1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

I. Develop proficiency as a computer science engineer with an ability to solve a wide range of computational problems and have sustainable development in industry or any other work environment.

   Analyze and adapt quickly to new environments and technologies, gather new information, and work on emerging technologies to solve multidisciplinary engineering problems.

II. Possess the ability to think analytically and logically to understand technical problems with computational systems for a lifelong learning which leads to pursuing research.

IV. Adopt ethical practices to collaborate with team members and team leaders to build technology with cutting-edge technical solutions for computing systems

V. Strongly focus on design thinking and critical analysis to create innovative products and become entrepreneurs.

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 of Computer Science and Engineering.

   4. Efficiently design, build and develop system application software for distributed and centralized computing environments in varying domains and platforms.

   5. Understand the working of current Industry trends, the new hardware architectures, the software components and design solutions for real world problems by Communicating and effectively working with professionals in various engineering fields and pursue research orientation for a lifelong professional development in computer and automation arenas.

   6. Model a computer based automation system and design algorithms that explore the understanding of the tradeoffs involved in digital transformation.

PEO/PO Mapping:

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Contribution 1: Reasonable 2: Significant 3: Strong
### Year I

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# ANNA UNIVERSITY, CHENNAI
NON - AUTONOMOUS COLLEGES AFFILIATED ANNA UNIVERSITY
M.E. COMPUTER SCIENCE AND ENGINEERING
REGULATIONS – 2021
CHOICE BASED CREDIT SYSTEM
I TO IV SEMESTERS CURRICULA AND SYLLABI

## SEMESTER I

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*Audit course is optional

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MA4151  APPLIED PROBABILITY AND STATISTICS FOR COMPUTER SCIENCE ENGINEERS

COURSE OBJECTIVES:

- To encourage students to develop a working knowledge of the central ideas of Linear Algebra.
- To enable students to understand the concepts of Probability and Random Variables.
- To understand the basic probability concepts with respect to two dimensional random variables along with the relationship between the random variables and the significance of the central limit theorem.
- To apply the small / large sample tests through Tests of hypothesis.
- To enable the students to use the concepts of multivariate normal distribution and principal components analysis.

UNIT I  LINEAR ALGEBRA  12

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  TESTING OF HYPOTHESIS  12
Sampling distributions – Type I and Type II errors – Small and Large samples – Tests based on Normal, t, Chi square and F distributions for testing of mean , variance and proportions – Tests for independence of attributes and goodness of fit.

UNIT V  MULTIVARIATE ANALYSIS  12
Random vectors and matrices – Mean vectors and covariance matrices – Multivariate normal density and its properties – Principal components – Population principal components – Principal components from standardized variables.

TOTAL : 60 PERIODS

COURSE OUTCOMES:
At the end of the course, students will be able to
CO1: apply the concepts of Linear Algebra to solve practical problems.
CO2: use the ideas of probability and random variables in solving engineering problems.
CO3: be familiar with some of the commonly encountered two dimensional random variables and be equipped for a possible extension to multivariate analysis.
CO4: use statistical tests in testing hypotheses on data.
CO5: develop critical thinking based on empirical evidence and the scientific approach to knowledge development.

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RM4151 RESEARCH METHODOLOGY AND IPR

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
Intellectual Property – The concept of IPR, Evolution and development of concept of IPR, IPR development process, Trade secrets, utility Models, IPR & Biodiversity, Role of WIPO and WTO in
IPR establishments, Right of Property, Common rules of IPR practices, Types and Features of IPR Agreement, Trademark, Functions of UNESCO in IPR maintenance.

UNIT V PATENTS 6

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CP4151 ADVANCED DATA STRUCTURES AND ALGORITHMS L T P C
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COURSE OBJECTIVES:

- To understand the usage of algorithms in computing
- To learn and use hierarchical data structures and its operations
- To learn the usage of graphs and its applications
- To select and design data structures and algorithms that is appropriate for problems
- To study about NP Completeness of problems.

UNIT I ROLE OF ALGORITHMS IN COMPUTING & COMPLEXITY 9
ANALYSIS
Algorithms – Algorithms as a Technology -Time and Space complexity of algorithms- Asymptotic
analysis-Average and worst-case analysis-Asymptotic notation-Importance of efficient algorithms- Program performance measurement - Recurrences: The Substitution Method – The Recursion-Tree Method- Data structures and algorithms.

UNIT II HIERARCHICAL DATA STRUCTURES

UNIT III GRAPHS

UNIT IV ALGORITHM DESIGN TECHNIQUES

UNIT V NP COMPLETE AND NP HARD

TOTAL : 45 PERIODS

SUGGESTED ACTIVITIES:
1. Write an algorithm for Towers of Hanoi problem using recursion and analyze the complexity (No of disc-4)
2. Write any one real time application of hierarchical data structure
3. Write a program to implement Make_Set, Find_Set and Union functions for Disjoint Set Data Structure for a given undirected graph G(V,E) using the linked list representation with simple implementation of Union operation
4. Find the minimum cost to reach last cell of the matrix from its first cell
5. Discuss about any NP completeness problem

COURSE OUTCOMES:
CO1: Design data structures and algorithms to solve computing problems.
CO2: Choose and implement efficient data structures and apply them to solve problems.
CO3: Design algorithms using graph structure and various string-matching algorithms to solve real-life problems.
CO4: Design one’s own algorithm for an unknown problem.
CO5: Apply suitable design strategy for problem solving.
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CP4152 DATABASE PRACTICES L T P C 3 0 2 4

COURSE OBJECTIVES
- Describe the fundamental elements of relational database management systems
- Explain the basic concepts of relational data model, entity-relationship model, relational database design, relational algebra and SQL.
- Understand query processing in a distributed database system
- Understand the basics of XML and create well-formed and valid XML documents.
- Distinguish the different types of NoSQL databases
- To understand the different models involved in database security and their applications in real time world to protect the database and information associated with them.

UNIT I RELATIONAL DATA MODEL 15

Suggested Activities:
Data Definition Language
- Create, Alter and Drop
- Enforce Primary Key, Foreign Key, Check, Unique and Not Null Constraints
Creating Views  
Data Manipulation Language  
- Insert, Delete, Update  
- Cartesian Product, Equi Join, Left Outer Join, Right Outer Join and Full Outer Join  
- Aggregate Functions  
- Set Operations  
- Nested Queries  
Transaction Control Language  
- Commit, Rollback and Save Points

UNIT II  DISTRIBUTED DATABASES, ACTIVE DATABASES AND OPEN DATABASE CONNECTIVITY  

Suggested Activities:  
- Distributed Database Design and Implementation  
- Row Level and Statement Level Triggers  
- Accessing a Relational Database using PHP, Python and R

UNIT III  XML DATABASES  

Suggested Activities:  
- Creating XML Documents, Document Type Definition and XML Schema  
- Using a Relational Database to store the XML documents as text  
- Using a Relational Database to store the XML documents as data elements  
- Creating or publishing customized XML documents from pre-existing relational databases  
- Extracting XML Documents from Relational Databases  
- XML Querying

UNIT IV  NOSQL DATABASES AND BIG DATA STORAGE SYSTEMS  

Suggested Activities:  
- Creating Databases using MongoDB, DynamoDB, Voldemort Key-Value Distributed Data Store Hbase and Neo4j.  
- Writing simple queries to access databases created using MongoDB, DynamoDB, Voldemort Key-Value Distributed Data Store Hbase and Neo4j.
UNIT V DATABASE SECURITY


Suggested Activities:
Implementing Access Control in Relational Databases

TOTAL : 75 PERIODS

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

CO1: Convert the ER-model to relational tables, populate relational databases and formulate SQL queries on data.

CO2: Understand and write well-formed XML documents

CO3: Be able to apply methods and techniques for distributed query processing.

CO4: Design and implement secure database systems.

CO5: Use the data control, definition, and manipulation languages of the NoSQL databases

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CO-PO Mapping
COURSE OBJECTIVES:
- To understand the basic concepts of networks
- To explore various technologies in the wireless domain
- To study about 4G and 5G cellular networks
- To learn about Network Function Virtualization
- To understand the paradigm of Software defined networks

UNIT I  NETWORKING CONCEPTS  9

UNIT II  WIRELESS NETWORKS  9
Wireless access techniques- IEEE 802.11a, 802.11g, 802.11e, 802.11n/ac/ax/ay/be, QoS – Bluetooth – Protocol Stack – Security – Profiles – zigbee

UNIT III  MOBILE DATA NETWORKS  9

UNIT IV  SOFTWARE DEFINED NETWORKS  9

UNIT V  NETWORK FUNCTIONS VIRTUALIZATION  9
Motivation-Virtual Machines –NFV benefits-requirements – architecture- NFV Infrastructure - Virtualized Network Functions - NFV Management and Orchestration- NFV Use Cases- NFV and SDN –Network virtualization – VLAN and VPN

TOTAL : 45 PERIODS

COURSE OUTCOMES:
CO1: Explain basic networking concepts
CO2: Compare different wireless networking protocols
CO3: Describe the developments in each generation of mobile data networks
CO4: Explain and develop SDN based applications
CO5: Explain the concepts of network function virtualization
SUGGESTED ACTIVITIES:
1. Execute various network utilities such as tracert, pathping, ipconfig
2. Implement the Software Defined Networking using Mininet
3. Implement routing in Mininet
4. Install a virtual machine and study network virtualization
5. Simulate various network topologies in Network Simulator

REFERENCES
2. Houda Labiod, Costantino de Santis, Hosam Affi “Wi-Fi, Bluetooth, Zigbee and WiMax”, Springer 2007 (UNIT 2)

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CP4154 PRINCIPLES OF PROGRAMMING LANGUAGES  L T P C
3 0 0 3

COURSE OBJECTIVES:
- To understand and describe syntax and semantics of programming languages
- To understand data, data types, and basic statements
- To understand call-return architecture and ways of implementing them
- To understand object-orientation, concurrency, and event handling in programming languages
- To develop programs in non-procedural programming paradigms
UNIT I  SYNTAX AND SEMANTICS  9

UNIT II  DATA, DATA TYPES, AND BASIC STATEMENTS  9

UNIT III  SUBPROGRAMS AND IMPLEMENTATIONS  9

UNIT IV  OBJECT-ORIENTATION, CONCURRENCY, AND EVENT HANDLING  9

UNIT V  FUNCTIONAL AND LOGIC PROGRAMMING LANGUAGES  9
Introduction to lambda calculus – fundamentals of functional programming languages – Programming with Scheme – Programming with ML – Introduction to logic and logic programming – Programming with Prolog – multi-paradigm languages

TOTAL : 45 PERIODS

COURSE OUTCOMES:
CO1: Describe syntax and semantics of programming languages
CO2: Explain data, data types, and basic statements of programming languages
CO3: Design and implement subprogram constructs
CO4: Apply object-oriented, concurrency, and event handling programming constructs
CO5: Develop programs in Scheme, ML, and Prolog and Understand and adopt new programming language

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### CP4161 ADVANCED DATA STRUCTURES AND ALGORITHMS LABORATORY

#### COURSE OBJECTIVES:
- To acquire the knowledge of using advanced tree structures
- To learn the usage of heap structures
- To understand the usage of graph structures and spanning trees
- To understand the problems such as matrix chain multiplication, activity selection and Huffman coding
- To understand the necessary mathematical abstraction to solve problems.

#### LIST OF EXPERIMENTS:
1. Implementation of recursive function for tree traversal and Fibonacci
2. Implementation of iteration function for tree traversal and Fibonacci
3. Implementation of Merge Sort and Quick Sort
4. Implementation of a Binary Search Tree
5. Red-Black Tree Implementation
6. Heap Implementation
7. Fibonacci Heap Implementation
8. Graph Traversals
9. Spanning Tree Implementation
10. Shortest Path Algorithms (Dijkstra's algorithm, Bellman Ford Algorithm)
11. Implementation of Matrix Chain Multiplication
12. Activity Selection and Huffman Coding Implementation

#### HARDWARE/SOFTWARE REQUIREMENTS
1. 64-bit Open source Linux or its derivative
2. Open Source C++ Programming tool like G++/GCC

#### COURSE OUTCOMES:
- **CO1**: Design and implement basic and advanced data structures extensively
- **CO2**: Design algorithms using graph structures

TOTAL : 60 PERIODS
**CO3:** Design and develop efficient algorithms with minimum complexity using design techniques

**CO4:** Develop programs using various algorithms.

**CO5:** Choose appropriate data structures and algorithms, understand the ADT/libraries, and use it to design algorithms for a specific problem.

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**CP4291**

**INTERNET OF THINGS**

**COURSE OBJECTIVES:**
- To Understand the Architectural Overview of IoT
- To Understand the IoT Reference Architecture and Real World Design Constraints
- To Understand the various IoT levels
- To understand the basics of cloud architecture
- To gain experience in Raspberry PI and experiment simple IoT application on it

**UNIT I**

**INTRODUCTION**
9+6
Internet of Things- Domain Specific IoTs - IoT and M2M-Sensors for IoT Applications–Structure of IoT– IoT Map Device- IoT System Management with NETCONF-YANG

**UNIT II**

**IoT ARCHITECTURE, GENERATIONS AND PROTOCOLS**
9+6
Description & Characteristics

UNIT III  IOT PROTOCOLS AND TECHNOLOGY  9+6

UNIT IV  CLOUD ARCHITECTURE BASICS  9+6
The Cloud types; IaaS, PaaS, SaaS - Development environments for service development; Amazon,
Azure, Google Appcloud platform in industry

UNIT V  IOT PROJECTS ON RASPBERRY PI  9+6
Building IoT with RASPBERRY PI - Creating the sensor project - Preparing Raspberry Pi - Clayster
libraries – Hardware Interacting with the hardware - Interfacing the hardware - Internal representation
of sensor values - Persisting data - External representation of sensor values - Exporting sensor data

SUGGESTED ACTIVITIES:
1. Develop an application for LED Blink and Pattern using Arduino or Raspberry Pi
2. Develop an application for LED Pattern with Push Button Control using Arduino or Raspberry Pi
3. Develop an application for LM35 Temperature Sensor to display temperature values using
   arduino or Raspberry Pi
4. Develop an application for Forest fire detection end node using Raspberry Pi device and
   sensor
5. Develop an application for home intrusion detection web application
6. Develop an application for Smart parking application using python and Django for web
   application

COURSE OUTCOMES:
CO1: Understand the various concept of the IoT and their technologies
CO2: Develop the IoT application using different hardware platforms
CO3: Implement the various IoT Protocols
CO4: Understand the basic principles of cloud computing
CO5: Develop and deploy the IoT application into cloud environment

TOTAL: 75 PERIODS

REFERENCES:
1. Arshdeep Bahga, Vijay Madisetti, Internet of Things: A hands-on approach, Universities
   Press, 2015
2. Dieter Uckelmann, Mark Harrison, Florian Michahelles (Eds), Architecting the Internet of
4. Ovidiu Vermesan Peter Friess, 'Internet of Things – From Research and Innovation to
   Market Deployment', River Publishers, 2014
5. N. Ida, Sensors, Actuators and Their Interfaces: A Multidisciplinary Introduction, 2nd
   EditionScitech Publishers, 2020
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### CP4292  MULTICORE ARCHITECTURE AND PROGRAMMING

**L T P C**

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**COURSE OBJECTIVES:**
- To understand the need for multi-core processors, and their architecture.
- To understand the challenges in parallel and multithreaded programming.
- To learn about the various parallel programming paradigms.
- To develop multicore programs and design parallel solutions.

**UNIT I**  MULTI-CORE PROCESSORS


**UNIT II**  PARALLEL PROGRAM CHALLENGES

- Performance – Scalability – Synchronization and data sharing – Data races – Synchronization primitives (mutexes, locks, semaphores, barriers) – deadlocks and livelocks – communication between threads (condition variables, signals, message queues and pipes).

**UNIT III**  SHARED MEMORY PROGRAMMING WITH OpenMP


**UNIT IV**  DISTRIBUTED MEMORY PROGRAMMING WITH MPI

- MPI program execution – MPI constructs – libraries – MPI send and receive – Point-to-point and Collective communication – MPI derived datatypes – Performance evaluation

**UNIT V**  PARALLEL PROGRAM DEVELOPMENT

- Case studies – n-Body solvers – Tree Search – OpenMP and MPI implementations and comparison.

**TOTAL: 45 PERIODS**
PRACTICALS:
1. Write a simple Program to demonstrate an OpenMP Fork-Join Parallelism.
2. Create a program that computes a simple matrix-vector multiplication \( b=Ax \), either in C/C++. Use OpenMP directives to make it run in parallel.
3. Create a program that computes the sum of all the elements in an array \( A \) (C/C++) or a program that finds the largest number in an array \( A \). Use OpenMP directives to make it run in parallel.
4. Write a simple Program demonstrating Message-Passing logic using OpenMP.
5. Implement the All-Pairs Shortest-Path Problem (Floyd's Algorithm) Using OpenMP.
6. Implement a program Parallel Random Number Generators using Monte Carlo Methods in OpenMP.
7. Write a Program to demonstrate MPI-broadcast-and-collective-communication in C.
8. Write a Program to demonstrate MPI-scatter-gather-and-all gather in C.
9. Write a Program to demonstrate MPI-send-and-receive in C.
10. Write a Program to demonstrate by performing-parallel-rank-with-MPI in C.

TOTAL: 30 PERIODS

TOTAL:45+30=75 PERIODS

COURSE OUTCOMES:
At the end of the course, the students should be able to:
CO1: Describe multicore architectures and identify their characteristics and challenges.
CO2: Identify the issues in programming Parallel Processors.
CO3: Write programs using OpenMP and MPI.
CO4: Design parallel programming solutions to common problems.
CO5: Compare and contrast programming for serial processors and programming for parallel processors.

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CP4252  MACHINE LEARNING

COURSE OBJECTIVES:
- To understand the concepts and mathematical foundations of machine learning and types of problems tackled by machine learning
- To explore the different supervised learning techniques including ensemble methods
- To learn different aspects of unsupervised learning and reinforcement learning
- To learn the role of probabilistic methods for machine learning
- To understand the basic concepts of neural networks and deep learning

UNIT I  INTRODUCTION AND MATHEMATICAL FOUNDATIONS  

UNIT II  SUPERVISED LEARNING  

UNIT III  UNSUPERVISED LEARNING AND REINFORCEMENT LEARNING  

UNIT IV  PROBABILISTIC METHODS FOR LEARNING  

UNIT V  NEURAL NETWORKS AND DEEP LEARNING  
Neural Networks – Biological Motivation- Perceptron – Multi-layer Perceptron – Feed Forward Network – Back Propagation-Activation and Loss Functions- Limitations of Machine Learning – Deep Learning – Convolution Neural Networks – Recurrent Neural Networks – Use cases

45 PERIODS

SUGGESTED ACTIVITIES:
1. Give an example from our daily life for each type of machine learning problem
2. Study at least 3 Tools available for Machine Learning and discuss pros & cons of each
3. Take an example of a classification problem. Draw different decision trees for the example and explain the pros and cons of each decision variable at each level of the tree
4. Outline 10 machine learning applications in healthcare
5. Give 5 examples where sequential models are suitable.
6. Give at least 5 recent applications of CNN

PRACTICAL EXERCISES: 30 PERIODS
1. Implement a Linear Regression with a Real Dataset (https://www.kaggle.com/harrywang/housing). Experiment with different features in building a model. Tune the model's hyperparameters.
2. Implement a binary classification model. That is, answers a binary question such as "Are houses in this neighborhood above a certain price?" (use data from exercise 1). Modify the classification threshold and determine how that modification influences the model. Experiment with different classification metrics to determine your model's effectiveness.
3. Classification with Nearest Neighbors. In this question, you will use the scikit-learn’s KNN classifier to classify real vs. fake news headlines. The aim of this question is for you to read the scikit-learn API and get comfortable with training/validation splits. Use California Housing Dataset
4. In this exercise, you'll experiment with validation sets and test sets using the dataset. Split a training set into a smaller training set and a validation set. Analyze deltas between training set and validation set results. Test the trained model with a test set to determine whether your trained model is overfitting. Detect and fix a common training problem.
5. Implement the k-means algorithm using https://archive.ics.uci.edu/ml/datasets/Codon+usage dataset
6. Implement the Naïve Bayes Classifier using
https://archive.ics.uci.edu/ml/datasets/Gait+Classification dataset
7. Project - (in Pairs) Your project must implement one or more machine learning algorithms and apply them to some data.
   a. Your project may be a comparison of several existing algorithms, or it may propose a new algorithm in which case you still must compare it to at least one other approach.
   b. You can either pick a project of your own design, or you can choose from the set of pre-defined projects.
   c. You are free to use any third-party ideas or code that you wish as long as it is publicly available.
   d. You must properly provide references to any work that is not your own in the write-up.
   e. Project proposal You must turn in a brief project proposal. Your project proposal should describe the idea behind your project. You should also briefly describe software you will need to write, and papers (2-3) you plan to read.

List of Projects (datasets available)
1. Sentiment Analysis of Product Reviews
2. Stock Prediction
3. Sales Forecasting
4. Music Recommendation
5. Handwriting Digit Classification
6. Fake News Detection
7. Sports Prediction
8. Object Detection
Disease Prediction

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

**CO1:** Understand and outline problems for each type of machine learning

**CO2:** Design a Decision tree and Random forest for an application

**CO3:** Implement Probabilistic Discriminative and Generative algorithms for an application and analyze the results.

**CO4:** Use a tool to implement typical Clustering algorithms for different types of applications.

**CO5:** Design and implement an HMM for a Sequence Model type of application and identify applications suitable for different types of Machine Learning with suitable justification.

TOTAL: 75 PERIODS

**REFERENCES**

**CO-PO Mapping**

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COURSE OBJECTIVES:

- To understand the rationale for software development process models
- To understand why the architectural design of software is important;
- To understand the five important dimensions of dependability, namely, availability, reliability, safety, security, and resilience.
- To understand the basic notions of a web service, web service standards, and service-oriented architecture;
- To understand the different stages of testing from testing during development of a software system

UNIT I SOFTWARE PROCESS & MODELING


UNIT II SOFTWARE DESIGN


UNIT III SYSTEM DEPENDABILITY AND SECURITY


UNIT IV SERVICE-ORIENTED SOFTWARE ENGINEERING, SYSTEMS ENGINEERING AND REAL-TIME SOFTWARE ENGINEERING


UNIT V SOFTWARE TESTING AND SOFTWARE CONFIGURATION MANAGEMENT


SUGGESTED ACTIVITIES

1. Comparatively analysing different Agile methodologies.
2. Describing the scenarios where ‘Scrum’ and ‘Kanban’ are used.
3. Mapping the data flow into suitable software architecture.
4. Developing behavioural representations for a class or component.
5. Implementing simple applications as RESTful service.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
The Students will be able to

CO1: Identify appropriate process models based on the Project requirements
CO2: Understand the importance of having a good Software Architecture.
CO3: Understand the five important dimensions of dependability, namely, availability, reliability, safety, security, and resilience.
CO4: Understand the basic notions of a web service, web service standards, and service-oriented architecture;
CO5: Be familiar with various levels of Software testing

REFERENCES:

CP4211 TERM PAPER WRITING AND SEMINAR L T P C 0 0 2 1

In this course, students will develop their scientific and technical reading and writing skills that they need to understand and construct research articles. A term paper requires a student to obtain information from a variety of sources (i.e., Journals, dictionaries, reference books) and then place it in logically developed ideas. The work involves the following steps:

1. Selecting a subject, narrowing the subject into a topic
2. Stating an objective.
3. Collecting the relevant bibliography (atleast 15 journal papers)
4. Preparing a working outline.
5. Studying the papers and understanding the authors contributions and critically analysing each paper.
6. Preparing a working outline
7. Linking the papers and preparing a draft of the paper.
8. Preparing conclusions based on the reading of all the papers.
9. Writing the Final Paper and giving final Presentation

Please keep a file where the work carried out by you is maintained.
Activities to be carried out
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<tr>
<th>Activity</th>
<th>Instructions</th>
<th>Submission week</th>
<th>Evaluation</th>
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<td>Selection of area of interest and Topic</td>
<td>You are requested to select an area of interest, topic and state an objective</td>
<td>2nd week</td>
<td>3 % Based on clarity of thought, current relevance and clarity in writing</td>
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<td>Stating an Objective</td>
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<td>Collecting Information about your area &amp; topic</td>
<td>1. List 1 Special Interest Groups or professional society</td>
<td>3rd week</td>
<td>3% (the selected information must be area specific and of international and national standard)</td>
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<td>2. List 2 journals</td>
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<td>3. List 2 conferences, symposia or workshops</td>
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<td>4. List 1 thesis title</td>
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<td>5. List 3 web presences (mailing lists, forums, news sites)</td>
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<td>6. List 3 authors who publish regularly in your area</td>
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<td>7. Attach a call for papers (CFP) from your area</td>
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| Collection of Journal papers in the topic in the context of the objective – collect 20 & then filter | • You have to provide a complete list of references you will be using - Based on your objective - Search various digital libraries and Google Scholar  
• When picking papers to read - try to:  
• Pick papers that are related to each other in some ways and/or that are in the same field so that you can write a meaningful survey out of them,  
• Favour papers from well-known journals and conferences,  
• Favour “first” or “foundational” papers in the field (as indicated in other people’s survey paper),  
• Favour more recent papers,  
• Pick a recent survey of the field so you can quickly gain an overview,  
• Find relationships with respect to each other and to your topic area (classification scheme/categorization)  
• Mark in the hard copy of papers whether complete work or section/sections of the paper are being considered | 4th week | 6% (the list of standard papers and reason for selection) |
<p>| Reading and notes for first 5 papers         | Reading Paper Process                                                       | 5th week        | 8% (the table given should indicate your understanding of the                                    |</p>
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<td>Reading and notes for next 5 papers</td>
<td>Repeat Reading Paper Process</td>
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<td>Reading and notes for final 5 papers</td>
<td>Repeat Reading Paper Process</td>
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<td>Draft outline 1 and Linking papers</td>
<td>Prepare a draft Outline, your survey goals, along with a classification /</td>
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<td>Abstract</td>
<td>Prepare a draft abstract and give a presentation</td>
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<td>Introduction Background</td>
<td>Write an introduction and background sections</td>
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- Paper and the evaluation is based on your conclusions about each paper.
- The table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper.
- This component will be evaluated based on the linking and classification among the papers.
- Clarity, purpose and conclusion.
- Presentation & Viva Voce.
Sections of the paper | Write the sections of your paper based on the classification / categorization diagram in keeping with the goals of your survey | 11th week | 10% (this component will be evaluated based on the linking and classification among the papers)
---|---|---|---
Your conclusions | Write your conclusions and future work | 12th week | 5% (conclusions – clarity and your ideas)
Final Draft | Complete the final draft of your paper | 13th week | 10% (formatting, English, Clarity and linking) 4% Plagiarism Check Report
Seminar | A brief 15 slides on your paper | 14th & 15th week | 10% (based on presentation and Viva-voce)

TOTAL: 30 PERIODS

CP4212 SOFTWARE ENGINEERING LABORATORY L T P C 0 0 2 1

LAB OBJECTIVE:
The Software Engineering Lab has been developed by keeping in mind the following objectives:
- To impart state-of-the-art knowledge on Software Engineering and UML in an interactive manner through the Web.
- Present case studies to demonstrate practical applications of different concepts.
- Provide a scope to students where they can solve small, real-life problems.

LIST OF EXPERIMENTS:
1. Write a Problem Statement to define a title of the project with bounded scope of project
2. Select relevant process model to define activities and related task set for assigned project
3. Prepare broad SRS (Software Requirement Specification) for the above selected projects
4. Prepare USE Cases and Draw Use Case Diagram using modelling Tool
5. Develop the activity diagram to represent flow from one activity to another for software development
6. Develop data Designs using DFD Decision Table & ER Diagram.
7. Draw class diagram, sequence diagram, Collaboration Diagram, State Transition Diagram for the assigned project
8. Write Test Cases to Validate requirements of assigned project from SRS Document
9. Evaluate Size of the project using function point metric for the assigned project
10. Estimate cost of the project using COCOMO and COCOCMOII for the assigned project
11. Use CPM/PERT for scheduling the assigned project
12. Use timeline Charts or Gantt Charts to track progress of the assigned project

TOTAL: 30 PERIODS

LAB OUTCOME:
CO1: Can produce the requirements and use cases the client wants for the software being Produced.
CO2: Participate in drawing up the project plan. The plan will include at least extent and work assessments of the project, the schedule, available resources, and risk management can model and specify the requirements of mid-range software and their architecture.

CO3: create and specify such a software design based on the requirement specification that the software can be implemented based on the design.

CO4: Can assess the extent and costs of a project with the help of several different assessment methods.

### CO-PO Mapping

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### CP4391 SECURITY PRACTICES

**COURSE OBJECTIVES:**
- To learn the core fundamentals of system and web security concepts
- To have through 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**

**UNIT III SECURITY MANAGEMENT**

**UNIT IV CYBER SECURITY AND CLOUD SECURITY**
Cyber Forensics- Disk Forensics – Network Forensics – Wireless Forensics – Database Forensics – Malware Forensics – Mobile Forensics – Email Forensics- Best security practices for automate
Cloud infrastructure management – Establishing trust in IaaS, PaaS, and SaaS Cloud types. Case study: DVWA

UNIT V  PRIVACY AND STORAGE SECURITY


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.

TOTAL: 45 PERIODS

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MP4092 HUMAN COMPUTER INTERACTION L T P C
3 0 0 3

COURSE OBJECTIVES:

- To learn the foundations of Human Computer Interaction
- Understanding Interaction Styles and to become familiar with the design technologies for individuals and persons with disabilities.
- To understand the process of Evaluation of Interaction Design.
- To clarify the significance of task analysis for ubiquitous computing
- To get insight on web and mobile interaction.

UNIT I FOUNDATIONS OF HCI


UNIT II INTERACTION STYLES


UNIT III EVALUATION OF INTERACTION

Evaluation Techniques- assessing user experience- usability testing – Heuristic evaluation and walkthroughs, analytics predictive models. Cognitive models, Socio-organizational issues and stakeholder requirements, Communication and collaboration models

UNIT IV MODELS AND THEORIES

Task analysis, dialog notations and design, Models of the system, Modeling rich interaction, Ubiquitous computing

UNIT V WEB AND MOBILE INTERACTION

Hypertext, Multimedia and WWW, Designing for the web Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow. Use Transitions-Lookup patterns-Feedback patterns Mobile apps, Mobile navigation, content and control idioms, Multi-touch gestures, Inter-app integration, Mobile web

COURSE OUTCOMES:

CO1: Understand the basics of human computer interactions via usability engineering and cognitive modeling.
CO2: Understand the basic design paradigms, complex interaction styles.
CO3: Understand the models and theories for user interaction
CO4: Examine the evaluation of interaction designs and implementations.
CO5: Elaborate the above issues for web and mobile applications.

REFERENCES

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MP4251 CLOUD COMPUTING TECHNOLOGIES L T P C
3 0 0 3

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
Management – Virtualization for data center automation

UNIT II  CLOUD PLATFORM ARCHITECTURE

UNIT III  AWS CLOUD PLATFORM - IAAS

UNIT IV  PAAS CLOUD PLATFORM

UNIT V  PROGRAMMING MODEL
Introduction to Hadoop Framework - Mapreduce, Input splitting, map and reduce functions, specifying input and output parameters, configuring and running a job – Developing Map Reduce Applications - Design of Hadoop file system – Setting up Hadoop Cluster- Aneka: Cloud Application Platform, Thread Programming, Task Programming and Map Reduce Programming in Aneka

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.

TOTAL: 45 PERIODS

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**CO-PO Mapping**

**BD4151  FOUNDATIONS OF DATA SCIENCE  L T P C**

3 0 0 3

**COURSE OBJECTIVES:**
- To apply fundamental algorithms to process data.
- Learn to apply hypotheses and data into actionable predictions.
- Document and transfer the results and effectively communicate the findings using visualization techniques.
- To learn statistical methods and machine learning algorithms required for Data Science.
- To develop the fundamental knowledge and understand concepts to become a data science professional.

**UNIT I  INTRODUCTION TO DATA SCIENCE**
Data science process – roles, stages in data science project – working with data from files – working with relational databases – exploring data – managing data – cleaning and sampling for modeling and validation – introduction to NoSQL.

**UNIT II  MODELING METHODS**

**UNIT III  INTRODUCTION TO R**

**UNIT IV  MAP REDUCE**
Introduction – distributed file system – algorithms using map reduce, Matrix-Vector Multiplication by Map Reduce – Hadoop - Understanding the Map Reduce architecture - Writing Hadoop MapReduce Programs - Loading data into HDFS - Executing the Map phase - Shuffling and sorting - Reducing phase execution.
UNIT V  DATA VISUALIZATION


TOTAL : 45 PERIODS

COURSE OUTCOMES:
CO1: Obtain, clean/process and transform data.
CO2: Analyze and interpret data using an ethically responsible approach.
CO3: Use appropriate models of analysis, assess the quality of input, derive insight from results, and investigate potential issues.
CO4: Apply computing theory, languages and algorithms, as well as mathematical and statistical models, and the principles of optimization to appropriately formulate and use data analyses.
CO5: Formulate and use appropriate models of data analysis to solve business-related challenges.

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### CO-PO Mapping

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MP4152  WIRELESS COMMUNICATIONS  L T P C
3 0 0 3

COURSE OBJECTIVES:
- To understand the basic concepts in cellular communication.
- To learn the characteristics of wireless channels.
- To understand the impact of digital modulation techniques in fading.
- To get exposed to diversity techniques in wireless communication.
To acquire knowledge in multicarrier systems.

UNIT I  CELLULAR CONCEPTS

UNIT II  THE WIRELESS CHANNEL
Overview of wireless systems – Physical modeling for wireless channels – Time and Frequency coherence – Statistical channel models – Capacity of wireless Channel- Capacity of Flat Fading Channel – Channel Side Information at Receiver – Channel Side Information at Transmitter and Receiver –Capacity comparisons – Capacity of Frequency Selective Fading channels.

UNIT III  PERFORMANCE OF DIGITAL MODULATION OVER WIRELESS CHANNELS

UNIT IV  DIVERSITY TECHNIQUES

UNIT V  MULTICARRIER MODULATION
Data Transmission using Multiple Carriers – Multicarrier Modulation with Overlapping Sub channels – Mitigation of Subcarrier Fading – Discrete Implementation of Multicarrier Modulation – Peak to average Power Ratio- Frequency and Timing offset.

SUGGESTED ACTIVITIES:
1: Survey on various features of cellular networks
2: Study the nature of cellular networks
3: A comparative study on the performance of different digital modulation techniques
4: Perform a review of various diversity techniques in wireless communication
5: Presentation on design of multicarrier systems for 5G

COURSE OUTCOMES:
CO1: Design solutions for cellular communication
CO2: Determine the capacity of wireless channels
CO3: Analyze the performance of the digital modulation techniques in fading channels
CO4: Apply various diversity techniques in wireless communication
CO5: Design multicarrier systems in wireless communication

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SE4071 AGILE METHODOLOGIES L T P C 3 0 0 3

COURSE OBJECTIVES:
- To learn the fundamental principles and practices associated with each of the agile development methods
- To apply the principles and practices of agile software development on a project of interest and relevance to the student.
- To provide a good understanding of software design and a set of software technologies and APIs.
- To do a detailed examination and demonstration of Agile development and testing techniques.
- To understand Agile development and testing.

UNIT I AGILE SOFTWARE DEVELOPMENT 9
Basics and Fundamentals of Agile Process Methods, Values of Agile, Principles of Agile, stakeholders, Challenges . Lean Approach: Waste Management, Kaizen and Kanban, add process and products add value. Roles related to the lifecycle, differences between Agile and traditional plans, differences between Agile plans at different lifecycle phases. Testing plan links between testing, roles and key techniques, principles, understand as a means of assessing the initial status of a project/ How Agile helps to build quality
UNIT II AGILE AND SCRUM PRINCIPLES

UNIT III AGILE PRODUCT MANAGEMENT
Communication, Planning, Estimation Managing the Agile approach Monitoring progress, Targeting and motivating the team, Managing business involvement, Escalating issue. Quality, Risk, Metrics and Measurements, Managing the Agile approach Monitoring progress, Targeting and motivating the team, Managing business involvement and Escalating issue

UNIT IV AGILE REQUIREMENTS AND AGILE TESTING

UNIT V AGILE REVIEW AND SCALING AGILE FOR LARGE PROJECTS

COURSE OUTCOMES:
CO1: Analyze existing problems with the team, development process and wider organization
CO2: Apply a thorough understanding of Agile principles and specific practices
CO3: Select the most appropriate way to improve results for a specific circumstance or need
CO4: Judge and craft appropriate adaptations to existing practices or processes depending upon analysis of typical problems
CO5: Evaluate likely successes and formulate plans to manage likely risks or problems

REFERENCES
CP4095 PERFORMANCE ANALYSIS OF COMPUTER SYSTEMS 3 0 0 3

COURSE OBJECTIVES:

- To understand the mathematical foundations needed for performance evaluation of computer systems
- To understand the metrics used for performance evaluation
- To understand the analytical modeling of computer systems
- To enable the students to develop new queuing analysis for both simple and complex systems
- To appreciate the use of smart scheduling and introduce the students to analytical techniques for evaluating scheduling policies

UNIT I OVERVIEW OF PERFORMANCE EVALUATION 9

UNIT II MARKOV CHAINS AND SIMPLE QUEUES 9

UNIT III MULTI-SERVER AND MULTI-QUEUE SYSTEMS 9
Server Farms: M/M/k and M/M/k/k – Capacity Provisioning for Server Farms – Time Reversibility and Burke’s Theorem – Networks of Queues and Jackson Product Form – Classed and Closed Networks of Queues.

UNIT IV REAL-WORLD WORKLOADS 9
UNIT V  SMART SCHEDULING IN THE M/G/1 9

TOTAL : 45 PERIODS

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

CO1: Identify the need for performance evaluation and the metrics used for it
CO2: Distinguish between open and closed queuing networks
CO3: Apply Little’s law and other operational laws to open and closed systems
CO4: Use discrete-time and continuous-time Markov chains to model real world systems
CO5: Develop analytical techniques for evaluating scheduling policies

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CP4001  ADVANCED OPERATING SYSTEM  3 0 0 3

COURSE OBJECTIVES

- To get a comprehensive knowledge of the architecture of distributed systems.
• To understand the deadlock and shared memory issues and their solutions in distributed environments.
• To know the security issues and protection mechanisms for distributed environments.
• To get a knowledge of multiprocessor operating systems and database operating systems.

UNIT I  INTRODUCTION

UNIT II  DISTRIBUTED DEADLOCK DETECTION AND RESOURCE MANAGEMENT

UNIT III  DISTRIBUTED SHARED MEMORY AND SCHEDULING

UNIT IV  DATA SECURITY

UNIT-V  MULTIPROCESSOR AND DATABASE OPERATING SYSTEM
Multiprocessor operating systems - basic multiprocessor system architectures – interconnection networks for multiprocessor systems – caching – hypercube architecture. Multiprocessor Operating System - structures of multiprocessor operating system, operating system design issues- threads-process synchronization and scheduling. Database Operating systems :Introduction- requirements of a database operating system Concurrency control : theoretical aspects – introduction, database systems – a concurrency control model of database systems- the problem of concurrency control – serializability theory- distributed database systems, concurrency control algorithms – introduction, basic synchronization primitives, lock based algorithms-timestamp based algorithms,
optimistic algorithms – concurrency control algorithms: data replication.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
After the completion of this course, student will be able to
CO1: Understand and explore the working of Theoretical Foundations of OS.
CO2: Analyze the working principles of Distributed Deadlock Detection and resource management
CO3: Understand the concepts of distributed shared memory and scheduling mechanisms
CO4: Understand and analyze the working of Data security
CO5: Apply the learning into multiprocessor system architectures.

REFERENCES:
1. Mukesh Singhal, Niranjan G. Shivaratri, "Advanced concepts in operating systems: Distributed, Database and multiprocessor operating systems", TMH, 2001

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MU4251 DIGITAL IMAGE PROCESSING L T P C 3 0 0 3

COURSE OBJECTIVES:
- To study fundamental concepts of digital image processing.
- To understand and learn image processing operations and restoration.
- To use the concepts of Feature Extraction
- To study the concepts of Image Compression.
- To expose students to current trends in the field of image segmentation.

UNIT I INTRODUCTION 9
Examples of fields that use digital image processing, fundamental steps in digital image processing, components of image processing system. Digital Image Fundamentals: A simple image formation model, image sampling and quantization, basic relationships between pixels.
Image enhancement in the spatial domain: Basic gray-level transformation, histogram processing, enhancement using arithmetic and logic operators, basic spatial filtering, smoothing, and sharpening spatial filters, combining the spatial enhancement methods.

**Suggested Activities:**
- Discussion of Mathematical Transforms.
- Numerical problem solving using Fourier Transform.
- External learning – Image Noise and its types.

**Suggested Evaluation Methods:**
- Tutorial – Image transforms.
- Assignments on histogram specification, histogram equalization and spatial filters.
- Quizzes on noise modeling.

**UNIT II IMAGE RESTORATION**

A model of the image degradation/restoration process, noise models, restoration in the presence of noise—only spatial filtering, Weiner filtering, constrained least squares filtering, geometric transforms; Introduction to the Fourier transform and the frequency domain, estimating the degradation function. Color Image Processing: Color fundamentals, color models, pseudo color image processing, basics of full–color image processing, color transforms, smoothing and sharpening, color segmentation.

**Suggested Activities:**
- Discussion on Image Artifacts and Blur.
- Discussion of Role of Wavelet Transforms in Filter and Analysis.
- Numerical problem solving in Wavelet Transforms.
- External learning – Image restoration algorithms.

**Suggested Evaluation Methods:**
- Tutorial – Wavelet transforms.
- Assignment problems on order statistics and multi-resolution expansions.
- Quizzes on wavelet transforms.

**UNIT III FEATURE EXTRACTION**


**Suggested Activities:**
- External learning – Feature selection and reduction.
- External learning – Image salient features.
- Assignment on numerical problems in texture computation.

**Suggested Evaluation Methods:**
- Assignment problems on feature extraction and reduction.
- Quizzes on feature selection and extraction.
UNIT IV IMAGE COMPRESSION

Fundamentals, image compression models, error-free compression, lossy predictive coding, image compression standards Morphological Image Processing: Preliminaries, dilation, erosion, open and closing, hit or miss transformation, basic morphological algorithms

Suggested Activities:
- Flipped classroom on different image coding techniques.
- Practical – Demonstration of EXIF format for given camera.
- Practical – Implementing effects quantization, color change.
- Case study of Google’s WebP image format.

Suggested Evaluation Methods:
- Evaluation of the practical implementations.
- Assignment on image file formats

UNIT V IMAGE SEGMENTATION


Suggested Activities:
- Flipped classroom on importance of segmentation.

Suggested Evaluation Methods:
- Tutorial – Image segmentation and edge detection.

COURSE OUTCOMES:
CO1: Apply knowledge of Mathematics for image processing operations
CO2: Apply techniques for image restoration.
CO3: Identify and extract salient features of images.
CO4: Apply the appropriate tools (Contemporary) for image compression and analysis.
CO5: Apply segmentation techniques and do object recognition.

REFERENCES

TOTAL: 45 PERIODS
BD4071    HIGH PERFORMANCE COMPUTING FOR BIG DATA          L T P C
                                                     3 0 0 3

COURSE OBJECTIVES:
• To learn the fundamental concepts of High Performance Computing.
• To learn the network & software infrastructure for high performance computing.
• To understand real time analytics using high performance computing.
• To learn the different ways of security perspectives and technologies used in HPC.
• To understand the emerging big data applications.

UNIT I     INTRODUCTION

UNIT II    NETWORK & SOFTWARE INFRASTRUCTURE FOR HIGH PERFORMANCE BDA

UNIT III    REAL TIME ANALYTICS USING HIGH PERFORMANCE COMPUTING
Technologies that support Real time analytics – MOA: Massive online analysis – GPFS: General parallel file system – Client case studies – Key distinctions – Machine data analytics – operational analytics – HPC Architecture models – In Database analytics – In memory analytics

UNIT IV     SECURITY AND TECHNOLOGIES
UNIT V  EMERGING BIG DATA APPLICATIONS

Deep learning Accelerators – Accelerators for clustering applications in machine learning -
Accelerators for classification algorithms in machine learning – Accelerators for Big data Genome
Sequencing

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of the course, the student should be able to:

CO1: Understand the basics concepts of High Performance computing systems.
CO2: Apply the concepts of network and software infrastructure for high performance computing
CO3: Use real time analytics using high performance computing.
CO4: Apply the security models and big data applications in high performance computing
CO5: Understand the emerging big data applications.

REFERENCES:
1. Pethuru Raj, Anupama Raman, Dhivya Nagaraj and Siddhartha Duggirala, "High-
Performance Big-Data Analytics: Computing Systems and Approaches", Springer, 1st
2. "Big Data Management and Processing", Kuan-Ching Li , Hai Jiang, Albert Y. Zomaya,
3. "High Performance Computing for Big Data: Methodologies and Applications", Chao
wang ,CRC Press,1st Edition,2018
4. "High-Performance Data Mining And Big Data Analytics", Khosrow Hassibi, Create
5. "High performance computing: Modern systems and practices", Thomas Sterling,

WEB REFERENCES:
1. https://www.hpcwire.com/

ONLINE RESOURCES:
2. https://www.nics.tennessee.edu/computing-resources/what-is-hpc

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COURSE OBJECTIVES:
- To understand the basics of information retrieval with pertinence to modeling, query operations and indexing
- To get an understanding of machine learning techniques for text classification and clustering.
- To understand the various applications of information retrieval giving emphasis to multimedia IR, web search
- To get an understanding of machine learning techniques for text classification and clustering.
- To understand the concepts of digital libraries

UNIT I INTRODUCTION: MOTIVATION

UNIT II MODELING

UNIT III INDEXING
Static and Dynamic Inverted Indices – Index Construction and Index Compression. Searching - Sequential Searching and Pattern Matching. Query Operations -Query Languages – Query Processing - Relevance Feedback and Query Expansion - Automatic Local and Global Analysis – Measuring Effectiveness and Efficiency

UNIT IV EVALUATION AND PARALLEL INFORMATION RETRIEVAL

UNIT V SEARCHING THE WEB

COURSE OUTCOMES:
CO1: Build an Information Retrieval system using the available tools.
CO2: Identify and design the various components of an Information Retrieval system.
CO3: Categorize the different types of IR Models.

CO4: Apply machine learning techniques to text classification and clustering which is used for efficient Information Retrieval.

CO5: Design an efficient search engine and analyze the Web content structure.

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CP4096 SOFTWARE QUALITY ASSURANCE

COURSE OBJECTIVES:
- Be exposed to the software quality factors, Quality Assurance (SQA) architecture and SQA components.
- Understand the integration of SQA components into the project life cycle.
- Be familiar with the software quality infrastructure.
- Be exposed to the management components of software quality.
- Be familiar with the Quality standards, certifications and assessments

UNIT I INTRODUCTION TO SOFTWARE QUALITY & ARCHITECTURE
Need for Software quality – Software quality assurance (SQA) – Software quality factors- McCall’s quality model – SQA system components – Pre project quality components – Development and quality plans.
UNIT II  SQA COMPONENTS AND PROJECT LIFE CYCLE  
Integrating quality activities in the project life cycle – Reviews – Software Testing – Quality of software maintenance components – Quality assurance for external participants contribution – CASE tools for software quality Management.

UNIT III  SOFTWARE QUALITY INFRASTRUCTURE  
Procedures and work instructions – Supporting quality devices - Staff training and certification - Corrective and preventive actions – Configuration management – Software change control – Configuration management audit -Documentation control.

UNIT IV  SOFTWARE QUALITY MANAGEMENT & METRICS  
Project process control – Software quality metrics – Cost of software quality – Classical quality cost model – Extended model – Application and Problems in application of Cost model.

UNIT V  STANDARDS, CERTIFICATIONS & ASSESSMENTS  

COURSE OUTCOMES:
CO1: Utilize the concepts of SQA in software development life cycle
CO2: Demonstrate their capability to adopt quality standards.
CO3: Assess the quality of software products.
CO4: Apply the concepts in preparing the quality plan & documents.
CO5: Ensure whether the product meets company’s quality standards and client’s expectations and demands

TOTAL: 45 PERIODS

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COURSE OBJECTIVES:
- To impart knowledge on the functional architecture of autonomous vehicles
- To impart knowledge on Localization and mapping fundamentals
- To impart knowledge on process end effectors and robotic controls
- To learn Robot cell design, Robot Transformation and Sensors
- To learn Micro/Nano Robotic Systems

UNIT I  INTRODUCTION AND FUNCTIONAL ARCHITECTURE  9
Functional architecture - Major functions in an autonomous vehicle system, Motion Modeling - Coordinate frames and transforms, point mass model, Vehicle modeling (kinematic and dynamic bicycle model - two-track models), Sensor Modeling - encoders, inertial sensors, GPS.

UNIT II  PERCEPTION FOR AUTONOMOUS SYSTEMS  9
SLAM - Localization and mapping fundamentals, LIDAR and visual SLAM, Navigation – Global path planning, Local path planning, Vehicle control - Control structures, PID control, Linear quadratic regulator, Sample controllers.

UNIT III  ROBOTICS INTRODUCTION, END EFFECTORS AND CONTROL  9

UNIT IV  ROBOT TRANSFORMATIONS, SENSORS AND ROBOT CELL DESIGN  9

UNIT V  MICRO/NANO ROBOTICS SYSTEM  9
Micro/Nano robotics system overview-Scaling effect-Top down and bottom up approach Actuators of Micro/Nano robotics system-Nano robot communication techniques-Fabrication of micro/nano grippers-Wall climbing micro robot working principles-Biomimetic robot-Swarm robot-Nano robot in targeted drug delivery system.
COURSE OUTCOMES:
CO1: Understand architecture and modeling of autonomous systems.
CO2: Employ localization mapping techniques for autonomous systems
CO3: Design solutions for autonomous systems control.
CO4: Analyze Robot Transformations, Sensors and Cell Design
CO5: Explain the working principles of Micro/Nano Robotic systems

TOTAL: 45 PERIODS

REFERENCES

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CP4097 WEB ANALYTICS L T P C
3 0 0 3

COURSE OBJECTIVES:
- To understand the Web analytics platform, and their evolution.
- To learn about the various Data Streams Data.
- To learn about the benefits of surveys and capturing of data
- To understand Common metrics of web as well as KPI related concepts.
- To learn about the various Web analytics versions.
UNIT I  INTRODUCTION
Definition, Process, Key terms: Site references, Keywords and Key phrases; building block terms: Visit characterization terms, Content characterization terms, Conversion metrics; Categories: Offsite web, on site web; Web analytics platform, Web analytics evolution, Need for web analytics, Advantages, Limitations.

UNIT II  DATA COLLECTION
Click stream Data: Web logs, Web Beacons, JavaScript tags, Packet Sniffing; Outcomes Data: E-commerce, Lead generation, Brand/Advocacy and Support; Research data: Mindset, Organizational structure, Timing; Competitive Data: Panel-Based measurement, ISP-based measurement, Search Engine data.

UNIT III  QUALITATIVE ANALYSIS
Heuristic evaluations: Conducting a heuristic evaluation, Benefits of heuristic evaluations; Site Visits: Conducting a site visit, Benefits of site visits; Surveys: Website surveys, Post-visit surveys, creating and running a survey, Benefits of surveys. Capturing data: Web logs or JavaScript's tags, Separate data serving and data capture, Type and size of data, Innovation, Integration, Selecting optimal web analytic tool, Understanding click stream data quality, Identifying unique page definition, Using cookies, Link coding issues.

UNIT IV  WEB METRICS

UNIT V  WEB ANALYTICS 2.0
Web analytics 1.0, Limitations of web analytics 1.0, Introduction to analytic 2.0, Competitive intelligence analysis : CI data sources, Toolbar data, Panel data ,ISP data, Search engine data, Hybrid data, Website traffic analysis: Comparing long term traffic trends, Analyzing competitive site overlap and opportunities. Google Analytics: Brief introduction and working, Adwords, Benchmarking, Categories of traffic: Organic traffic, Paid traffic; Google website optimizer, Implementation technology, Limitations, Performance concerns, Privacy issues.

TOTAL: 45 PERIODS

COURSE OUTCOMES
Upon completion of this course, the students should be able to:
CO1:Understand the Web analytics platform, and their evolution.
CO2:Use the various Data Streams Data.
CO3:Know how the survey of capturing of data will benefit.
CO4:Understand Common metrics of web as well as KPI related concepts.
CO5:Apply various Web analytics versions in existence.

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### MP4091

**COURSE OBJECTIVES:**
- To familiarize with the Innovation Canvas to justify potentially successful products.
- To learn various ways in which to develop a product idea.
- To understand about how Big Data can play a vital role in Cognitive Computing.
- To know about the business applications of Cognitive Computing.
- To get into all applications of Cognitive Computing.

### UNIT I  FOUNDATION OF COGNITIVE COMPUTING

Foundation of Cognitive Computing: cognitive computing as a new generation, the uses of cognitive systems, system cognitive, gaining insights from data, Artificial Intelligence as the foundation of cognitive computing, understanding cognition Design Principles for Cognitive Systems: Components of a cognitive system, building the corpus, bringing data into cognitive system, machine learning, hypotheses generation and scoring, presentation, and visualization services.

### UNIT II  NATURAL LANGUAGE PROCESSING IN COGNITIVE SYSTEMS

Natural Language Processing in support of a Cognitive System: Role of NLP in a cognitive system, semantic web, Applying Natural language technologies to Business problems Representing knowledge in Taxonomies and Ontologies: Representing knowledge, Defining Taxonomies and Ontologies, knowledge representation, models for knowledge representation, implementation considerations.
UNIT III  BIG DATA AND COGNITIVE COMPUTING

Relationship between Big Data and Cognitive Computing: Dealing with human-generated data, defining big data, architectural foundation, analytical data warehouses, Hadoop, data in motion and streaming data, integration of big data with traditional data. Applying Advanced Analytics to cognitive computing: Advanced analytics is on a path to cognitive computing, Key capabilities in advanced analytics, using advanced analytics to create value, Impact of open source tools on advanced analytics.

UNIT IV  BUSINESS IMPLICATIONS OF COGNITIVE COMPUTING

Preparing for change, advantages of new disruptive models, knowledge meaning to business, difference with a cognitive systems approach, meshing data together differently, using business knowledge to plan for the future, answering business questions in new ways, building business specific solutions, making cognitive computing a reality, cognitive application changing the market. The process of building a cognitive application: Emerging cognitive platform, defining the objective, defining the domain, understanding the intended users and their attributes, questions and exploring insights, training and testing.

UNIT V  APPLICATION OF COGNITIVE COMPUTING

Building a cognitive health care application: Foundations of cognitive computing for healthcare, constituents in healthcare ecosystem, learning from patterns in healthcare data, Building on a foundation of big data analytics, cognitive applications across the health care ecosystem, starting with a cognitive application for healthcare, using cognitive applications to improve health and wellness, using a cognitive application to enhance the electronic medical record Using cognitive application to improve clinical teaching.

COURSE OUTCOMES:
CO1: Explain applications in Cognitive Computing.
CO2: Describe Natural language processor role in Cognitive computing.
CO3: Explain future directions of Cognitive Computing
CO4: Evaluate the process of taking a product to market
CO5: Comprehend the applications involved in this domain.

TOTAL:45 PERIODS

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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

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.

TOTAL: 45 PERIODS

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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BD4251 BIG DATA MINING AND ANALYTICS

COURSE OBJECTIVES:
- To understand the computational approaches to Modeling, Feature Extraction
- To understand the need and application of Map Reduce
- To understand the various search algorithms applicable to Big Data
- To analyze and interpret streaming data
- To learn how to handle large data sets in main memory and learn the various clustering techniques applicable to Big Data

UNIT I DATA MINING AND LARGE SCALE FILES

UNIT II  SIMILAR ITEMS  9

UNIT III  MINING DATA STREAMS  9

UNIT IV  LINK ANALYSIS AND FREQUENT ITEMSETS  9

UNIT V  CLUSTERING  9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to
CO1: Design algorithms by employing Map Reduce technique for solving Big Data problems.
CO2: Design algorithms for Big Data by deciding on the apt Features set.
CO3: Design algorithms for handling petabytes of datasets
CO4: Design algorithms and propose solutions for Big Data by optimizing main memory consumption
CO5: Design solutions for problems in Big Data by suggesting appropriate clustering techniques.

REFERENCES:

WEB REFERENCES:
1. https://swayam.gov.in/nd2_arp19_ap60/preview

ONLINE RESOURCES:
1. https://examupdates.in/big-data-analytics/
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**MOBILE AND PERVERSIVE COMPUTING**

**COURSE OBJECTIVES:**
- To understand the basics of Mobile Computing and Personal Computing
- To learn the role of cellular networks in Mobile and Pervasive Computing
- To expose to the concept of sensor and mesh networks
- To expose to the context aware and wearable computing
- To learn to develop applications in mobile and pervasive computing environment

**UNIT I**

**INTRODUCTION**


**UNIT II**

**3G AND 4G CELLULAR NETWORKS**


**UNIT III**

**SENSOR AND MESH NETWORKS**


**UNIT IV**

**CONTEXT AWARE COMPUTING & WEARABLE COMPUTING**

Adaptability – Mechanisms for Adaptation - Functionality and Data – Transcoding – Location Aware Computing – Location Representation – Localization Techniques – Triangulation and Scene

UNIT V APPLICATION DEVELOPMENT
Three tier architecture - Model View Controller Architecture - Memory Management – Information Access Devices – PDAs and Smart Phones – Smart Cards and Embedded Controls – J2ME – Programming for CLDC – GUI in MIDP – Application Development ON Android and iPhone

COURSE OUTCOMES:
CO1: Design a basic architecture for a pervasive computing environment
CO2: Design and allocate the resources on the 3G-4G wireless networks
CO3: Analyze the role of sensors in Wireless networks
CO4: Work out the routing in mesh network
CO5: Deploy the location and context information for application development
CO6: Develop mobile computing applications based on the paradigm of context aware computing and wearable computing

TOTAL:45 PERIODS

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64
### COURSE OBJECTIVES:
- To learn the basics of Web service.
- To become familiar with the Web Services building blocks
- To learn to work with RESTful web services.
- To implement the RESTful web services.
- To understand resource oriented Architecture.

### UNIT I  INTRODUCTION TO WEB SERVICE

### UNIT II  WEB SERVICE BUILDING BLOCKS
Introduction to SOAP: SOAP Syntax - Sending SOAP Messages - SOAP Implementations - Introduction to WSDL: WSDL Syntax - SOAP Binding - WSDL Implementations - Introduction to UDDI: The UDDI API - Implementations - The Future of UDDI

### UNIT III  RESTFUL WEB SERVICES

### UNIT IV  IMPLEMENTATION OF RESTFUL WEB SERVICES

### UNIT V  RESOURCE ORIENTED ARCHITECTURE
Resource- URIs - Addressability - Statelessness - Representations - Links and Connectedness - The Uniform Interface- Designing Read-Only Resource-Oriented Services : Resource Design - Turning Requirements Into Read-Only Resources - Figure Out the Data Set- Split the Data Set into Resources- Name the Resources - Design Representation- Link the Resources to Each Other- The HTTP Response

### COURSE OUTCOMES:
**CO1:** Explain how to write XML documents.
**CO2:** Apply the web service building blocks such as SOAP, WSDL and UDDI
**CO3:** Describe the RESTful web services.
CO4: Implement the RESTful web service with Spring Boot MVC
CO5: Discuss Resource-oriented Architecture.

REFERENCES
1. Leonard Richardson and Sam Ruby, RESTful Web Services, O’Reilly Media, 2007
3. Lindsay Bassett, Introduction to JavaScript Object Notation, O’Reilly Media, 2015

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CP4092 DATA VISUALIZATION TECHNIQUES

COURSE OBJECTIVES:
- To develop skills to both design and critique visualizations.
- To introduce visual perception and core skills for visual analysis.
- To understand technological advancements of data visualization
- To understand various data visualization techniques
- To understand the methodologies used to visualize large data sets

UNIT I INTRODUCTION AND DATA FOUNDATION
Basics - Relationship between Visualization and Other Fields - The Visualization Process - Pseudo code Conventions - The Scatter plot. Data Foundation - Types of Data - Structure within and between Records - Data Preprocessing - Data Sets
UNIT II  FOUNDATIONS FOR VISUALIZATION  9
Visualization stages - Semiology of Graphical Symbols - The Eight Visual Variables – Historical Perspective - Taxonomies - Experimental Semiotics based on Perception Gibson’s Affordance theory – A Model of Perceptual Processing.

UNIT III  VISUALIZATION TECHNIQUES  9

UNIT IV  INTERACTION CONCEPTS AND TECHNIQUES  9

UNIT V  RESEARCH DIRECTIONS IN VISUALIZATIONS  9

COURSE OUTCOMES:
CO1: Visualize the objects in different dimensions.
CO2: Design and process the data for Visualization.
CO3: Apply the visualization techniques in physical sciences, computer science, applied mathematics and medical sciences.
CO4: Apply the virtualization techniques for research projects.
CO5: Identify appropriate data visualization techniques given particular requirements imposed by the data.

TOTAL: 45 PERIODS

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### COURSE OBJECTIVES:

- To understand the optimization techniques used in compiler design.
- To be aware of the various computer architectures that support parallelism.
- To become familiar with the theoretical background needed for code optimization.
- To understand the techniques used for identifying parallelism in a sequential program.
- To learn the various optimization algorithms.

### UNIT I INTRODUCTION


### UNIT II INSTRUCTION-LEVEL PARALLELISM


### UNIT III OPTIMISING FOR PARALLELISM AND LOCALITY-THEORY


### UNIT IV OPTIMISING FOR PARALLELISM AND LOCALITY – APPLICATION


### UNIT V INTERPROCEDURAL ANALYSIS

Basic Concepts – Need for Interprocedural Analysis – A Logical Representation of Data Flow – A
COURSE OUTCOMES:
CO1: Design and implement techniques used for optimization by a compiler.
CO2: Modify the existing architecture that supports parallelism.
CO3: Modify the existing data structures of an open source optimising compiler.
CO4: Design and implement new data structures and algorithms for code optimization.
CO5: Critically analyse different data structures and algorithms used in the building of an optimising compiler.

TOTAL : 45 PERIODS

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CP4002 FORMAL MODELS OF SOFTWARE SYSTEMS

COURSE OBJECTIVES:
- To understand the goals, complexity of software systems, the role of Specification activities and qualities to control complexity.
- To understand the fundamentals of abstraction and formal systems
- To learn fundamentals of logic reasoning- Propositional Logic, temporal logic and apply to
models systems

- To understand formal specification models based on set theory, calculus and algebra and apply to a case study
- To learn Z, Object Z and B Specification languages with case studies.

UNIT I  SPECIFICATION FUNDAMENTALS

UNIT II  FORMAL METHODS

UNIT III  LOGIC

UNIT IV  SPECIFICATION MODELS

UNIT V  FORMAL LANGUAGES
COURSE OUTCOMES:
CO1: Understand the complexity of software systems, the need for formal specifications activities and qualities to control complexity.
CO2: Gain knowledge on fundamentals of abstraction and formal systems
CO3: Learn the fundamentals of logic reasoning- Propositional Logic, temporal logic and apply to models systems
CO4: Develop formal specification models based on set theory, calculus and algebra and apply to a typical case study
CO5: Have working knowledge on Z, Object Z and B Specification languages with case studies.

TOTAL: 45 PERIODS

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AP4094 ROBOTICS

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
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

UNIT III ROBOTICS CONTROL
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
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
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.

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

TOTAL: 45 PERIODS

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ML4291  NATURAL LANGUAGE PROCESSING  L T P C
2 0 2 3

COURSE OBJECTIVES:
- To understand basics of linguistics, probability and statistics
- To study statistical approaches to NLP and understand sequence labeling
- To outline different parsing techniques associated with NLP
- To explore semantics of words and semantic role labeling of sentences
- To understand discourse analysis, question answering and chatbots

UNIT I  INTRODUCTION 6

UNIT II  STATISTICAL NLP AND SEQUENCE LABELING 6

UNIT III  CONTEXTUAL EMBEDDING 6
Constituency –Context Free Grammar –Lexicalized Grammars- CKY Parsing – Earley's algorithm-Evaluating Parsers -Partial Parsing – Dependency Relations- Dependency Parsing - Transition Based - Graph Based

UNIT IV  COMPUTATIONAL SEMANTICS 6

UNIT V  DISCOURSE ANALYSIS AND SPEECH PROCESSING 6
SUGGESTED ACTIVITIES:
1. Probability and Statistics for NLP Problems
2. Carry out Morphological Tagging and Part-of-Speech Tagging for a sample text
3. Design a Finite State Automata for more Grammatical Categories
4. Problems associated with Vector Space Model
5. Hand Simulate the working of a HMM model
6. Examples for different types of work sense disambiguation
7. Give the design of a Chatbot

PRACTICAL EXERCISES:
1. Download nltk and packages. Use it to print the tokens in a document and the sentences from it.
2. Include custom stop words and remove them and all stop words from a given document using nltk or spaCY package
3. Implement a stemmer and a lemmatizer program.
4. Implement a simple Part-of-Speech Tagger
5. Write a program to calculate TFIDF of documents and find the cosine similarity between any two documents.
6. Use nltk to implement a dependency parser.
7. Implement a semantic language processor that uses WordNet for semantic tagging.
8. Project - (in Pairs) Your project must use NLP concepts and apply them to some data.
   a. Your project may be a comparison of several existing systems, or it may propose a new system in which case you still must compare it to at least one other approach.
   b. You are free to use any third-party ideas or code that you wish as long as it is publicly available.
   c. You must properly provide references to any work that is not your own in the write-up.
   d. Project proposal You must turn in a brief project proposal. Your project proposal should describe the idea behind your project. You should also briefly describe software you will need to write, and papers (2-3) you plan to read.

List of Possible Projects
1. Sentiment Analysis of Product Reviews
2. Information extraction from News articles
3. Customer support bot
4. Language identifier
5. Media Monitor
6. Paraphrase Detector
7. Identification of Toxic Comment
8. Spam Mail Identification

COURSE OUTCOMES:
CO1: Understand basics of linguistics, probability and statistics associated with NLP
CO2: Implement a Part-of-Speech Tagger
CO3: Design and implement a sequence labeling problem for a given domain
CO4: Implement semantic processing tasks and simple document indexing and searching system using the concepts of NLP
CO5: Implement a simple chatbot using dialogue system concepts

TOTAL: 60 PERIODS

REFERENCES
1. Daniel Jurafsky and James H. Martin, “Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition” (Prentice Hall Series in Artificial Intelligence), 2020
2. Jacob Eisenstein. “Natural Language Processing”, MIT Press, 2019
3. Samuel Burns “Natural Language Processing: A Quick Introduction to NLP with Python and NLTK, 2019

CO-PO Mapping

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IF4093 GPU COMPUTING L T P C 3 0 0 3

COURSE OBJECTIVES:
- To understand the basics of GPU architectures
- To understand CPU GPU Program Partitioning
- To write programs for massively parallel processors
- To understand the issues in mapping algorithms for GPUs
- To introduce different GPU programming models
UNIT I  GPU ARCHITECTURE  
Evolution of GPU architectures - Understanding Parallelism with GPU –Typical GPU Architecture - CUDA Hardware Overview - Threads, Blocks, Grids, Warps, Scheduling - Memory Handling with CUDA: Shared Memory, Global Memory, Constant Memory and Texture Memory.

UNIT II  CUDA PROGRAMMING  
Using CUDA - Multi GPU - Multi GPU Solutions - Optimizing CUDA Applications: Problem Decomposition, Memory Considerations, Transfers, Thread Usage, Resource Contentions.

UNIT III  PROGRAMMING ISSUES  

UNIT IV  OPENCL BASICS  

UNIT V  ALGORITHMS ON GPU  
Parallel Patterns: Convolution, Prefix Sum, Sparse Matrix - Matrix Multiplication - Programming Heterogeneous Cluster.

SUGGESTED ACTIVITIES:
1. Debugging Lab
2. Performance Lab
3. Launching Nsight
4. Running Performance Analysis
5. Understanding Metrics
6. NVIDIA Visual Profiler
7. Matrix Transpose Optimization
8. Reduction Optimization

COURSE OUTCOMES:
CO1: Describe GPU Architecture
CO2: Write programs using CUDA, identify issues and debug them
CO3: Implement efficient algorithms in GPUs for common application kernels, such as matrix multiplication
CO4: Write simple programs using OpenCL
CO5: Identify efficient parallel programming patterns to solve problems

TOTAL: 45 PERIODS

REFERENCES
4. Jason Sanders, Edward Kandrot, “CUDA by Example: An Introduction to General Purpose

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**IF4073**

**DEVOPS AND MICROSERVICES**

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**COURSE OBJECTIVES:**
- To learn the basic concepts and terminology of DevOps
- To gain knowledge on DevOps platform
- To understand building and deployment of code
- To be familiar with DevOps automation tools
- To learn basics of MLOps

**UNIT I**

**INTRODUCTION**

Software Engineering - traditional and Agile process models - DevOps - Definition - Practices - DevOps life cycle process - need for DevOps - Barriers

**UNIT II**

**DEVOPS PLATFORM AND SERVICES**

Cloud as a platform - IaaS, PaaS, SaaS - Virtualization - Containers - Supporting Multiple Data Centers - Operation Services - Hardware provisioning - software Provisioning - IT services - SLA - capacity planning - security - Service Transition - Service Operation Concepts.

**UNIT III**

**BUILDING, TESTING AND DEPLOYMENT**

Microservices architecture - coordination model - building and testing - Deployment pipeline - Development and Pre-commit Testing - Build and Integration Testing - continuous integration - monitoring - security - Resources to Be Protected - Identity Management

**UNIT IV**

**DEVOPS AUTOMATION TOOLS**

UNIT V MLOPS
MLOps - Definition - Challenges - Developing Models - Deploying to production - Model Governance - Real world examples

SUGGESTED ACTIVITIES:
1. Creating a new Git repository, cloning existing repository, Checking changes into a Git repository, Pushing changes to a Git remote, Creating a Git branch
2. Installing Docker container on windows/Linux, issuing docker commands
3. Building Docker Images for Python Application
4. Setting up Docker and Maven in Jenkins and First Pipeline Run
5. Running Unit Tests and Integration Tests in Jenkins Pipelines

COURSE OUTCOMES:
CO1: Implement modern software Engineering process
CO2: work with DevOps platform
CO3: build, test and deploy code
CO4: Explore DevOps tools
CO5: Correlate MLOps concepts with real time examples

TOTAL:75 PERIODS

REFERENCES
4. Mark Treveil, and the Dataiku Team-"Introducing MLOps" - O'Reilly Media- 2020

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MP4292 MOBILE APPLICATION DEVELOPMENT L T P C
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COURSE OBJECTIVES:
- To facilitate students to understand android SDK
- To help students to gain basic understanding of Android application development
To understand how to work with various mobile application development frameworks
To inculcate working knowledge of Android Studio development tool
To learn the basic and important design concepts and issues of development of mobile applications

UNIT I MOBILE PLATFORM AND APPLICATIONS

UNIT II INTRODUCTION TO ANDROID

UNIT III ANDROID APPLICATION DESIGN ESSENTIALS

UNIT IV ANDROID USER INTERFACE DESIGN & MULTIMEDIA
User Interface Screen elements, Designing User Interfaces with Layouts, Drawing and Working with Animation. Playing Audio and Video, Recording Audio and Video, Using the Camera to Take and Process Pictures

UNIT V ANDROID APIs
Using Android Data and Storage APIs, Managing data using Sqlite, Sharing Data between Applications with Content Providers, Using Android Networking APIs, Using Android Web APIs, Using Android Telephony APIs, Deploying Android Application to the World.

TOTAL:45 PERIODS

LIST OF EXPERIMENTS:
1. Develop an application that uses GUI components, Font, Layout Managers and event listeners.
2. Develop an application that makes use of databases
3. Develop a native application that uses GPS location information
4. Implement an application that creates an alert upon receiving a message
5. Develop an application that makes use of RSS Feed.
6. Create an application using Sensor Manager
7. Create an android application that converts the user input text to voice.
8. Develop a Mobile application for simple and day to day needs (Mini Project)

COURSE OUTCOMES:
CO1: Identify various concepts of mobile programming that make it unique from programming for other platforms
CO2: Create, test and debug Android application by setting up Android development
CO3: Demonstrate methods in storing, sharing and retrieving data in Android applications
CO4: Utilize rapid prototyping techniques to design and develop sophisticated mobile interfaces
CO5: Create interactive applications in Android using databases with multiple activities including audio, video and notifications and deploy them in marketplace

TOTAL: 75 PERIODS

REFERENCES
4. Reto Meier, "Professional Android 2 Application Development", Wiley India Pvt Ltd, 2010
5. Mark L Murphy, “Beginning Android”, Wiley India Pvt Ltd, 2009

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IF4071 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 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
**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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**CP4072 BLOCKCHAIN TECHNOLOGIES**

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**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 HYPERLEDGER AND SOLIDITY PROGRAMMING  10
Introduction to Hyperledger, Distributed Ledger Technology & its Challenges, Hyperledger &
Distributed Ledger Technology, Hyperledger Fabric, Hyperledger Composer. Solidity - Language of
Smart Contracts, Installing Solidity & Ethereum Wallet, Basics of Solidity, Layout of a Solidity
Source File & Structure of Smart Contracts, General Value Types.

UNIT V  BLOCKCHAIN APPLICATIONS  8
Internet of Things, Medical Record Management System, Domain Name Service and Future of
Blockchain, Alt Coins.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS:
1. Create a Simple Blockchain in any suitable programming language.
2. Use Geth to Implement Private Ethereum Block Chain.
4. Build Hyperledger Fabric with Smart Contract.
5. Create Case study of Block Chain being used in illegal activities in real world.
6. Using Python Libraries to develop Block Chain Application.

TOTAL: 30 PERIODS

SUPPLEMENTARY RESOURCES:
• NPTEL online course : https://nptel.ac.in/courses/106/104/106104220/#
• Udemy: https://www.udemy.com/course/build-your-blockchain-az/
• EDUXLABS Online training :https://eduxlabs.com/courses/blockchain-technology-
training/?tab=tab-curriculum

TOTAL: 75 PERIODS

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:
1. Imran Bashir, “Mastering Blockchain: Distributed Ledger Technology, Decentralization, and
CO-PO Mapping

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SE4073 EMBEDDED SOFTWARE DEVELOPMENT

COURSE OBJECTIVES:

- To understand the architecture of embedded processor, microcontroller, and peripheral devices.
- To interface memory and peripherals with embedded systems.
- To study the embedded network environment.
- To understand challenges in Real time operating systems.
- To study, analyse and design applications on embedded systems.

UNIT I EMBEDDED PROCESSORS


UNIT II EMBEDDED COMPUTING PLATFORM


UNIT III EMBEDDED NETWORK ENVIRONMENT


UNIT IV REAL-TIME CHARACTERISTICS

UNIT V  SYSTEM DESIGN TECHNIQUES


SUGGESTED ACTIVITIES:
1. Study of ARM evaluation system
2. Interfacing ADC and DAC.
3. Interfacing LED and PWM.
4. Interfacing real time clock and serial port.
5. Interfacing keyboard and LCD.
6. Interfacing EPROM and interrupt.
8. Interrupt performance characteristics of ARM and FPGA.
9. Flashing of LEDS.
10. Interfacing stepper motor and temperature sensor.

COURSE OUTCOMES:
CO1: Understand different architectures of embedded processor, microcontroller and peripheral devices. Interface memory and peripherals with embedded systems.
CO2: Interface memory and peripherals with embedded systems.
CO3: Work with embedded network environment.
CO4: Understand challenges in Real time operating systems.
CO5: Design and analyse applications on embedded systems.

TOTAL: 75 PERIODS

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### IF4291  FULL STACK WEB APPLICATION DEVELOPMENT  L T P C  
3 0 2 4

**COURSE OBJECTIVES:**
- Develop TypeScript Application
- Develop Single Page Application (SPA)
- Able to communicate with a server over the HTTP protocol
- Learning all the tools need to start building applications with Node.js
- Implement the Full Stack Development using MEAN Stack

#### UNIT I  FUNDAMENTALS & TYPESCRIPT LANGUAGE


#### UNIT II  ANGULAR


#### UNIT III  NODE.js

UNIT IV  EXPRESS.Js

UNIT V  MONGODB

LIST OF EXPERIMENTS
1. Accessing the Weather API from Angular
2. Accessing the Stock Market API from Angular
3. Call the Web Services of Express.js From Angular
4. Read the data in Node.js from MongoDB
5. CRUD operation in MongoDB using Angular

COURSE OUTCOMES:
CO1: Develop basic programming skills using Javascript
CO2: Implement a front-end web application using Angular.
CO3: Will be able to create modules to organise the server
CO4: Build RESTful APIs with Node, Express and MongoDB with confidence.
CO5: Will learn to Store complex, relational data in MongoDB using Mongoose

TOTAL : 45 + 30 = 75 PERIODS

REFERENCES
1. Adam Freeman, Essential TypeScript, Apress, 2019
2. Mark Clow, Angular Projects, Apress, 2018
3. Alex R. Young, Marc Harter, Node.js in Practice, Manning Publication, 2014

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CP4071 BIO INFORMATICS

L T P C
3 0 2 4

COURSE OBJECTIVES:
- Exposed to the need for Bioinformatics technologies
- Be familiar with the modeling techniques
- Learn microarray analysis
- Exposed to Pattern Matching and Visualization
- To know about Microarray Analysis

UNIT I INTRODUCTION
Need for Bioinformatics technologies – Overview of Bioinformatics technologies
Structural bioinformatics – Data format and processing – Secondary resources and applications – Role of Structural bioinformatics – Biological Data Integration System.

UNIT II DATAWAREHOUSING AND DATAMINING IN BIOINFORMATICS
Bioinformatics data – Data warehousing architecture – data quality – Biomedical data analysis – DNA data analysis – Protein data analysis – Machine learning – Neural network architecture and applications in bioinformatics.

UNIT III MODELING FOR BIOINFORMATICS

UNIT IV PATTERN MATCHING AND VISUALIZATION

UNIT V MICROARRAY ANALYSIS

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS:
1. Manipulating DNA strings
2. Use Protein Data Bank to visualize and Analyze the Proteins from protein database
3. Explore the Human Genome with the SciPy Stack
4. Hidden Markov Model for Biological Sequence
5. Molecular Modeling using MMTK package
6. Sequence Alignment using Biopython, Pairwise and multiple sequence alignment using ClustalW and BLAST
7. Simple generation and manipulation of genome graphs
8. DNA data handling using Biopython
9. Chaos Game Representation of a genetic sequence
10. Visualize the microarray data using Heatmap

**TOTAL: 30 PERIODS**

**COURSE OUTCOMES:**

**CO1:** Understand the different Data formats

**CO2:** Develop machine learning algorithms.

**CO3:** Develop models for biological data.

**CO4:** Apply pattern matching techniques to bioinformatics data – protein data, genomic data.

**CO5:** Apply micro array technology for genomic expression study.

**TOTAL: 45 +30=75 PERIODS**

**REFERENCES**


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**CO4291**

**CYBER PHYSICAL SYSTEMS**

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**COURSE OBJECTIVES:**

- To learn about the principles of cyber-physical systems
- To familiarize with the basic requirements of CPS.
- To know about CPS models
- To facilitate the students to understand the CPS foundations
- To make the students explore the applications and platforms.
- To provide introduction to practical aspects of cyber physical systems.
- To equip students with essential tools to implement CPS.
UNIT I  INTRODUCTION TO CYBER-PHYSICAL SYSTEMS  6
Cyber-Physical Systems(CPS)-Emergence of CPS, Key Features of Cyber-Physical Systems,,
CPS Drivers-Synchronous Model : Reactive Components, Properties of Components, Composing
Components, Designs- Asynchronous Model of CPS: Processes, Design Primitives, Coordination Protocols

UNIT II  CPS - REQUIREMENTS  12
Safety Specifications: Specifications, Verifying Invariants, Enumerative Search, Symbolic Search-
Liveness Requirements: Temporal Logic, Model Checking, Proving Liveness

UNIT III  CPS MODELS  9
Dynamical Systems: Continuous, Linear Systems-Time Models, Linear Systems, Designing
Controllers, Analysis Techniques- Timed Model: Processes, Protocols, Automata- Hybrid
Dynamical Models

UNIT IV  CPS FOUNDATIONS  9
Symbolic Synthesis for CPS- Security in CPS-Synchronization of CPS-Real-Time Scheduling for
CPS

UNIT V  APPLICATIONS AND PLATFORMS  9
Medical CPS- CPS Built on Wireless Sensor Networks- CyberSim User Interface- iClebo Kobuki -
IRobot Create- myRIO- Cybersim- Matlab toolboxes - Simulink.

LIST OF EXPERIMENTS  (30)
1. Installation of Xilinx SDK, LABVIEW, MatLab and Cybersim
2. Installation of, myRIO iRobot Create Wiring, Kobuki Wiring
3. CPS DEsign with the iRobot Create
4. CPS Design with the Kobuki.
5. Write a program in MATLAB to implement open loop system stability.
6. Write a program in MATLAB to implement timed automation.

COURSE OUTCOMES:
CO1: Explain the core principles behind CPS
CO2: Discuss the requirements of CPS.
CO3: Explain the various models of CPS.
CO4: Describe the foundations of CPS.
CO5: Use the various platforms to implement the CPS.

TOTAL: 45+30=75 PERIODS

REFERENCES
1. Raj Rajkumar, Dionisio De Niz , and Mark Klein, Cyber-Physical Systems, Addison-
Wesley Professional, 2016
3. Lee, Edward Ashford, and Sanjit Arunkumar Seshia. Introduction to embedded systems: A
cyber physical systems approach. 2nd Edition, 2017
4. André Platzer, Logical Analysis of Hybrid Systems: Proving Theorems for Complex
MU4291 Mixed Reality

COURSE OBJECTIVES:
- To study about Fundamental Concept and Components of Virtual Reality
- To study about Interactive Techniques in Virtual Reality
- To study about Visual Computation in Virtual Reality
- To study about Augmented and Mixed Reality and Its Applications
- To know about I/O Interfaces and its functions.

UNIT I INTRODUCTION TO VIRTUAL REALITY

Suggested Activities:
- Flipped classroom on uses of MR applications.
- Videos – Experience the virtual reality effect.
- Assignment on comparison of VR with traditional multimedia applications.

Suggested Evaluation Methods:
- Tutorial – Applications of MR.
- Quizzes on the displayed video and the special effects.

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MU4291 MIXED REALITY L T P C 3 0 2 4

COURSE OBJECTIVES:
- To study about Fundamental Concept and Components of Virtual Reality
- To study about Interactive Techniques in Virtual Reality
- To study about Visual Computation in Virtual Reality
- To study about Augmented and Mixed Reality and Its Applications
- To know about I/O Interfaces and its functions.

UNIT I INTRODUCTION TO VIRTUAL REALITY

Suggested Activities:
- Flipped classroom on uses of MR applications.
- Videos – Experience the virtual reality effect.
- Assignment on comparison of VR with traditional multimedia applications.

Suggested Evaluation Methods:
- Tutorial – Applications of MR.
- Quizzes on the displayed video and the special effects.
UNIT II
INTERACTIVE TECHNIQUES IN VIRTUAL REALITY


Suggested Activities:
- Flipped classroom on modeling three dimensional objects.
- External learning – Collision detection algorithms.
- Practical – Creating three dimensional models.

Suggested Evaluation Methods:
- Tutorial – Three dimensional modeling techniques.
- Brainstorming session on collision detection algorithms.
- Demonstration of three dimensional scene creation.

UNIT III
VISUAL COMPUTATION IN VIRTUAL REALITY


Suggested Activities:
- External learning – Different types of programming toolkits and Learn different types of available VR applications.
- Practical – Create VR scenes using any toolkit and develop applications.

Suggested Evaluation Methods:
- Tutorial – VR tool comparison.
- Brainstorming session on tools and technologies used in VR.
- Demonstration of the created VR applications.

UNIT IV
AUGMENTED AND MIXED REALITY

Taxonomy, technology and features of augmented reality, difference between AR and VR, Challenges with AR, AR systems and functionality, Augmented reality methods, visualization techniques for augmented reality, wireless displays in educational augmented reality applications, mobile projection interfaces, marker-less tracking for augmented reality, enhancing interactivity in AR environments, evaluating AR systems.

Suggested Activities:
- External learning - AR Systems

Suggested Evaluation Methods:
- Brainstorming session different AR systems and environments.

UNIT V
I/O INTERFACE IN VR & APPLICATION OF VR

Human factors: Introduction, the eye, the ear, the somatic senses. VR Hardware: Introduction, sensor hardware, Head-coupled displays, Acoustic hardware, Integrated VR systems. VR Software: Introduction, Modeling virtual world, Physical simulation, VR toolkits, Introduction to
VRML, Input -- Tracker, Sensor, Digitalglobe, Movement Capture, Video-based Input, 3D Menus & 3D Scanner etc. Output -- Visual / Auditory / Haptic Devices. VR Technology in Film & TV Production. VR Technology in Physical Exercises and Games. Demonstration of Digital Entertainment by VR.

**Suggested Activities:**
- External learning – Different types of sensing and tracking devices for creating mixed reality environments.
- Practical – Create MR scenes using any toolkit and develop applications.

**Suggested Evaluation Methods:**
- Tutorial – Mobile Interface Design.
- Brainstorming session on wearable computing devices and games design.
- Demonstration and evaluation of the developed MR application.

**PRACTICALS:**
1. Study of tools like Unity, Maya, 3DS MAX, AR toolkit, Vuforia and Blender.
2. Use the primitive objects and apply various projection methods by handling the camera.
3. Download objects from asset stores and apply various lighting and shading effects.
4. Model three dimensional objects using various modeling techniques and apply textures over them.
5. Create three dimensional realistic scenes and develop simple virtual reality enabled mobile applications which have limited interactivity.
6. Add audio and text special effects to the developed application.
7. Develop VR enabled applications using motion trackers and sensors incorporating full haptic interactivity.
8. Develop AR enabled applications with interactivity like E learning environment, Virtual walkthroughs and visualization of historic places.
10. Develop simple MR enabled gaming applications.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**
**CO1:** Understand the Fundamental Concept and Components of Virtual Reality
**CO2:** Able to know the Interactive Techniques in Virtual Reality
**CO3:** Can know about Visual Computation in Virtual Reality
**CO4:** Able to know the concepts of Augmented and Mixed Reality and Its Applications
**CO5:** Know about I/O Interfaces and its functions.

**TOTAL: 45+30=75 PERIODS**

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AUDIT COURSES

AX4091 ENGLISH FOR RESEARCH PAPER WRITING L T P C 2 0 0 0

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

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

REFERENCES:


AX4092 DISASTER MANAGEMENT L T P C

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 6
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 6
Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People’s Participation in Risk Assessment. Strategies for Survival

TOTAL : 30 PERIODS

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

REFERENCES:

AX4093 CONSTITUTION OF INDIA L T P C 2 0 0 0

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 of nationhood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution 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.
UNIT II  அறநநறி கலை 6
1. அறநநறி வல்லித் திளக்கங்கள்
   - அம்பா வலிப்புடன், அண்ட்பாயம், பெயர் அறிவு, கலை, புகழ்
2. பிர அறநநறி - இலக்கியம் முறை
   - சிறந்த இலக்கியம், இலக்கியம், அண்ட்பாயப்பதிவு (அட்சம் ஒலிப்புத் தந்து)

UNIT III  கணக்கான கருப்பியங்கள் 6
1. கணக்கான புரட்சி
   - இலக்கியம் முறை வழக்கம்
2. கணக்கான திருக்காலம் மன்னுத்தனம்
   - விளக்கத்திறன் அற்பாக்கப்படும் கலை

UNIT IV  அருள்நநறி தமிழ் 6
1. இலக்கியம் முறையானது
   - பாரி பல்கலைக்கழக வர்த்தமணர், பல்கலைக்கழக நியமண
உதவியிட்டு, அட்சம் ஒலிப்பு ஒலிப்புத் தந்து, அறிவு
பொருள்
2. தமிழ்
   - அண்ட்பாயக் களப்புமலர்
3. சிகிச்சாப் (617, 618)
   - சிகிச்சாப் சிகிச்சாத்திசை
4. கால்வர்த்தமணம் திருமலை மரப்பாகம்
5. புரட்சி
   - சிகிச்சா பல்கலைக்கழகப்
6. ஆக்காக்கள் (4)
   - வேலூர்
   - கல்லறை (11)
   - மூலை (11)
   - மூலை, புத்த குறுவற்றிடம் 50 (27)
   - அண்ட்பாயத்திறன் விளக்கம்

UNIT V  தவிர சுறா திறக்கியம் 6
1. இந்தியாவின் சுறா
   - கையாளும் முறைமை
   - கையாளும் விளக்கம்
   - கையாளும் திறக்கியம்
   - பாரிய திறக்கியம்
   - பாரிய திறக்கியம்.
- தொடகம்.
- தொட்டுவிடுதகலப் பபொரொட்டமும் தமிழ் இலக்கியமும்.
- முதொயவிடுதகலயும் தமிழ் இலக்கியமும்.
- தபண் விடுதகலயும் விளிம்புநிகலயினரின் பமம்பொட்டில் தமிழ் இலக்கியமும்.
- அறிவியல் தமிழ்.
- இகணயத்தில் தமிழ்.
- சுற்றுசூழல் பமம்பொட்டில் தமிழ் இலக்கியம்.

TOTAL: 30 PERIODS

கோட்டு தொடகியுடன் வேறுபடுத்தலும் / புத்தகங்கள்

1. தமிழ் இகணயகல்விக்கழகம் (Tamil Virtual University) - www.tamilvu.org
2. தமிழ் விக்கிப்பீட்டோ (Tamil Wikipedia) -https://ta.wikipedia.org
3. தர்மபுர ஆத்திரியல் புலேன்
4. வாழ்லோம் கல்விக்கழகம்
5. தமிழ் கல்விக்கழகம் (thamilvalarchithurai.com)
6. அறிவியல் கல்விக்கழகம் - கோட்டுப் பல்கலைக்கழகம். குறிப்பிட்டு}

OCE431 INTEGRATED WATER RESOURCES MANAGEMENT L T P C 3 0 0 3

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
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
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 –

UNIT IV  WATER AND HEALTH WITHIN THE IWRM CONTEXT

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

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.

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:
UNIT I  FUNDAMENTALS WASH
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

UNIT III  CHALLENGES IN MANAGEMENT AND DEVELOPMENT

UNIT IV  GOVERNANCE
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
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 in to the aspects of sustainable resource management in the absence of a clear level playing field in the developmental aspects.

REFERENCES


**OCE433 PRINCIPLES OF SUSTAINABLE DEVELOPMENT**

**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**
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 L T P C 3 0 0 3

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

issues – public hearing in EIA- EIA consultant accreditation.

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

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

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

OME431 VIBRATION AND NOISE CONTROL STRATEGIES

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
Introduction – Sources and causes of Vibration · Mathematical Models · Displacement, velocity and Acceleration · Classification of vibration: free and forced vibration, undamped and damped vibration, linear and non-linear vibration · Single Degree Freedom Systems · Vibration isolation · Determination of natural frequencies

UNIT-II BASICS OF NOISE
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
Experimental Methods in Vibration Analysis · Vibration Measuring Instruments · Selection of Sensors · Accelerometer Mountings · Vibration Exciters · Mechanical, Hydraulic, Electromagnetic and Electrodynamics · Frequency Measuring Instruments · System Identification from Frequency Response · Testing for resonance and mode shapes

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
Specification of Vibration Limits · Vibration severity standards · Vibration as condition Monitoring Tool · Case Studies · Vibration Isolation methods · Dynamic Vibration Absorber · Need for Balancing · Static and Dynamic Balancing machines · Field balancing · Major sources of noise · Noise survey techniques · Measurement technique for vehicular noise · Road vehicles Noise standard · Noise due to construction equipment and domestic appliances · Industrial noise sources and its strategies · Noise control at the source · Noise control along the path · Acoustic Barriers · Noise control at the receiver · Sound transmission through barriers · Noise reduction Vs Transmission loss · Enclosures
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:

OME432 ENERGY CONSERVATION AND MANAGEMENT IN DOMESTIC SECTORS

COURSE OBJECTIVES:
- To learn the present energy scenario and the need for energy conservation.
- To understand the different measures for energy conservation in utilities.
- Acquaint students with principle theories, materials, and construction techniques to create energy efficient buildings.
- To identify the energy demand and bridge the gap with suitable technology for sustainable habitat
- 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  9

UNIT IV  ENERGY EFFICIENT BUILDINGS  9

UNIT V  ENERGY STORAGE TECHNOLOGIES  9
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.

TOTAL: 45 PERIODS

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:

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 9

TOTAL: 45 PERIODS

REFERENCES:
UNIT I       NEED FOR ELECTRIC VEHICLES
History and need for electric and hybrid vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies, comparison of diesel, petrol, electric and hybrid vehicles, limitations, technical challenges

UNIT II       ELECTRIC VEHICLE ARCHITECTURE
Electric vehicle types, layout and power delivery, performance – traction motor characteristics, tractive effort, transmission requirements, vehicle performance, energy consumption, Concepts of hybrid electric drive train, architecture of series and parallel hybrid electric drive train, merits and demerits, mild and full hybrids, plug-in hybrid electric vehicles and range extended hybrid electric vehicles, Fuel cell vehicles.

UNIT III       ENERGY STORAGE
Batteries – types – lead acid batteries, nickel based batteries, and lithium based batteries, electrochemical reactions, thermodynamic voltage, specific energy, specific power, energy efficiency, Battery modeling and equivalent circuit, battery charging and types, battery cooling, Ultra-capacitors, Flywheel technology, Hydrogen fuel cell, Thermal Management of the PEM fuel cell

UNIT IV       ELECTRIC DRIVES AND CONTROL
Types of electric motors – working principle of AC and DC motors, advantages and limitations, DC motor drives and control, Induction motor drives and control, PMSM and brushless DC motor - drives and control, AC and Switch reluctance motor drives and control – Drive system efficiency – Inverters – DC and AC motor speed controllers

UNIT V       DESIGN OF ELECTRIC VEHICLES

TOTAL: 45 PERIODS

REFERENCES:
COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:

- Applying the principles of generic development process; and understanding the organization structure for new product design and development.
- Identifying opportunity and planning for new product design and development.
- Conducting customer need analysis; and setting product specification for new product design and development.
- Generating, selecting, and testing the concepts for new product design and development.
- 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

UNIT IV  CONCEPT GENERATION, SELECTION & TESTING

UNIT V  INDUSTRIAL DESIGN & PROTOTYPING

TOTAL: 45 PERIODS

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

- Apply the principles of generic development process; and understand the organization structure for new product design and development.
- Identify opportunity and plan for new product design and development.
• Conduct customer need analysis; and set product specification for new product design and development.
• Generate, select, and test the concepts for new product design and development.
• Apply the principles of Industrial design and prototype for design and develop new products.

TEXT BOOK:

REFERENCES:

OBA431 SUSTAINABLE MANAGEMENT LT P C 3 0 0 3

COURSE OBJECTIVES:
• To provide students with fundamental knowledge of the notion of corporate sustainability.
• To determine how organizations impacts on the environment and socio-technical systems, the relationship between social and environmental performance and competitiveness, the approaches and methods.

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
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

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 9
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 9
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 9
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.
COURSE OBJECTIVE

➢ To understand intellectual property rights and its valuation.

UNIT I  INTRODUCTION  9
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  9
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  9

UNIT IV  STRATEGIES IN INTELLECTUAL PROPERTY  9
Strategies for investing in R&D, Patent Information and databases, IPR strength in India, Traditional Knowledge, Case studies.

UNIT V  MODELS  9
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.
COURSE OBJECTIVE
➢ To help students develop knowledge and competence in ethical management and decision making in organizational contexts.

UNIT I  ETHICS AND SOCIETY  9
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  9
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  9
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  9
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  9
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.

TOTAL: 45 PERIODS

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
COURSE OBJECTIVES:

- To study about Internet of Things technologies and its role in real time applications.
- To introduce the infrastructure required for IoT.
- To familiarize the accessories and communication techniques for IoT.
- To provide insight about the embedded processor and sensors required for IoT.
- To familiarize the different platforms and Attributes for IoT.

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

UNIT II   IOT ARCHITECTURE   9

UNIT III   PROTOCOLS AND WIRELESS TECHNOLOGIES FOR IOT   9
PROTOCOLS:
NFC, SCADA and RFID, Zigbee MIPI, M-PHY, UniPro, SPMI, SPI, M-PCIe 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   9
Services/Attributes: Big-Data Analytics for IOT, Dependability, Interoperability, Security, Maintainability.
Embedded processors for IOT: Introduction to Python programming - Building IOT with RASPBERRY PI and Arduino.

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

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 L T P C 3 0 0 3

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

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

UNIT II NEURAL NETWORKS

UNIT III MACHINE LEARNING – FUNDAMENTALS & FEATURE SELECTIONS & CLASSIFICATIONS
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                                      9
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  9

UNIT III  PHOTOVOLTAIC SYSTEM DESIGN  9
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  9

UNIT V  OTHER RENEWABLE ENERGY SOURCES  9
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  9
Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, functions, opportunities, challenges and benefits, Difference between conventional & Smart Grid, 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  9
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  9
Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Phasor Measurement Unit(PMU) & 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  9

UNIT V  HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS  9
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.

TOTAL : 45 PERIODS

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

DS4015 BIG DATA ANALYTICS

COURSE OBJECTIVES:
- To understand the basics of big data analytics
- To understand the search methods and visualization
- To learn mining data streams
- To learn frameworks
- To gain knowledge on R language

UNIT I INTRODUCTION TO BIG DATA

UNIT II SEARCH METHODS AND VISUALIZATION

UNIT III MINING DATA STREAMS

UNIT IV FRAMEWORKS
MapReduce – Hadoop, Hive, MapR – Sharding – NoSQL Databases - S3 - Hadoop Distributed File Systems – Case Study- Preventing Private Information Inference Attacks on Social Networks-Grand Challenge: Applying Regulatory Science and Big Data to Improve Medical Device Innovation
UNIT V  R LANGUAGE

COURSE OUTCOMES:
CO1: understand the basics of big data analytics
CO2: Ability to use Hadoop, Map Reduce Framework.
CO3: Ability to identify the areas for applying big data analytics for increasing the business outcome.
CO4: gain knowledge on R language
CO5: Contextually integrate and correlate large amounts of information to gain faster insights.

TOTAL: 45 PERIODS

REFERENCE:

NC4201  INTERNET OF THINGS AND CLOUD  L T P C
3 0 0 3

COURSE OBJECTIVES:
- To understand Smart Objects and IoT Architectures
- To learn about various IOT-related protocols
- To build simple IoT Systems using Arduino and Raspberry Pi.
- To understand data analytics and cloud in the context of IoT
- To develop IoT infrastructure for popular applications

UNIT I  FUNDAMENTALS OF IoT

UNIT II  PROTOCOLS FOR IoT

UNIT III  CASE STUDIES/INDUSTRIAL APPLICATIONS
Case studies with architectural analysis: IoT applications – Smart City – Smart Water – Smart Agriculture – Smart Energy – Smart Healthcare – Smart Transportation – Smart Retail – Smart waste management.
UNIT IV  CLOUD COMPUTING INTRODUCTION  9

UNIT V  IoT AND CLOUD  9

COURSE OUTCOMES:
At the end of the course, the student will be able to:
CO1: Understand the various concept of the IoT and their technologies..
CO2: Develop IoT application using different hardware platforms
CO3: Implement the various IoT Protocols
CO4: Understand the basic principles of cloud computing.
CO5: Develop and deploy the IoT application into cloud environment

REFERENCES

MX4073     MEDICAL ROBOTICS     L   T   P   C
3  0  0  3

COURSE OBJECTIVES:
- To explain the basic concepts of robots and types of robots
- To discuss the designing procedure of manipulators, actuators and grippers
- To impart knowledge on various types of sensors and power sources
- To explore various applications of Robots in Medicine
- To impart knowledge on wearable robots

UNIT I  INTRODUCTION TO ROBOTICS  9
Introduction to Robotics, Overview of robot subsystems, Degrees of freedom, configurations and concept of workspace, Dynamic Stabilization

Sensors and Actuators
Sensors and controllers, Internal and external sensors, position, velocity and acceleration sensors, Proximity sensors, force sensors Pneumatic and hydraulic actuators, Stepper motor control circuits, End effectors, Various types of Grippers, PD and PID feedback actuator models

UNIT II  MANIPULATORS & BASIC KINEMATICS  9
Construction of Manipulators, Manipulator Dynamic and Force Control, Electronic and pneumatic manipulator, Forward Kinematic Problems, Inverse Kinematic Problems, Solutions of Inverse
Kinematic problems

**Navigation and Treatment Planning**
Variable speed arrangements, Path determination – Machinery vision, Ranging – Laser – Acoustic, Magnetic, fiber optic and Tactile sensor

**UNIT III SURGICAL ROBOTS**
Da Vinci Surgical System, Image guided robotic systems for focal ultrasound based surgical applications, System concept for robotic Tele-surgical system for off-pump, CABG surgery, Urologic applications, Cardiac surgery, Neuro-surgery, Pediatric and General Surgery, Gynecologic Surgery, General Surgery and Nanorobotics. Case Study

**UNIT IV REHABILITATION AND ASSISTIVE ROBOTS**
Pediatric Rehabilitation, Robotic Therapy for the Upper Extremity and Walking, Clinical-Based Gait Rehabilitation Robots, Motion Correlation and Tracking, Motion Prediction, Motion Replication. Portable Robot for Tele rehabilitation, Robotic Exoskeletons – Design considerations, Hybrid assistive limb. Case Study

**UNIT V WEARABLE ROBOTS**
Augmented Reality, Kinematics and Dynamics for Wearable Robots, Wearable Robot technology, Sensors, Actuators, Portable Energy Storage, Human–robot cognitive interaction (cHRI), Human–robot physical interaction (pHRI). Wearable Robotic Communication - case study

**COURSE OUTCOMES:**
- **CO1:** Describe the configuration, applications of robots and the concept of grippers and actuators
- **CO2:** Explain the functions of manipulators and basic kinematics
- **CO3:** Describe the application of robots in various surgeries
- **CO4:** Design and analyze the robotic systems for rehabilitation
- **CO5:** Design the wearable robots

**REFERENCES**
VE4202 EMBEDDED AUTOMATION

COURSE OBJECTIVES:
- To learn about the process involved in the design and development of real-time embedded system
- To develop the embedded C programming skills on 8-bit microcontroller
- To study about the interfacing mechanism of peripheral devices with 8-bit microcontrollers
- To learn about the tools, firmware related to microcontroller programming
- To build a home automation system

UNIT - I INTRODUCTION TO EMBEDDED C PROGRAMMING
C Overview and Program Structure - C Types, Operators and Expressions - C Control Flow - C Functions and Program Structures - C Pointers And Arrays - FIFO and LIFO - C Structures - Development Tools

UNIT - II AVR MICROCONTROLLER
ATMEGA 16 Architecture - Nonvolatile and Data Memories - Port System - Peripheral Features : Time Base, Timing Subsystem, Pulse Width Modulation, USART, SPI, Two Wire Serial Interface, ADC, Interrupts - Physical and Operating Parameters

UNIT – III HARDWARE AND SOFTWARE INTERFACING WITH 8-BIT SERIES CONTROLLERS
Lights and Switches - Stack Operation - Implementing Combinational Logic - Expanding I/O - Interfacing Analog To Digital Convertors - Interfacing Digital To Analog Convertors - LED Displays : Seven Segment Displays, Dot Matrix Displays - LCD Displays - Driving Relays - Stepper Motor Interface - Serial EEPROM - Real Time Clock - Accessing Constants Table - Arbitrary Waveform Generation - Communication Links - System Development Tools

UNIT – IV VISION SYSTEM

UNIT – V HOME AUTOMATION
Home Automation - Requirements - Water Level Notifier - Electric Guard Dog - Tweeting Bird Feeder - Package Delivery Detector - Web Enabled Light Switch - Curtain Automation - Android Door Lock - Voice Controlled Home Automation - Smart Lighting - Smart Mailbox - Electricity Usage Monitor -Proximity Garage Door Opener - Vision Based Authentic Entry System

COURSE OUTCOMES:
On successful completion of this course, students will be able to
CO1: analyze the 8-bit series microcontroller architecture, features and pin details

TOTAL: 45 PERIODS
CO2: write embedded C programs for embedded system application
CO3: design and develop real time systems using AVR microcontrollers
CO4: design and develop the systems based on vision mechanism
CO5: design and develop a real time home automation system

REFERENCES:

CX4016 ENVIRONMENTAL SUSTAINABILITY L T P C
UNIT I INTRODUCTION 3 0 0 3
Valuing the Environment: Concepts, Valuing the Environment: Methods, Property Rights, Externalities, and Environmental Problems

UNIT II CONCEPT OF SUSTAINABILITY 9
Sustainable Development: Defining the Concept, the Population Problem, Natural Resource Economics: An Overview, Energy, Water, Agriculture

UNIT III SIGNIFICANCE OF BIODIVERSITY 9
Biodiversity, Forest Habitat, Commercially Valuable Species, Stationary - Source Local Air Pollution, Acid Rain and Atmospheric Modification, Transportation

UNIT IV POLLUTION IMPACTS 9
Water Pollution, Solid Waste and Recycling, Toxic Substances and Hazardous Wastes, Global Warming.

UNIT V ENVIRONMENTAL ECONOMICS 9
Development, Poverty, and the Environment, Visions of the Future, Environmental economics and policy by Tom Tietenberg, Environmental Economics

TOTAL : 45 PERIODS

REFERENCES
UNIT I        REINFORCMENTS  
Introduction – composites –classification and application; reinforcements- fibres and its properties; preparation of reinforced materials and quality evaluation; preforms for various composites

UNIT II        MATRICES  
Preparation, chemistry, properties and applications of thermoplastic and thermostet resins; mechanism of interaction of matrices and reinforcements; optimization of matrices

UNIT III       COMPOSITE MANUFACTURING  
Classification; methods of composites manufacturing for both thermoplastics and thermostets- Hand layup, Filament Winding, Resin transfer moulding, prepregs and autoclave moulding, pultrusion, vacuum impregnation methods, compression moulding; post processing of composites and composite design requirements

UNIT IV        TESTING  
Fibre volume and weight fraction, specific gravity of composites, tensile, flexural, impact, compression, inter laminar shear stress and fatigue properties of thermostet and thermoplastic composites.

UNIT V        MECHANICS  
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

REFERENCES

UNIT I        BASICS OF NANOCOMPOSITES  

UNIT II        METAL BASED NANOCOMPOSITES  
Metal-metal nanocomposites, some simple preparation techniques and their properties. Metal-
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

UNIT I IPR 9

UNIT II AGREEMENTS, TREATIES AND PATENT FILING PROCEDURES 9

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

TOTAL : 45 PERIODS

REFERENCES