1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):
   I. Apply quantitative modeling and data analysis techniques to the solution of real world business problems, communicate findings, and effectively present results using data visualization techniques.
   II. Apply principles of Data Science to the analysis of business problems.
   III. Employ cutting edge tools and technologies to analyze big data.
   IV. Adopt ethical practices, collaborate with team members as a member or leader, and engage in constant updation of tools and techniques.
   V. Strongly focus on ingenious ideas and critical analysis to serve the society, locally and internationally as entrepreneurs using the principles of data analytics.

2. PROGRAM OUTCOMES (POs):
   1. An ability to independently carry out research / investigation and development work to solve practical problems.
   2. An ability to write and present a substantial technical report/document.
   3. Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.
   4. Understand the impact of big data for business decisions and strategy.
   5. Gain hands-on experience on large-scale analytics tools to solve some open big data problems.
   6. Understand the concept and challenge of big data and the inadequacy of existing technologies to analyze big data.
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YEAR I SEMESTER III

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YEAR II SEMESTER III

| PROJECT WORK II | |

YEAR IV SEMESTER IV

| PROJECT WORK I | |

YEAR II SEMESTER IV

| PROJECT WORK II | |

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| PROJECT WORK I | |

YEAR IV SEMESTER IV

| PROJECT WORK II |

YEAR III SEMESTER IV

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## SEMESTER III, ELECTIVE IV

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## AUDIT COURSES (AC)

Registration for any of these courses is optional to students

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**FOUNDATION COURSES (FC)**

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**PROFESSIONAL CORE COURSES (PCC)**

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### RESEARCH METHODOLOGY AND IPR COURSES (RMC)

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COURSE OBJECTIVES:

- To compute probabilities and moments of standard distributions.
- To gain knowledge about regression and correlation.
- To provide the most appropriate estimator of the parameter in statistical inference.
- To decide whether to accept or reject specific values of a parameter.
- To understand many real-world problems fall naturally within the framework of multivariate normal theory.

UNIT I  PROBABILITY AND RANDOM VARIABLES  12

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

UNIT III  ESTIMATION THEORY  12

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 :
After completing this course, students should demonstrate competency in the following topics:

- Basic probability axioms and rules and the moments of discrete and continuous random variables.
- To deal with problems involving two dimensional random variables.
- Consistency, efficiency and unbiasedness of estimators, method of maximum likelihood estimation and Central Limit Theorem.
- Use statistical tests in testing hypotheses on data.
- Perform exploratory analysis of multivariate data, such as multivariate normal density, calculating descriptive statistics, testing for multivariate normality.

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

UNIT I RESEARCH DESIGN 6
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 6
Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods. Data - Preparing, Exploring, examining and displaying.

UNIT III DATA ANALYSIS AND REPORTING 6
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 6

UNIT V PATENTS 6
Patents – objectives and benefits of patent, Concept, features of patent, Inventive step, Specification, Types of patent application, process E-filing, Examination of patent, Grant of patent,
Revocation, Equitable Assignments, Licences, Licensing of related patents, patent agents, Registration of patent agents.

TOTAL : 30 PERIODS

REFERENCES:

CP4151 ADVANCED DATA STRUCTURES AND ALGORITHMS

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 ANALYSIS

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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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.
REFERENCES

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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

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:
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
9. 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
9. Trevor Hastie, Robert Tibshirani, Jerome Friedman, “The Elements of Statistical Learning”,
CO-PO Mapping

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CP4152 DATABASE PRACTICES

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


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  15

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  15

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  15

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  15

Suggested Activities:
Implementing Access Control in Relational Databases

COURSE OUTCOMES
At the end of the course, the students will be able to
• Convert the ER-model to relational tables, populate relational database and formulate SQL queries on data.
• Understand and write well-formed XML documents
• Be able to apply methods and techniques for distributed query processing.
• Design and implement secure database systems.
• Use the data control, definition, and manipulation languages of the NoSQL databases

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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

TOTAL : 60 PERIODS

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

- To set up single and multi-node Hadoop Clusters.
- To solve Big Data problems using Map Reduce Technique.
- To learn NoSQL queries.
- To design algorithms that uses Map Reduce Technique to apply on Unstructured and structured data.
- To learn Scalable machine learning using Mahout.

LIST OF EXPERIMENTS:

1. Set up a pseudo-distributed, single-node Hadoop cluster backed by the Hadoop Distributed File System, running on Ubuntu Linux. After successful installation on one node, configuration of a multi-node Hadoop cluster (one master and multiple slaves).
2. MapReduce application for word counting on Hadoop cluster.
3. Unstructured data into NoSQL data and do all operations such as NoSQL query with API.
5. Page Rank Computation.
6. Mahout machine learning library to facilitate the knowledge build up in big data analysis.

HARDWARE/SOFTWARE REQUIREMENTS

1. Java
2. Hadoop
3. Mahout
4. HBase/MongoDB

COURSE OUTCOMES:

CO1: Set up single and multi-node Hadoop Clusters.
CO2: Apply Map Reduce technique for various algorithms.
CO3: Design new algorithms that use Map Reduce to apply on Unstructured and structured data.
CO4: Develop Scalable machine learning algorithms for various Big data applications using Mahout.
CO5: Represent NoSQL data.

TOTAL: 30 PERIODS

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BD4201  BIG DATA SECURITY  L T P C  3 0 0 3

COURSE OBJECTIVES:
- To understand the mathematical foundations of security principles
- To appreciate the different aspects of encryption techniques
- To understand the role played by authentication in security
- To understand the security concerns of big-data.

UNIT I  SYMMETRIC TECHNIQUES  9

UNIT II  ASYMMETRIC TECHNIQUES  9

UNIT III  AUTHENTICATION  9

UNIT IV  SECURITY ANALYTICS I  9

UNIT V  SECURITY ANALYTICS II  9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
After the completion of this course, students will be able to
- CO1: Design algorithms in a secure manner for Big data applications
- CO2: Use available security practices in big-data analytics.
- CO3: Understand Mathematical foundations of security principles and different aspects of encryption techniques.
CO4: Explain the role played by authentication in security.
CO5: Analyze and find solutions for Security concerns of big-data.

REFERENCES

WEB REFERENCES:

ONLINE REFERENCES:

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BD4251 BIG DATA MINING AND ANALYTICS L T P C 3 0 0 3

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

UNIT III MINING DATA STREAMS

UNIT IV LINK ANALYSIS AND FREQUENT ITEMSETS

UNIT V CLUSTERING

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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MP4251 CLOUD COMPUTING TECHNOLOGIES

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

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.

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BD4202 INFORMATION STORAGE MANAGEMENT L T P C 3 0 0 3

COURSE OBJECTIVES:
- To understand the storage architecture and technologies in Information management
- To learn to establish and manage a data center
- To learn various storage technologies for the required application
- To apply security measures to the data center

UNIT I STORAGE TECHNOLOGY 9
Review data creation - Amount of data being created - Understand the value of data to a business - Challenges in data storage and data management - Solutions available for data storage - Core elements of a data center infrastructure - Role of each element in supporting business activities.

UNIT II STORAGE SYSTEM ARCHITECTURE 9
Hardware and software components of the host environment - Key protocols and concepts used by each component - Physical and logical components of a connectivity environment - Major physical components of a disk drive and their function - Logical constructs of a physical disk - Access characteristics - Performance Implications - Concept of RAID and its components - Different RAID levels and their suitability for different application environments - Compare and contrast integrated and modular storage systems - High-level architecture and working of an intelligent storage system.

UNIT III INTRODUCTION TO NETWORKED STORAGE 9
Evolution of networked storage - Architecture - Components - Topologies of FC-SAN - NAS - IP-SAN - Benefits of the different networked storage options - Understand the need for long-Term archiving solutions - Describe how CAS fulfill the need - Understand the appropriateness - Different networked storage options - Different application environments.

UNIT IV INFORMATION AVAILABILITY, MONITORING & MANAGING DATA CENTERS 9
List reasons for planned or unplanned outages - Impact of downtime - Business continuity (BC) - Disaster recovery (DR) - RTO - RPO - Identify single points of failure - List solutions to mitigate failures - Architecture of backup/recovery - Different backup or recovery topologies - Replication technologies - Role in ensuring information availability and business continuity - Remote replication...
technologies - Role in providing disaster recovery and business continuity capabilities - Identify key areas to monitor in a data center - Industry standards for data center monitoring and management - Key metrics - Key management tasks.

UNIT V SECURING STORAGE AND STORAGE VIRTUALIZATION

Information security - Critical security attributes - Storage security domains - List and analyze the common threats in each domain - Virtualization technologies - Block-level and file-level virtualization technologies and processes.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of the course, the student should be able to:
CO1: Understand the basics of storage management for Information maintenance.
CO2: Study the requirements and strategies for the data center.
CO3: Learn various storage technologies for the required application.
CO4: Apply security measures to the data center.
CO5: Analyze Quality of Service in Storage.

REFERENCES:

WEB REFERENCES:
1. https://nptel.ac.in/courses/106108058/.

ONLINE RESOURCES:

3. CO-PO Mapping

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</table>
COURSE OBJECTIVES:

- To learn the internal architecture of an embedded processor including timers and interrupts.
- To learn and use embedded C programming.
- To provide exposure on architecture and components of IIOT.
- To introduce the communication protocols of IIOT.
- To study about visualization and data processing of IIOT.

UNIT I EMBEDDED PROCESSOR 9

UNIT II EMBEDDED C PROGRAMMING 9
Programming Embedded Systems in C - Memory And I/O Devices Interfacing - Implementing Timers, Interrupts and Serial communication in embedded C- Need For RTOS - Multiple Tasks and Processes – Context Switching - Priority Based Scheduling Policies.

UNIT III INTRODUCTION & ARCHITECTURE OF IIOT 9

UNIT IV COMMUNICATION TECHNOLOGIES OF IIOT 9
Hardwire the sensors with different protocols such as HART, MODBUS-Serial & Parallel, Ethernet, BACNet, Current, M2M etc. Need of protocols; Communication Protocols: Wi-Fi, Wi-Fi direct, IEEE 802.15.4, Zigbee, Z wave, BLE, SPI, RFID, Industry standards communication technology (COAP, LoRAWAN, OPC UA, MQTT AMQP IIOT), connecting into existing Modbus and Profibus technology, wireless network communication.

UNIT V VISUALIZATION OF IIOT 9
Cloud platforms: Overview of cots cloud platforms, predix, thingworx, azure etc. Front-end EDGE devices, Enterprise data for IIoT, Emerging descriptive data standards for IIoT, Cloud database, Cloud computing, Fog or Edge computing. Connecting an Arduino/Raspberry pi to the Web: Introduction, setting up the Arduino/Raspberry pi development environment, Options for Internet connectivity with Arduino, Configuring your Arduino/Raspberry pi board for the IoT.

TOTAL: 45 PERIODS

SUGGESTED ACTIVITIES:

1. A Study on the various embedded processors like virtual watches, PDAS, digital cameras, mp3 players
2. Develop an application using embedded C programming in arduino
3. Build a project using IIOT components
4. Study of communication protocols and technology in IIOT
5. Presentation on most prominent IIOT visualization tools

PRACTICAL EXERCISES:
1. Experiments on Arduino, ESp8266, raspberry Pi
5. Demonstration of MQTT communication
6. Demonstration of LoRa communication.

TOTAL: 30 PERIODS

HARDWARE/SOFTWARE REQUIREMENTS
1. Arduino
2. ESp8266
3. Raspberry Pi

COURSE OUTCOMES:
CO1: Describe the internal architecture of an embedded processor including timers and interrupts.
CO2: Write the embedded C programming.
CO3: Use the components of IIOT for building applications.
CO4: Demonstrate and perform the communication by using the protocols.
CO5: Explain about visualization and data processing of IIOT.

TOTAL: 75 PERIODS

REFERENCES:
BD4211  BIG DATA MINING AND ANALYTICS LABORATORY  L  T  P  C  
0  0  4  2

COURSE OBJECTIVES:
- To learn to process big data using Hadoop framework and MapReduce.
- To analyze big data using classification and clustering techniques.
- To realize storage of big data using MongoDB and Hbase.
- To develop big data applications for streaming data using Apache Spark.

LIST OF EXPERIMENTS:
1. Install, configure and run Hadoop and HDFS.
2. Implement word count / frequency programs using MapReduce(MR).
3. Implement an MR program that processes a weather dataset.
4. Implement SVM and clustering techniques using R.
5. Visualize data using any plotting framework.
6. Implement an application that stores big data in Hbase / MongoDB using Hadoop / R.

TOTAL: 60 PERIODS

LAB REQUIREMENTS FOR A BATCH OF 30 STUDENTS

SOFTWARE
Hadoop, R Package, Hbase, MongoDB, Apache Spark

COURSE OUTCOMES:
Upon completion of this course, the students will be able to
CO1: Process big data using Hadoop framework.
CO2: Implement MapReduce framework for processing big data.
CO3: Perform data analysis using classification and clustering techniques.
CO4: Realize storage of big data using MongoDB, Hbase and Apache Spark
CO5: Perform graphical data analysis
BD4212  
TERM PAPER WRITING AND SEMINAR  

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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| Collecting Information about your area & topic | 1. List 1 Special Interest Groups or professional society  
2. List 2 journals  
3. List 2 conferences, symposia or workshops  
4. List 1 thesis title  
5. List 3 web presences (mailing lists, forums, news sites)  
6. List 3 authors who publish regularly in your area  
7. Attach a call for papers (CFP) from your area. | 3rd week | 3%  (the selected information must be area specific and of international and national standard) |
| Collection of Journal papers 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) |
| Reading and notes for first 5 papers | Reading Paper Process  
- For each paper form a Table answering the following questions:  
  - What is the main topic of the article?  
  - What was/were the main issue(s) the author said they want to discuss? | 5th week | 8%  (the table given should indicate your understanding of the paper and the evaluation is) |
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<th>Reading and notes for next 5 papers</th>
<th>Repeat Reading Paper Process</th>
<th>6th week</th>
<th>8%</th>
<th>(the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)</th>
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<td>Reading and notes for final 5 papers</td>
<td>Repeat Reading Paper Process</td>
<td>7th week</td>
<td>8%</td>
<td>(the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)</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 / categorization diagram</td>
<td>8th week</td>
<td>8%</td>
<td>(this component will be evaluated based on the linking and</td>
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<td>Abstract</td>
<td>Prepare a draft abstract and give a presentation</td>
<td>9th week</td>
<td>6% (Clarity, purpose and conclusion)</td>
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<td>6% Presentation &amp; Viva Voce</td>
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<td>Introduction &amp; Background</td>
<td>Write an introduction and background sections</td>
<td>10th week</td>
<td>5% (Clarity)</td>
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<td>Sections of the paper</td>
<td>Write the sections of your paper based on the classification / categorization diagram in keeping with the goals of your survey</td>
<td>11th week</td>
<td>10% (this component will be evaluated based on the linking and classification among the papers)</td>
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<td>Your conclusions</td>
<td>Write your conclusions and future work</td>
<td>12th week</td>
<td>5% (Conclusions – clarity and your ideas)</td>
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<td>Final Draft</td>
<td>Complete the final draft of your paper</td>
<td>13th week</td>
<td>10% (formatting, English, Clarity and linking)</td>
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<td>Seminar</td>
<td>A brief 15 slides on your paper</td>
<td>14th &amp; 15th week</td>
<td>10% (based on presentation and Viva-voce)</td>
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**TOTAL: 30 PERIODS**

**BD4071  HIGH PERFORMANCE COMPUTING FOR BIG DATA**  

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

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

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CO-PO Mapping

MP4094 WEB SERVICES AND API DESIGN

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.

TOTAL: 45 PERIODS

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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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 9

UNIT II MODELING 9

UNIT III INDEXING 9
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 9

UNIT V SEARCHING THE WEB 9

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.
REFERENCES

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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
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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BD4001 PRINCIPLES OF SUPPLY CHAIN MANAGEMENT L T P C 3 0 0 3

COURSE OBJECTIVES:
- To analyze the supply chain scenario in India and its enabling factors.
- To make students to get insights on supply chain process from sourcing to distribution.
- To enhance the skills on supply chain integration and sustainable supply chain strategies among the students.
- To build knowledge in students to take care of any kinds of supply chain assignments in business organizations.

UNIT I INTRODUCTION
Role of Logistics and Supply chain Management: Scope and Importance - Evolution of Supply Chain - Decision Phases in Supply Chain - Competitive and Supply chain Strategies – Drivers of Supply Chain Performance and Obstacles.

UNIT II SUPPLY CHAIN NETWORK DESIGN

UNIT III LOGISTICS IN SUPPLY CHAIN
Role of transportation in supply chain – factors affecting transportation decision – Design option for transportation network – Tailored transportation – Routing and scheduling in transportation.

UNIT IV SOURCING AND COORDINATION IN SUPPLY CHAIN
Role of sourcing supply chain supplier selection assessment and contracts - Design collaboration - sourcing planning and analysis - supply chain coordination - Bullwhip effect – Effect of lack of coordination in supply chain and obstacles – Building strategic partnerships and trust within a supply chain.

UNIT V SUPPLY CHAIN AND INFORMATION TECHNOLOGY

TOTAL : 45 PERIODS

COURSE OUTCOME:
Upon completion of the course, the student should be able to:
CO1: Understand the framework and scope of supply chain management.
CO2: Build and manage a competitive supply chain using strategies, models, techniques and information technology.

CO3: Analyze the logistics in supply chain

CO4: Plan the demand, inventory and supply and optimize supply chain Network

CO5: Evaluate the impact of IT on the Supply chain.

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BD4002 COMPUTATIONAL GEOMETRY

COURSE OBJECTIVES
- To understand geometric problems.
- To learn the algorithmic solutions for geometric problems.
- To learn the solutions for proximity problems.
- To map problems in various application domains to a geometric problem.

UNIT I INTRODUCTION
Introduction – Application Domains – Line Segment Intersection – Intersection of Convex Polygons – Polygon Triangulation.

UNIT II GEOMETRIC SEARCHING

UNIT III CONVEX HULL PROBLEM
UNIT IV PROXIMITY PROBLEMS

UNIT V VORONOI DIAGRAM
Voronoi Diagram – Proximity Problems Solved by the Voronoi Diagram – Planar Applications.

TOTAL : 45 PERIODS

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

CO1: Transform problems in different applications to geometric problems

CO2: Use algorithms and techniques to solve search and point location problems

CO3: Understand and solve the complex hull problem

CO4: Solve proximity problems using various techniques

CO5: Use the appropriate and relevant, fundamental and applied computational knowledge, methodologies and modern tools in solving real-world problems.

REFERENCES:
1. Dr. Kalyanrao Takale , Dr. Shrikisan Gaikwad , Dr. Mrs. Nivedita Mahajan , Dr. Amjad Shaikh , Prof. Mrs. Shamal Deshmukh , Prof. S.R. Patil,1st Edition,,"Computational Geometry",2021.
2. David Mount,CMSC 754: Computational Geometry, 2021.Lecture notes from his Fall 2021 computational geometry course at Maryland.

WEB REFERENCES:
1. https://nptel.ac.in/courses/106/102/106102011/

ONLINE RESOURCES:

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COURSE OBJECTIVES:

- To give the knowledge of soft computing theories fundamentals
- To provide the mathematical background for carrying out the optimization associated with neural network learning
- To familiarize the ideas of fuzzy sets, fuzzy logic, use of heuristics and Fuzzy Logic Control Systems
- To introduce the mathematical background for genetic algorithms
- To expose the hybrid soft computing systems and its applications

UNIT I  SOFT COMPUTING FUNDAMENTALS  

UNIT II  NEURAL NETWORKS  

UNIT III  FUZZY COMPUTING AND MODELING  

UNIT IV  GENETIC ALGORITHM AND APPLICATIONS  

UNIT V  HYBRID SOFT COMPUTING AND APPLICATIONS  
COURSE OUTCOMES:
After completion of the course, the student will be able to:
CO1: Apply various soft computing concepts for practical applications
CO2: Choose and design suitable neural network for real time problems
CO3: Use fuzzy logic rules and reasoning to handle uncertainty and develop decision making and expert system
CO4: Describe the importance of genetic algorithms for solving combinatorial optimization problems
CO5: Analysis the various hybrid soft computing techniques and apply in real time problems

TOTAL: 45 PERIODS

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MU4152  MULTIMEDIA COMMUNICATION NETWORKS  L T P C  3 0 0 3

COURSE OBJECTIVES:
- To recapitulate the fundamentals of networking and understand the requirements for multimedia communication.
- To learn guaranteed service model.
- To learn communication protocols that is frequently used in IoT ecosystems.
- To explore the support provided for multimedia communication in 3G and 4G networks.
- To study about VoIP and real time multimedia network applications.
UNIT I  
INTRODUCTION

Suggested Activities:
- Flipped classroom on network externalities and Economies of scale.
- External learning – Inter-continental backbone network and Autonomous Systems model of the Internet.
- Assignments on computing the playout time of packets.

Suggested Evaluation Methods:
- Quiz and discussion on network externalities and economies of scale.
- Assignments on proprietary protocols used in IoT and M2M.
- Assignments on problems related to playout time of multimedia applications.

UNIT II  
GUARANTEED SERVICE MODEL

Suggested Activities:
- Flipped classroom on IntServ and DiffServ networks.
- External learning – Exploring the ways of using DSCP in IP header.
- Assignments on finish time problems related to WFQ and its variants.

Suggested Evaluation Methods:
- Quiz and discussion on IntServ and DiffServ networks.
- Assignments on configuring a router in such a way that DSCP fielder is exploited to provide QoS.
- Assignments on problems related to the virtual finish and actual finish of packets in WFQ and its variants.

UNIT III  
MULTIMEDIA TRANSPORT

Suggested Activities:
- External learning – Exploring various media players available and the ways to customize them.
- Exploring the ways to configure RTP.
- Flipped classroom on RTP and RTCP.
Suggested Evaluation Methods:
- Assignments on media players available and configuring them.
- Configuring RTP and RTSP.
- Quiz and discussion on RTP and RTCP.

UNIT IV  MULTIMEDIA OVER WIRELESS NETWORKS

Suggested Activities:
- Flipped classroom on IMSVoLTE architecture.
- External learning – Multimedia support in 5G networks.
- Analyzing the protocols of IP media subsystem.

Suggested Evaluation Methods:
- Quiz and discussion on IMSVoLTE architecture.
- Assignments on multimedia support in 5G networks.
- Assignments on analyzing the headers of IP multimedia subsystem.

UNIT V  MULTIMEDIA NETWORKED APPLICATIONS

Suggested Activities:
- Flipped classroom on SCIBus and S.100.
- External learning – Multimedia access networks and edge networks.
- Exploring the ways to configure SIP.

Suggested Evaluation Methods:
- Quiz and discussion on SCIBus and S.100.
- Assignments on multimedia access networks and edge networks.
- Configuring SIP using suitable commands.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On completion of the course, the students will be able to:
CO1: Deploy the right multimedia communication models.
CO2: Apply QoS to multimedia network applications at the network level with efficient scheduling and routing techniques.
CO3: Apply QoS to multimedia network applications at the end system level with efficient scheduling and routing techniques.
CO4: Understand IP multimedia subsystem and IP initiatives in cellular networks to support multimedia traffic.

CO5: Design and implement VoIP based solutions for multimedia transport.

CO6: Develop the real-time multimedia network applications.

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BD4003 PARALLEL AND DISTRIBUTED COMPUTING L T P C
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COURSE OBJECTIVES:
- To select the appropriate parallel programming model for the given application.
- To practice the constructs of a parallel programming model to convert a sequential program to parallel program.
- To develop parallel programs using OpenMP and MPI constructs.
- To study software components of distributed computing systems. Know about the communication and interconnection architecture of multiple computer systems.
- To recognize the inherent difficulties that arise due to distributedness of computing resources.
- To understand the concepts of networks & protocols, mobile & wireless computing and their applications in solving real world problems.

UNIT I FUNDAMENTALS
Introduction to Parallel and Distributed Computing - Parallel and Distributed Architectures, Socket programming - Parallel Performance, Shared Memory and Threads – Parallel Algorithms - Parallel Algorithms, OpenMP - Scalable Algorithms, Message Passing - Parallel, work sharing and
Synchronization constructs. MPI data types and tags, environment management routines. Data level parallelism - Vector architecture- Graphics processing units-Programming the GPU.

UNIT II PROCESS AND DISTRIBUTED OBJECTS 9

UNIT III OPERATING SYSTEM ISSUES I 9

UNIT IV OPERATING SYSTEM ISSUES II 9

UNIT V DISTRIBUTED TRANSACTION PROCESSING 9

COURSE OUTCOMES:
Upon completion of the course, the student should be able to:
CO1: Work on appropriate parallel programming model
CO2: Model and visualize Design protocols for ensuring cache coherence
CO3: Students will be familiar with the design of the Distributed system.
CO4: To implementation and security issues of distributed systems.
CO5: To implement Transaction Processing of distributed systems.

REFERENCES:

WEB REFERENCES:
ONLINE RESOURCES:
1. https://www.youtube.com/watch?v=dlBVWMdGhqw&list=PLUJ7JmcrTifBROWODSG8wgyI20XgBuE-N
2. https://www.youtube.com/watch?v=qbQCQ0U6H0o&list=PLbMVogVj5nJQRvzENlvMKAv9q70ScSRZBQ

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BD4091 PREDICTIVE MODELLING L T P C 3 0 0 3

COURSE OBJECTIVES:
- To understand the terms and terminologies of predictive modeling.
- To study the various predictive models, their merits, demerits and application.
- To get exposure to various analytical tools available for predictive modeling.
- To learn the predictive modeling markup language.
- To get familiar with the technologies in predictive modeling.

UNIT I INTRODUCTION TO PREDICTIVE MODELING 9
Core ideas in data mining - Supervised and unsupervised learning - Classification vs. Prediction - Steps in data mining- SEMMA Approach - Sampling - Pre-processing - Data cleaning - Data Partitioning - Building a model - Statistical models - Statistical models for predictive analytics.

UNIT II PREDICTIVE MODELING BASICS 9

UNIT III PREDICTIVE MODELS 9
UNIT IV  PREDICTIVE MODELING MARKUP LANGUAGE  

UNIT V  TECHNOLOGIES AND CASE STUDIES  

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of the course, the student should be able to:
CO1: Design and analyze appropriate predictive models.
CO2: Define the predictive models using PMML.
CO3: Apply statistical tools for analysis.
CO4: Use various analytical tools available for predictive modeling.
CO5: Apply predictive modeling markup language in data manipulation.

REFERENCES:

WEB REFERENCES:
1. https://nptel.ac.in/courses/108108111/
2. https://www.coursera.org/learn/predictive-modeling-analytics

ONLINE RESOURCES:
1. https://bookdown.org/egarpor/PM-UC3M/
2. https://cics.nd.edu/research/applications/materials/

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BDA004  IMAGE PROCESSING AND ANALYSIS  L T P C
3 0 0 3

COURSE OBJECTIVES:
- To understand the basics of digital images and noise models
- To understand spatial domain filters and frequency domain filters
- To understand the image processing techniques
- To familiarize the image processing environment and their applications
- To appreciate the use of image processing in various applications

UNIT I  SPATIAL DOMAIN PROCESSING  9

UNIT II  FREQUENCY DOMAIN PROCESSING  9

UNIT III  SEGMENTATION AND EDGE DETECTION  9

UNIT IV  INTEREST POINTS, MORPHOLOGY, AND TEXTURE  9

UNIT V  COLOR IMAGES AND IMAGE COMPRESSION  9

COURSE OUTCOMES:
CO1: Design and implement algorithms for image processing applications that incorporate different concepts of medical Image Processing
CO2: Explain image modalities, sensing, acquisition, sampling, and quantization, noise models and implement spatial filter operations
CO3: Familiar with the use of MATLAB and its equivalent open source tools
CO4: Critically analyze different approaches to image processing applications
CO5: Explore the possibility of applying image processing concepts in various applications

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MP4091 COGNITIVE COMPUTING L T P C 3 0 0 3

COURSE OBJECTIVES:
- To familiarize Use 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 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 eco system, 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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IF4095 SOCIAL NETWORK ANALYSIS

COURSE OBJECTIVES:
- Formalise different types of entities and relationships as nodes and edges and represent this information as relational data.
- Understand the fundamental concepts in analyzing the large-scale data that are derived from social networks.
- Understand the basic concepts and principles of different theoretical models of social networks analysis.
- Transform data for analysis using graph-based and statistics-based social network measures.
- Choose among social network designs based on research goals.

UNIT I GRAPH THEORY AND STRUCTURE

UNIT II SOCIAL NETWORK GRAPH ANALYSIS
Social network exploration/processing and properties: Finding overlapping communities, similarity...
between graph nodes, counting triangles in graphs, neighborhood properties of graphs. Pregel paradigm and Apache Giraph graph processing system.

UNIT III INFORMATION DIFFUSION IN SOCIAL NETWORKS

UNIT IV CASCADING IN SOCIAL NETWORKS

UNIT V LINK ANALYSIS & COMMUNITY DETECTION

SUGGESTED ACTIVITIES:
- Twitter Intelligence project performs tracking and analysis of the Twitter
- Large-Scale Network Embedding as Sparse Matrix Factorization
- Implement how Information Propagation on Twitter
- Social Network Analysis and Visualization software application.
- Implement the Structure of Links in Networks

COURSE OUTCOMES:
CO1: Plan and execute network analytical computations.
CO2: Implement mining algorithms for social networks
CO3: Analyze and evaluate social communities.
CO4: Use social network analysis in behavior analytics
CO5: Perform mining on large social networks and illustrate the results.

TOTAL : 45 PERIODS

REFERENCES
1. Practical Social Network Analysis with Python, Krishna Raj P. M. Ankith Mohan and K. G. Srinivasa. Springer, 2018
2. SOCIAL NETWORK ANALYSIS: METHODS AND APPLICATIONS, STANLEY WASSERMAN, and KATHERINE F’ AUST. CAMBRIDGE UNIVERSITY PRESS, 2012
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### COURSE OBJECTIVES:
- To understand and deploy practical virtualization solutions and enterprise solutions.
- Able to understand Server Virtualization and Virtualization Platform.
- Understand the technologies of Virtualization and Network Virtualization.
- To understand the concepts of Virtualization storage.
- To study virtual machine products.

### UNIT I  OVERVIEW OF VIRTUALIZATION
- System architectures - Virtual Machine basics - Process vs System Virtual Machines - Taxonomy.
- Emulation: Basic Interpretation - Threaded Interpretation - Precoded and Direct Threaded Interpretation - Binary Translation. System Virtual Machines - Key concepts - Resource utilization basics.

### UNIT II  PROCESS VIRTUAL MACHINES

### UNIT III  HIGH LEVEL LANGUAGE VIRTUAL MACHINES AND SERVER VIRTUALIZATION

### UNIT IV  NETWORK AND STORAGE VIRTUALIZATION

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**BD4005**  VIRTUALIZATION TECHNIQUES AND APPLICATIONS  
**L T P C**  3 0 0 3

---

59
UNIT V APPLYING VIRTUALIZATION


TOTAL : 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the student should be able to

CO1: Design and develop applications on virtual machine platforms

CO2: To understand the concepts of virtualization and virtual machines.

CO3: To understand the implementation of process and system virtual machines.

CO4: To explore the aspects of high level language virtual machines.

CO5: To gain expertise in server, network and storage virtualization.

REFERENCES:


WEB REFERENCES:

1. lecturer.eepis-its.edu/~isbat/materikuliah/.../Virtualization.ppt
2. cs.nju.edu.cn/distribute-systems/lecture-notes/c11.ppt

ONLINE RESOURCES:

1. https://www.simplilearn.com/virtualization

2. tutorialspoint.com/virtualization2.0/virtualization2.0_overview.htm

CO-PO Mapping

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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

30 PERIODS

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: 30 PERIODS

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.
   e. 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
CO 2: Implement a Part-of-Speech Tagger
CO 3: Design and implement a sequence labeling problem for a given domain
CO 4: Implement semantic processing tasks and simple document indexing and searching system using the concepts of NLP
CO 5: 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

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BD4006 DATA INTENSIVE COMPUTING

COURSE OBJECTIVES:
- To understand the basics of the various database systems including databases for Big data.
- To learn the architecture of data intensive computing.
- To learn parallel processing for data intensive computing.
- To learn the applications that involve Data intensive computing.

UNIT I INTRODUCTION
Introduction to Distributed systems – Databases Vs. File Systems - Distributed file systems(HDFS) – Distributed Machine-Learning System - Data Parallelism – Characteristics -Hadoop –Execution Engines -Map Reduce- Distributed Storage System for Structured Data – NoSQL databases - Casandra, Mongo DB-Developing a Distributed Application

UNIT II ARCHITECTURES AND SYSTEMS
Model - Architecture for Data Stream Management - Stream Queries – Sampling Data in a Stream Filter Streams

UNIT III TECHNOLOGIES AND TECHNIQUES
9

UNIT IV SECURITY
9
Security in Data Intensive Computing Systems - Data Security and Privacy in Data-Intensive Supercomputing Clusters - Information Security in Large Scale Distributed Systems -Privacy and Security Requirements of Data Intensive Applications in Clouds

UNIT V APPLICATIONS AND FUTURE TRENDS
9

TOTAL : 45 PERIODS

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

CO1: Design applications that involve data intensive computing.
CO2: Suggest appropriate architecture for data intensive computing systems.
CO3: Decide on the appropriate techniques of Map Reduce, Mongo DB, for the different Applications.
CO4: Identify parallel processing techniques for data intensive computing.
CO5: Decide on the various security techniques that are necessary for data intensive applications.

REFERENCES:

WEB REFERENCES:
2. https://www.computer.org/csdl/magazine/co/2008/04/mco2008040030/13rRUNvgyZ8

ONLINE RESOURCES:
1. https://www.slideshare.net/huda2018/dataintensive-technologies-for-cloudcomputing

CO-PO Mapping

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COURSE OBJECTIVES

- To study the major data mining problems as different types of computational tasks (prediction, classification, clustering, etc.) and the algorithms appropriate for addressing these tasks
- To learn how to analyze data through statistical and graphical summarization, supervised and unsupervised learning algorithms
- To systematically evaluate data mining algorithms and understand how to choose algorithms for different analysis tasks

UNIT I  INTRODUCTION DATA MINING
Introduction, Mining Association Rules in Large Databases, Mining Frequent Patterns - basic concepts - Efficient and scalable frequent item set mining methods, Apriori algorithm, FP-Growth algorithm, Associations - mining various kinds of association rules.

UNIT II  PREDICTIVE MODELING AND CLUSTERING

UNIT III  MINING DATA STREAMS

UNIT IV  DATA ANALYTIC METHODS USING R

UNIT V  FUNCTIONS AND PACKAGES IN R
Executing Scripts, Reading Datasets and Exporting Data from Manipulating and Processing Data in R, Working with Functions and Packages in R, Performing Graphical Analysis in R, Techniques Used for Visual Data Representation, Types of Data Visualization.

TOTAL: 45 PERIODS
COURSE OUTCOMES:
Upon completion of the course, the student should be able to:
CO1: Demonstrate accurate and efficient use of classification using the R system for the computations.
CO2: Demonstrate the related data mining techniques Using R
CO3: Demonstrate capacity for mathematical reasoning through analyzing, proving and explaining concepts from the theory that underpins classification and related data mining methods
CO4: Apply problem-solving using classification and related data mining techniques to diverse situations in business, biology, engineering and other sciences
CO5: Analyze the data visualization

REFERENCES:
1. Carlo Vercellis, Business Intelligence: Data mining and Optimization for Decision Making, WILEY.
3. Big Data Computing and Communications edited by Yu Wang, Hui Xiong, ShlomoArgamon, XiangYang Li, JianZhong Li Springer

WEB REFERENCES:
1. https://onlinecourses-archive.nptel.ac.in/noc18-mg11/announcements
2. https://swayam.gov.in/nd1_noc19_ma33/preview
3. www.datacamp.com/R-Tutorial

ONLINE RESOURCES:
1. https://www.youtube.com/watch?v=BB2O4VCu5j8

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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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MP4071 HEALTHCARE ANALYTICS L T P C 3 0 0 3

COURSE OBJECTIVES:
- To impart the fundamental concepts of Healthcare data analytics
- To give the knowledge about the Healthcare Data Sources.
- To familiarize Advanced Data Analytics for Healthcare
- To learn the Health IoT data analytics
- To implement the Applications and Practical Systems for Healthcare.

UNIT I INTRODUCTION 9
Introduction- Healthcare Data Sources and Basic Analytics - Healthcare Data Sources: Electronic Health Records: Components of HER- Coding system- Biomedical Image Analysis: Biomedical Imaging Modalities- Object Detection- Image Segmentation- Image Registration- Feature Extraction- Mining of Sensor Data in Healthcare: Mining Sensor Data in Medical Informatics: Scope and Challenges- Sensor Data Mining Applications

UNIT II HEALTHCARE DATA SOURCES 9
Biomedical Signal Analysis: Types of Biomedical Signals- ECG Signal Analysis- Denoising of Signals- Multivariate Biomedical Signal Analysis- Cross-Correlation Analysis- Methods to Study Connectivity- Genomic Data Analysis for Personalized Medicine: Genomic Data Generation-Methods and Standards for Genomic Data Analysis- Types of Computational Genomics Studies towards Personalized Medicine
UNIT III  ADVANCED DATA ANALYTICS FOR HEALTHCARE  

UNIT IV  HEALTH IOT DATA ANALYTICS  
Internet of things in the healthcare industry- IoT healthcare architecture- Characteristics of IoT health data- Health data analytics using Internet of things- Computational intelligence in Internet of things for future healthcare applications.

UNIT V  APPLICATIONS AND PRACTICAL SYSTEMS FOR HEALTHCARE  

COURSE OUTCOMES:
CO1: Describe the basics of healthcare data analytics.
CO2: Explain the Healthcare Data Sources.
CO3: Discuss the Advanced Data Analytics for Healthcare.
CO4: Express the Health IoT data analytics.
CO5: Apply the practical Systems for Healthcare.

TOTAL: 45 PERIODS

REFERENCES

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COURSE OBJECTIVES:
- To provide the required skill to apply the statistical tools in engineering Problems.
- To introduce the basic concepts of Time Series and Estimations.
- To acquaint the knowledge of Statistical Inference and Decision Theory.
- To provide the basic tools of Statistics for data analysis and Decision making on the sampling and inference.

UNIT I  |  INTRODUCTION TO TIME SERIES  |  9

UNIT II  |  ESTIMATION  |  9
Methods of estimation: Random samples, sampling distributions of estimators, Methods of moments, Unbiasedness: Unbiased estimator, Illustration of unbiased estimator for the parameter and parametric function. Definitions of Consistency, Sufficient condition for consistency, concept of efficiency and sufficiency. Neyman- Factorization theorem (without proof), concept of likelihood function, Maximum Likelihood, Properties of MLE (without proof), Estimation of the parameters of normal distribution and other standard distributions by MLE.

UNIT III  |  STATISTICAL INFERENCE AND DECISION THEORY  |  9

UNIT IV  |  REGRESSION AND RELIABILITY  |  9
Multiple linear regression, forward, backward & stepwise regression, Logistic Regression. Reliability of system of independent components, association of random variables, bounds on system reliability, improved bounds on system reliability using modular decompositions. Replacement policy comparisons, preservation of life distribution classes under reliability operations. Reversed hazard rate, cumulative reversed hazard function, relation between hazard function and reversed hazard function. Reversed lack of memory property.

UNIT V  |  STATISTICAL QUALITY CONTROL  |  9
Meaning and purpose of Statistical quality control, Concept of process control, product control, assignable causes, chance causes and rational subgroups. Control charts and their uses, Choice of subgroup sizes, Construction of control chart for (mean), R (range), s (standard deviation), c (no.of defectives), p (fraction defectives) with unequal subgroup size. Interpretation of non-random patterns of points. Modified control chart. CUSUM Chart. Consumer's risk, producer's risk, OCcurve, acceptance sampling plan by attributes and variables. Concept of Six Sigma.
COURSE OUTCOMES:

By the end of the course the students will be able to

CO1: Perform time series analysis of data.
CO2: Apply the concept of Point estimation by Method of moments and Maximum likelihood estimation.
CO3: Evaluate the regression and reliability for the statistical sampling data.
CO4: Apply various estimators for the statistical concepts.
CO5: Apply various techniques in quality control and acceptance sampling.

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

TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

REFERENCES:

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 6
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 6

UNIT III DISASTER PRONE AREAS IN INDIA 6
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

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

TOTAL : 30 PERIODS
REFERENCES:

AX4093 CONSTITUTION OF INDIA

COURSE OBJECTIVES:
Students will be able to:
- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals’ constitutional role and entitlement to civil and economic rights as well as the emergence 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:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. 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.

SUGGESTED READING

1. The Constitution of India, 1950 (Bare Act), Government Publication.
- பொரி முல்கலக்குத் பதர் தகொடுத்தது, பபகன் மயிலுக்குப் பபொர்கவ தகொடுத்தது, அதியமொன் ஒளகவக்கு நல்லிக்கனி தகொடுத்தது, அர் பண்புகள்

2. தற்காலத்தை
   - அண்டனச்சந்திர புலனா கிமுப்பு
3. கிருஷ்ணன் (617, 618)
   - துணை துணை விளக்க
4. தர்மகாண்டகம் நிதியீச் அங்களர்
5. பராமரியம்
   - சிங்கல் மங்கலகராச
6. சிறந்த (4)
   - சிறி
   கோன்கல் (11)
   சிலமைகன் (11) - பரங்க, பும்பா
   செம்மன்ற 50 (27) - பரங்க
   உத்தியூட்டலை அமைப்பிட்டிடேனூங்கள்

UNIT V

1. சாரங்கோடத் கொடு
   - காவலிண் மகா விரைவா
   - காவலிண் மகா விரைவா
   - கார்த்திக் பக்தா விரைவா
   - பாலவு தலக்கமம்
   - பால
2. தர்பாற் விரைவா சாரங்கோடத் கொடு
3. சமய விரைவா சாரங்கோடத் கொடு
4. பாலவு விரைவா சாரங்கோடத் கொடு
5. அரி விரைவா
6. தூண்டி விரைவா
7. தூண்டி விரைவா

TOTAL: 30 PERIODS

தொடர் தொடர்கச்சொல் எச்சுருவியிற்கு / புதுக்கக்கட

1. கல்வி தில்லியர் கல்லூரிக்குடன் (Tamil Virtual University)
   - www.tamilvu.org
2. கல்வி விக்கிப்பீடியொ (Tamil Wikipedia)
   - https://ta.wikipedia.org
3. காண்பு அக்கேர் கல்லூரியா
4. அருமையிற்கு கல்லூரியா
   - கல்லூர் பாதுகாக்கக்கடம், குறிப்பிட்டிடேனூங்கள்
5. கல்லூர் கல்லூரியா
   - கல்லூர் முன்னநிறுத்தில் கல்லூர் (thamilvalarchithurai.com)
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 – International law for groundwater management – World Water Forums – Global Water Partnerships - Development of IWRM in line with legal and regulatory framework.

UNIT IV WATER AND HEALTH WITHIN THE IWRM CONTEXT

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


TOTAL: 45 PERIODS

OUTCOMES

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

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

REFERENCES:

OCE432 WATER, SANITATION AND HEALTH

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

UNIT I FUNDAMENTALS WASH
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  L T P C
3 0 0 3

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 FRAME WORK
History and emergence of the concept of sustainable development - our common future - Stockholm to Rio plus 20– Rio Principles of sustainable development – Agenda 21 natural step-
peoples earth charter – business charter for sustainable development – UN Global Compact - Role of civil society, business and government – United Nations’ 2030 Agenda for sustainable development – 17 sustainable development goals and targets, indicators and intervention areas

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 9

UNIT II IMPACT IDENTIFICATION AND PREDICTION 10

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

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

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

TOTAL: 45 PERIODS

OUTCOMES:
• On completion of the course, the student is expected to be able to
  CO1 Understand need for environmental clearance, its legal procedure, need of EIA,
its types, stakeholders and their roles

**CO2** Understand various impact identification methodologies, prediction techniques and model of impacts on various environments

**CO3** Understand relationship between social impacts and change in community due to development activities and rehabilitation methods

**CO4** Document the EIA findings and prepare environmental management and monitoring plan

**CO5** Identify, predict and assess impacts of similar projects based on case studies

**REFERENCES:**

1. EIA Notification 2006 including recent amendments, by Ministry of Environment, Forest and Climate Change, Government of India
2. Sectoral Guidelines under EIA Notification by Ministry of Environment, Forest and Climate Change, Government of India

**OME431 VIBRATION AND NOISE CONTROL STRATEGIES**

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**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**


**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**

and Electrodynamics – Frequency Measuring Instruments -. System Identification from Frequency Response - Testing for resonance and mode shapes

UNIT- IV INSTRUMENTATION FOR NOISE MEASUREMENT AND ANALYSIS 9
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 9

TOTAL: 45 PERIODS

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 9

UNIT II HEATING, VENTILLATION & AIR CONDITIONING 9

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

OME433 ADDITIVE MANUFACTURING

UNIT I INTRODUCTION

UNIT II DESIGN FOR ADDITIVE MANUFACTURING

UNIT III VAT POLYMERIZATION

UNIT IV MATERIAL EXTRUSION AND SHEET LAMINATION

POWDER BASED PROCESS

UNIT V CASE STUDIES AND OPPORTUNITIES ADDITIVE MANUFACTURING PROCESSES

TOTAL: 45 PERIODS

REFERENCES:


OME434                        ELECTRIC VEHICLE TECHNOLOGY                     L T P C  
                                                          3 0 0 3

UNIT I   NEED FOR ELECTRIC VEHICLES  9
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 ARCHITECHTURE  9
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  9
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  9
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  9

TOTAL: 45 PERIODS
REFERENCES:

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

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

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

TEXT BOOK:

REFERENCES:

OBA431 SUSTAINABLE MANAGEMENT

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

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

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

UNIT V SUSTAINABLE MANAGEMENT OF RESOURCES, COMMODITIES AND COMMONS 9

TOTAL: 45 PERIODS

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

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

OBA432 MICRO AND SMALL BUSINESS MANAGEMENT L T P C 3 0 0 3

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 9

UNIT II SCREENING THE BUSINESS OPPORTUNITY AND FORMULATING THE BUSINESS PLAN 9
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 firmRole
planning in small business – importance of strategy formulation – management skills for small business creation and development.

UNIT III BUILDING THE RIGHT TEAM AND MARKETING STRATEGY

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

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

UNIT IV FINANCING SMALL BUSINESS

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

UNIT V VALUING SMALL BUSINESS AND CRISIS MANAGEMENT

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

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

REFERENCES

3. Journal articles on SME’s.
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/intuition/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

ET4251 IoT FOR SMART SYSTEMS L T P C
3 0 0 3

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
Overview, Hardware and software requirements for IOT, Sensor and actuators, Technology drivers, Business drivers, Typical IoT applications, Trends and implications.

UNIT II IOT ARCHITECTURE

UNIT III PROTOCOLS AND WIRELESS TECHNOLOGIES FOR IOT
PROTOCOLS:
NFC, SCADA and RFID, Zigbee MIPI, M-PHY, UniPro, SPMI, SPI, M-Pcle GSM, CDMA, LTE, GPRS, small cell.

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

UNIT IV IOT PROCESSORS
Services/Attributes: Big-Data Analytics for IOT, Dependability, Interoperability, Security, Maintainability.
Embedded processors for IOT: Introduction to Python programming - Building IOT with RASPBERRY PI and Arduino.

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

TOTAL: 45 PERIODS

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

REFERENCES:

ET4072 MACHINE LEARNING AND DEEP LEARNING L T P C

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
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

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:

PX4012 RENEWABLE ENERGY TECHNOLOGY L T P C 3 0 0 3

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

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

UNIT II SOLAR PHOTOVOLTAICS

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

UNIT IV WIND ENERGY CONVERSION SYSTEMS


UNIT V OTHER RENEWABLE ENERGY SOURCES

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

OUTCOMES:

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

REFERENCES:


PS4093 SMART GRID L T P C
3 0 0 3

COURSE OBJECTIVES

- To Study about Smart Grid technologies, different smart meters and advanced metering infrastructure.
- To know about the function of smart grid.
- To familiarize the power quality management issues in Smart Grid.
- To familiarize the high performance computing for Smart Grid applications
- To get familiarized with the communication networks for Smart Grid applications
UNIT I  INTRODUCTION TO SMART GRID  
Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, functions, opportunities, challenges and benefits, Difference between conventional & Smart Grid, Comparison of Micro grid and Smart grid, Present development & International policies in Smart Grid, Smart Grid Initiative for Power Distribution Utility in India – Case Study.

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

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

UNIT IV  POWER QUALITY MANAGEMENT IN SMART GRID  

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

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
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  9

UNIT II  PROTOCOLS FOR IoT  9

UNIT III  CASE STUDIES/INDUSTRIAL APPLICATIONS  9
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
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
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

TOTAL:45 PERIODS

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  L T P C 3 0 0 3

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  9
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  9
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  9
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  9

UNIT – V  HOME AUTOMATION  9
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

TOTAL: 45 PERIODS

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
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

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

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

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

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

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

TOTAL : 45 PERIODS

REFERENCES

TX4092 TEXTILE REINFORCED COMPOSITES

UNIT I REINFORCEMENTS
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 thermoset resins; mechanism of interaction of matrices and reinforcements; optimization of matrices

UNIT III COMPOSITE MANUFACTURING
Classification; methods of composites manufacturing for both thermoplastics and thermosets-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 thermoset 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

TOTAL: 45 PERIODS

REFERENCES

NT4002 NANOCOMPOSITE MATERIALS

UNIT I BASICS OF NANOCOMPOSITES

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

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

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  NANO COMPOSITE TECHNOLOGY


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

BY4016  IPR, BIOSAFETY AND ENTREPRENEURSHIP

L T P C
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UNIT I  IPR


UNIT II  AGREEMENTS, TREATIES AND PATENT FILING PROCEDURES

UNIT III  BIOSAFETY  9

UNIT IV GENETICALLY MODIFIED ORGANISMS  9
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  9

TOTAL : 45 PERIODS

REFERENCES