the student will be able to:
  CO1: Demonstrate the need for renewable energy sources.
  CO2: Develop a stand-alone photo voltaic system and implement a maximum power point tracking in the PV system.
CO3: Design a stand-alone and Grid connected PV system.
CO4: Analyze the different configurations of the wind energy conversion systems.
CO5: Realize the basic of various available renewable energy sources

REFERENCES:

PS4093 SMART GRID L T P C 3 0 0 3

COURSE OBJECTIVES
• To Study about Smart Grid technologies, different smart meters and advanced metering infrastructure.
• To know about the function of smart grid.
• To familiarize the power quality management issues in Smart Grid.
• To familiarize the high performance computing for Smart Grid applications
• To get familiarized with the communication networks 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, Comparison of Micro grid and Smart grid, Present development & International policies in Smart Grid, Smart Grid Initiative for Power Distribution Utility in India – Case Study.

UNIT II SMART GRID TECHNOLOGIES
Technology Drivers, Smart Integration of energy resources, Smart substations, Substation Automation, Feeder Automation, Transmission systems: EMS, FACTS and HVDC, Wide area monitoring, Protection and control, Distribution systems: DMS, Volt/Var control, Fault Detection, Isolation and service restoration, Outage management, High-Efficiency Distribution Transformers, Phase Shifting Transformers, Plug in Hybrid Electric Vehicles (PHEV) – Grid to Vehicle and Vehicle to Grid charging concepts.

UNIT III SMART METERS AND ADVANCED METERING INFRASTRUCTURE
Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Phasor Measurement Unit(PMU) & their application for monitoring & protection. Demand side management and demand response programs, Demand pricing and Time of Use, Real Time Pricing, Peak Time Pricing.
UNIT IV  POWER QUALITY MANAGEMENT IN SMART GRID


Unit V  HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS

Architecture and Standards - Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broadband over Power line (BPL), PLC, Zigbee, GSM, IP based Protocols, Basics of Web Service and CLOUD Computing, Cyber Security for Smart Grid.

COURSE OUTCOME:
Students able to
CO1: Relate with the smart resources, smart meters and other smart devices.
CO2: Explain the function of Smart Grid.
CO3: Experiment the issues of Power Quality in Smart Grid.
CO4: Analyze the performance of Smart Grid.
CO5: Recommend suitable communication networks for smart grid applications

REFERENCES

CP4391  SECURITY PRACTICES

COURSE OBJECTIVES:
- To learn the core fundamentals of system and web security concepts
- To have thorough understanding in the security concepts related to networks
- To deploy the security essentials in IT Sector
- To be exposed to the concepts of Cyber Security and cloud security
- To perform a detailed study of Privacy and Storage security and related Issues

UNIT I  SYSTEM SECURITY

UNIT II  NETWORK SECURITY  9

UNIT III  SECURITY MANAGEMENT  9

UNIT IV  CYBER SECURITY AND CLOUD SECURITY  9

UNIT V  PRIVACY AND STORAGE SECURITY  9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: Understand the core fundamentals of system security
CO2: Apply the security concepts to wired and wireless networks
CO3: Implement and Manage the security essentials in IT Sector
CO4: Explain the concepts of Cyber Security and Cyber forensics
CO5: Be aware of Privacy and Storage security Issues.

REFERENCES
COURSE OBJECTIVES:

- To gain expertise in Virtualization, Virtual Machines and deploy practical virtualization solution
- To understand the architecture, infrastructure and delivery models of cloud computing.
- To explore the roster of AWS services and illustrate the way to make applications in AWS
- To gain knowledge in the working of Windows Azure and Storage services offered by Windows Azure
- To develop the cloud application using various programming model of Hadoop and Aneka

UNIT I  VIRTUALIZATION AND VIRTUALIZATION INFRASTRUCTURE  6

UNIT II  CLOUD PLATFORM ARCHITECTURE  12

UNIT III  AWS CLOUD PLATFORM - IAAS  9

UNIT IV  PAAS CLOUD PLATFORM  9

UNIT V  PROGRAMMING MODEL  9
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- Aneka: Cloud Application Platform, Thread Programming, Task Programming and Map-Reduce Programming in Aneka

TOTAL: 45 Periods
COURSE OUTCOMES:
CO1: Employ the concepts of virtualization in the cloud computing
CO2: Identify the architecture, infrastructure and delivery models of cloud computing
CO3: Develop the Cloud Application in AWS platform
CO4: Apply the concepts of Windows Azure to design Cloud Application
CO5: Develop services using various Cloud computing programming models.

REFERENCES

IF4072 DESIGN THINKING L T P C 3 0 0 3

COURSE OBJECTIVES:
• To provide a sound knowledge in UI & UX
• To understand the need for UI and UX
• Research Methods used in Design
• Tools used in UI & UX
• Creating a wireframe and prototype

UNIT I UX LIFECYCLE TEMPLATE 8

UNIT II CONTEXTUAL INQUIRY 10
Constructing your work activity affinity diagram (WAAD). Abridged contextual analysis process. History of affinity diagrams.

UNIT III  
DESIGN THINKING, IDEATION, AND SKETCHING  

UNIT IV  
UX GOALS, METRICS, AND TARGETS  

UNIT V  
ANALYSING USER EXPERIENCE  

SUGGESTED ACTIVITIES:
1: Hands on Design Thinking process for a product
2: Defining the Look and Feel of any new Project
3: Create a Sample Pattern Library for that product (Mood board, Fonts, Colors based on UI principles)
4: Identify a customer problem to solve.
5: Conduct end-to-end user research - User research, creating personas, Ideation process (User stories, Scenarios), Flow diagrams, Flow Mapping

TOTAL : 45 PERIODS

COURSE OUTCOMES:
CO1: Build UI for user Applications  
CO2: Use the UI Interaction behaviors and principles  
CO3: Evaluate UX design of any product or application  
CO4: Demonstrate UX Skills in product development  
CO5: Implement Sketching principles

REFERENCES
MU4153 PRINCIPLES OF MULTIMEDIA L T P C
3 0 0 3

COURSE OBJECTIVES:
- To get familiarity with gamut of multimedia and its significance
- To acquire knowledge in multimedia components.
- To acquire knowledge about multimedia tools and authoring.
- To acquire knowledge in the development of multimedia applications.
- To explore the latest trends and technologies in multimedia

UNIT I INTRODUCTION

Suggested Activities:
1. Flipped classroom on media Components.
2. External learning – Interactive presentation.

Suggested Evaluation Methods:
1. Tutorial – Handling media components
2. Quizzes on different types of data presentation.

UNIT II ELEMENTS OF MULTIMEDIA
Text-Types, Font, Unicode Standard, File Formats, Graphics and Image data representations – data types, file formats, color models; video – color models in video, analog video, digital video, file formats, video display interfaces, 3D video and TV: Audio – Digitization, SNR, SQNR, quantization, audio quality, file formats, MIDI; Animation- Key Frames and Tweening, other Techniques, 2D and 3D Animation.

Suggested Activities:
1. Flipped classroom on different file formats of various media elements.

Suggested Evaluation Methods:
1. Demonstration on after effects animations.
2. Quizzes on file formats and color models.
UNIT III MULTIMEDIA TOOLS

Suggested Activities:
1. Flipped classroom on multimedia tools.
2. External learning – Comparison of various authoring tools.

Suggested Evaluation Methods:
1. Tutorial – Audio editing tool.
2. Quizzes on animation tools.

UNIT IV MULTIMEDIA SYSTEMS

Suggested Activities:
1. Flipped classroom on concepts of multimedia hardware architectures.
2. External learning – Digital repositories and hypermedia design.

Suggested Evaluation Methods:
1. Quizzes on multimedia hardware and compression techniques.
2. Tutorial – Hypermedia design.

UNIT V MULTIMEDIA APPLICATIONS FOR THE WEB AND MOBILE PLATFORMS

Suggested Activities:
1. External learning – Game consoles.
2. External learning – VRML scripting languages.

Suggested Evaluation Methods:
1. Demonstration of simple interactive games.
2. Tutorial – Simple VRML program.

COURSE OUTCOMES:
CO1: Handle the multimedia elements effectively.
CO2: Articulate the concepts and techniques used in multimedia applications.
CO3: Develop effective strategies to deliver Quality of Experience in multimedia applications.
CO4: Design and implement algorithms and techniques applied to multimedia objects.
CO5: Design and develop multimedia applications following software engineering models.

TOTAL : 45 PERIODS
REFERENCES:

CX4016 ENVIRONMENTAL SUSTAINABILITY

UNIT I INTRODUCTION
Valuing the Environment: Concepts, Valuing the Environment: Methods, Property Rights, Externalities, and Environmental Problems

UNIT II CONCEPT OF SUSTAINABILITY
Sustainable Development: Defining the Concept, the Population Problem, Natural Resource Economics: An Overview, Energy, Water, Agriculture

UNIT III SIGNIFICANCE OF BIODIVERSITY
Biodiversity, Forest Habitat, Commercially Valuable Species, Stationary - Source Local Air Pollution, Acid Rain and Atmospheric Modification, Transportation

UNIT IV POLLUTION IMPACTS
Water Pollution, Solid Waste and Recycling, Toxic Substances and Hazardous Wastes, Global Warming.

UNIT V ENVIRONMENTAL ECONOMICS
Development, Poverty, and the Environment, Visions of the Future, Environmental economics and policy by Tom Tietenberg, Environmental Economics

TOTAL : 45 PERIODS

REFERENCES
# TEXTILE REINFORCED COMPOSITES

<table>
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<tr>
<th>UNIT</th>
<th>REINFORCEMENTS</th>
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<td></td>
<td>Introduction – composites –classification and application; reinforcements- fibres and its properties; preparation of reinforced materials and quality evaluation; preforms for various composites</td>
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<td>Preparation, chemistry, properties and applications of thermoplastic and thermoset resins; mechanism of interaction of matrices and reinforcements; optimization of matrices</td>
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<td>Classification; methods of composites manufacturing for both thermoplastics and thermosets-Hand layup, Filament Winding, Resin transfer moulding, prepgreps and autoclave moulding, pultrusion, vacuum impregnation methods, compression moulding; post processing of composites and composite design requirements</td>
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<td>Fibre volume and weight fraction, specific gravity of composites, tensile, flexural, impact, compression, inter laminar shear stress and fatigue properties of thermoset and thermoplastic composites.</td>
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<td>Micro mechanics, macro mechanics of single layer, macro mechanics of laminate, classical lamination theory, failure theories and prediction of inter laminar stresses using at ware</td>
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**TOTAL: 45 PERIODS**

## REFERENCES


# NANOCOMPOSITE MATERIALS

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<th>UNIT</th>
<th>BASICS OF NANOCOMPOSITES</th>
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</table>
UNIT II METAL BASED NANOCOMPOSITES 9
Metal-metal nanocomposites, some simple preparation techniques and their properties. Metal-Oxide or Metal-Ceramic composites, Different aspects of their preparation techniques and their final properties and functionality. Fractal based glass-metal nanocomposites, its designing and fractal dimension analysis. Core-Shell structured nanocomposites

UNIT III POLYMER BASED NANOCOMPOSITES 9
Preparation and characterization of diblock Copolymer based nanocomposites; Polymer Carbon nanotubes based composites, their mechanical properties, and industrial possibilities.

UNIT IV NANOCOMPOSITE FROM BIOMATERIALS 9
Natural nanocomposite systems - spider silk, bones, shells; organic-inorganic nanocomposite formation through self-assembly. Biomimetic synthesis of nanocomposites material; Use of synthetic nanocomposites for bone, teeth replacement.

UNIT V NANOCOMPOSITE TECHNOLOGY 9

REFERENCES:
5. The search for novel, superhard materials- Stan Veprjek (Review Article) JVST A, 1999

TOTAL : 45 PERIODS

BY4016 IPR, BIOSAFETY AND ENTREPRENEURSHIP L T P C 3 0 0 3

UNIT I IPR 9

UNIT II AGREEMENTS, TREATIES AND PATENT FILING PROCEDURES 9
History of GATT Agreement – Madrid Agreement – Hague Agreement – WIPO Treaties –

UNIT III BIOSAFETY

UNIT IV GENETICALLY MODIFIED ORGANISMS
Definition of GMOs & LMOs – Roles of Institutional Biosafety Committee – RCGM – GEAC etc. for GMO applications in food and agriculture – Environmental release of GMOs – Risk Analysis – Risk Assessment – Risk management and communication – Overview of National Regulations and relevant International Agreements including Cartegana Protocol.

UNIT V ENTREPRENEURSHIP DEVELOPMENT

REFERENCES