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.
# M.E. Big Data Analytics

## Regulations – 2021

### Choice Based Credit System

#### I to IV Semesters Curricula and Syllabi

#### Semester I

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PROFESSIONAL ELECTIVES

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### AUDIT COURSES (AC)

Registration for any of these courses is optional to students

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MA4109  APPLIED PROBABILITY AND STATISTICS  L   T   P   C
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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.

REFERENCES:

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**UNIT I**

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

**UNIT II**

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

**UNIT III**

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

**UNIT IV**

INTELLECTUAL PROPERTY RIGHTS

**UNIT V**

PATENTS

**TOTAL : 30 PERIODS**

**REFERENCES:**

COURSE OBJECTIVES:

- To 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  9

UNIT II  HIERARCHICAL DATA STRUCTURES  9

UNIT III  GRAPHS  9

UNIT IV  ALGORITHM DESIGN TECHNIQUES  9

UNIT V  NP COMPLETE AND NP HARD  9

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.

REFERENCES:


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

Reading and getting data into R – ordered and unordered factors – arrays and matrices – lists and data frames – reading data from files – probability distributions – statistical models in R -
manipulating objects – data distribution.

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

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

CP4252 MACHINE LEARNING

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

UNIT II  SUPERVISED LEARNING  

UNIT III  UNSUPERVISED LEARNING AND REINFORCEMENT LEARNING  

UNIT IV  PROBABILISTIC METHODS FOR LEARNING  

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

45 PERIODS

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

PRACTICAL EXERCISES:  
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

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

TOTAL :  75 PERIODS

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

REFERENCES:

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.

**REFERENCES:**


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**BD4111**

**BIG DATA COMPUTING LABORATORY**

**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

REFERENCES:

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

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 RESOURCES:

BD4251    BIG DATA MINING AND ANALYTICS

COURSE OBJECTIVES:
• To understand the computational approaches to Modeling, Feature Extraction
• To understand the need and application of Map Reduce
• To understand the various search algorithms applicable to Big Data
• To analyze and interpret streaming data
• To learn how to handle large data sets in main memory and learn the various clustering techniques applicable to Big Data
UNIT I  DATA MINING AND LARGE SCALE FILES  9

UNIT II  SIMILAR ITEMS  9

UNIT III  MINING DATA STREAMS  9

UNIT IV  LINK ANALYSIS AND FREQUENT ITEMSETS  9

UNIT V  CLUSTERING  9

TOTAL: 45 PERIODS

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

REFERENCES:

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

ONLINE RESOURCES:
1. https://examupdates.in/big-data-analytics/
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 - IAAAS


UNIT IV PAAS CLOUD PLATFORM


UNIT V PROGRAMMING MODEL

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

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

**TOTAL: 45 PERIODS**

**REFERENCES**


**BD4202 INFORMATION STORAGE MANAGEMENT**

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**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**  
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**  
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
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
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.

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:
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:
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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<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>
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<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 topic in the context of the objective – collect 20 & then filter | • You have to provide a complete list of references you will be using- Based on your objective - Search various digital libraries and Google Scholar  
• When picking papers to read try to:  
  • Pick papers that are related to each other in some ways and/or that are in the same field so that you can write a meaningful survey out of them,  
  • Favour papers from well-known journals and conferences,  
  • Favour “first” or “foundational” papers in the field (as indicated in other people’s survey paper),  
  • Favour more recent papers,  
  • Pick a recent survey of the field so you can quickly gain an overview,  
  • Find relationships with respect | 4th week        | 6% (the list of standard papers and reason for selection)                                             |
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

<table>
<thead>
<tr>
<th>Reading and notes for first 5 papers</th>
<th>Reading Paper Process</th>
<th>5th week</th>
<th>8% (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>For each paper form a Table answering the following questions:</td>
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<td>What is the main topic of the article?</td>
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<td>What was/were the main issue(s) the author said they want to discuss?</td>
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<td>Why did the author claim it was important?</td>
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<td>How does the work build on other’s work, in the author’s opinion?</td>
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<td>What simplifying assumptions does the author claim to be making?</td>
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<td>What did the author do?</td>
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<td>How did the author claim they were going to evaluate their work and compare it to others?</td>
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<td>What did the author say were the limitations of their research?</td>
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<td>What did the author say were the important directions for future research?</td>
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<td>Conclude with limitations/issues not addressed by the paper (from the perspective of your survey)</td>
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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% (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</td>
<td>8% (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</td>
<td>8% (this component will be evaluated based on the linking and classification among the papers)</td>
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<tr>
<td>Abstract</td>
<td>Prepare a draft abstract and give a presentation</td>
<td>9th</td>
<td>6% (Clarity, purpose and conclusion)</td>
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<td>6% Presentation &amp; Viva Voce</td>
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<tr>
<td>Introduction Background</td>
<td>Write an introduction and background sections</td>
<td>10th</td>
<td>5% (clarity)</td>
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<tr>
<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</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</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</td>
<td>10% (formatting, English, Clarity and linking)</td>
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<td>4% Plagiarism</td>
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</table>
BD4071  HIGH PERFORMANCE COMPUTING FOR BIG DATA  L T P C 
3 0 0 3

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

UNIT I  INTRODUCTION  9

UNIT II  NETWORK & SOFTWARE INFRASTRUCTURE FOR HIGH PERFORMANCE BDA  9

UNIT II  REAL TIME ANALYTICS USING HIGH PERFORMANCE COMPUTING  9
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  9
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

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

UNIT I INTRODUCTION: MOTIVATION

UNIT II MODELING

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

UNIT IV EVALUATION AND PARALLEL INFORMATION RETRIEVAL

UNIT V SEARCHING THE WEB

COURSE OUTCOMES:
CO1: Build an Information Retrieval system using the available tools.
CO2: Identify and design the various components of an Information Retrieval system.
CO3: Categorize the different types of IR Models.
CO4: Apply machine learning techniques to text classification and clustering which is used for efficient Information Retrieval.
CO5: Design an efficient search engine and analyze the Web content structure.
REFERENCES

<table>
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<tr>
<th>CP4092</th>
<th>DATA VISUALIZATION TECHNIQUES</th>
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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

UNIT IV INTERACTION CONCEPTS AND TECHNIQUES
UNIT V RESEARCH DIRECTIONS IN VISUALIZATIONS


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.

REFERENCES

TOTAL: 45 PERIODS

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  9
Role of transportation in supply chain – factors affecting transportation decision – Design option for transportation network – Routing and scheduling in transportation.

UNIT IV  SOURCING AND COORDINATION IN SUPPLY CHAIN  9
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  9

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.

REFERENCES:

BD4002  COMPUTATIONAL GEOMETRY  L T P C
3 0 0 3

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  9
Introduction – Application Domains – Line Segment Intersection – Intersection of Convex Polygons – Polygon Triangulation.

UNIT II  GEOMETRIC SEARCHING  9
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:
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:
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  9

UNIT II  NEURAL NETWORKS  9
Fundamental Models of ANN: McCulloch- Pitts Model –Hebb Network – Linear Separability

UNIT III  FUZZY COMPUTING AND MODELING  9

UNIT IV  GENETIC ALGORITHM AND APPLICATIONS  9

UNIT V  HYBRID SOFT COMPUTING AND APPLICATIONS  9
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

REFERENCES:

MU4152 MULTIMEDIA COMMUNICATION NETWORKS

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
9

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.

REFERENCES:
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 Open MP 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  9
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

TOTAL: 45 PERIODS

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=diBVWMdGhwq&list=PLUJ7JmcTlfBROWODSG8wyvL20XqBuE-N
2. https://www.youtube.com/watch?v=qbQCQ0U6H0o&list=PLbMVogVj5nJQRvzENlvMKAv9q70ScSRZBQ

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
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

UNIT III PREDICTIVE MODELS
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/

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

BD4004 IMAGE PROCESSING AND ANALYSIS L T P C
3 0 0 3
UNIT I SPATIAL DOMAIN PROCESSING

UNIT II FREQUENCY DOMAIN PROCESSING

UNIT III SEGMENTATION AND EDGE DETECTION

UNIT IV INTEREST POINTS, MORPHOLOGY, AND TEXTURE

UNIT V COLOR IMAGES AND IMAGE COMPRESSION

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: Design and implement algorithms for image processing applications that incorporates 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

REFERENCES:

MP4091

COGNITIVE COMPUTING

L T P C
3 0 0 3

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

UNIT I  FOUNDATION OF COGNITIVE COMPUTING

Foundation of Cognitive Computing: cognitive computing as a new generation, the uses of cognitive systems, system cognitive, gaining insights from data, Artificial Intelligence as the foundation of cognitive computing, understanding cognition

Design Principles for Cognitive Systems: Components of a cognitive system, building the corpus, bringing data into cognitive system, machine learning, hypotheses generation and scoring, presentation, and visualization services.

UNIT II  NATURAL LANGUAGE PROCESSING IN COGNITIVE SYSTEMS

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

UNIT III  BIG DATA AND COGNITIVE COMPUTING

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

UNIT IV  BUSINESS IMPLICATIONS OF COGNITIVE COMPUTING

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

Building a cognitive health care application: Foundations of cognitive computing for healthcare, constituents in healthcare ecosystem, learning from patterns in healthcare Data, Building on a foundation of big data analytics, cognitive applications across the health care 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

REFERENCES

IF4095 SOCIAL NETWORK ANALYSIS L T P C 3 0 0 3

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 10
UNIT II  SOCIAL NETWORK GRAPH ANALYSIS  9
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  9

UNIT IV  CASCADING IN SOCIAL NETWORKS  8

UNIT V  LINK ANALYSIS & COMMUNITY DETECTION  9

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.

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
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  9

UNIT II  PROCESS VIRTUAL MACHINES  9

UNIT III  HIGH LEVEL LANGUAGE VIRTUAL MACHINES AND SERVER VIRTUALIZATION  9

UNIT IV  NETWORK AND STORAGE VIRTUALIZATION  9

UNIT V  APPLYING VIRTUALIZATION  9

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

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

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

UNIT I INTRODUCTION

UNIT II STATISTICAL NLP AND SEQUENCE LABELING
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
Word Senses and WordNet – Word Sense Disambiguation – Semantic Role Labeling – Proposition
Bank- FrameNet- Selectional Restrictions - Information Extraction - Template Filling

UNIT V DISCOURSE ANALYSIS AND SPEECH PROCESSING 6
Discourse Coherence – Discourse Structure Parsing – Centering and Entity Based Coherence –
Question Answering –Factoid Question Answering – Classical QA Models – Chatbots and

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:

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 asimple 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
CO2: Implement a Part-of-Speech Tagger
CO3: Design and implement a sequence labeling problem for a given domain
CO4: Implement semantic processing tasks and simple document indexing and searching system using the concepts of NLP
CO5: Implement a simple chatbot using dialogue system concepts

TOTAL: 60 PERIODS

REFERENCES

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

BD4006 DATA INTENSIVE COMPUTING L T P C
3 0 0 3

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 - Cassandra, Mongo DB - Developing a Distributed Application

UNIT II ARCHITECTURES AND SYSTEMS

UNIT III TECHNOLOGIES AND TECHNIQUES

UNIT IV SECURITY
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

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

BD4007 R LANGUAGE FOR MINING L T P C 3 0 0 3

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
Classification and Prediction-Issues Classification by Decision Tree Induction–Bayesian Classification - Other Classification Methods – Prediction–Clusters Analysis – Basics of cluster analysis -Types of Data in Cluster Analysis – Categorization of Major Clustering Methods – Partitioning Methods – Hierarchical Methods.

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

CP4097 WEB ANALYTICS L T P C
3 0 0 3

COURSE OBJECTIVES:
- To understand the Web analytics platform, and their evolution.
- To learn about the various Data Streams Data.
- To learn about the benefits of surveys and capturing of data
- To understand Common metrics of web as well as KPI related concepts.
- To learn about the various Web analytics versions.

UNIT I INTRODUCTION 9
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 9
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 9
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 9

UNIT V WEB ANALYTICS 2.0 9
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.

REFERENCES:
COURSE OBJECTIVES:
- To impart the fundamental concepts of Healthcare data analytics
- To give the knowledge about the Health care 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
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
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.

REFERENCES
BD4008 STATISTICS FOR BUSINESS ANALYTICS  L T P C  
3 0 0 3

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
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
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, OC curve, acceptance sampling plan by attributes and variables. Concept of Six Sigma.

TOTAL: 45 PERIODS

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.

REFERENCES:
AUDIT COURSES

AX4091 ENGLISH FOR RESEARCH PAPER WRITING

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

UNIT II REPERCUSSIONS OF DISASTERS AND HAZARDS

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

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

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

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

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

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

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

UNIT II PHILOSOPHY OF THE INDIAN CONSTITUTION
Preamble, Salient Features

UNIT III CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES

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

UNIT V LOCAL ADMINISTRATION

UNIT VI ELECTION COMMISSION
Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.
COURSE OUTCOMES:
Students will be able to:
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.
பருவாய் வகைக்கடி, அகமணே காணக்கொண்டு வருமடைகறி கூறிகொள்ள, அந்து பல்கலைகள்

2. புராணம்
   - அலங்காரக்குறிப்புப்பாடு பற்றிய
3. இடைநிலைமுறை (617, 618)
   - பெபன்சிறப்பு
4. திருமந்திரம் படைமுறை
5. புடானாள்
   - வைரமைதல் முறை
6. உராண்ட கூற்று கூற்று

UNIT V

1. தமிழ் தமிழ்
   - கணினியியல் பல்கலைக்கழகம்
   - கணினியியல் பல்கலைக்கழகம்
   - பல்கலைக்கழகம்
   - பல்கலைக்கழகம்

2. முதல் விக்கிப்பீடிச் செயற்கை
3. முதல் விக்கிப்பீடிச் செயற்கை
4. முதல் விக்கிப்பீடிச் செயற்கை

5. வெளிப்புத்தியா தமிழ்
6. தமிழ் பல்கலைக்கழகம்
7. தமிழ் பல்கலைக்கழகம்

TOTAL: 30 PERIODS

தமிழ் விளக்கத்தில் வைத்தியத்தில் / பகுதிகாளை

1. தமிழ் விளக்கத்தில் வைத்தியத்தில் (Tamil Virtual University)
   - www.tamilvu.org
2. தமிழ் விளக்கத்தில் வைத்தியத்தில் (Tamil Wikipedia)
   - https://ta.wikipedia.org
3. கணினியியல் வெளிப்புத்தியா
4. கணினியியல் வெளிப்புத்தியா
   - கணினியியல் வெளிப்புத்தியா
   - கணினியியல் வெளிப்புத்தியா
5. தமிழ் விளக்கத்தில் வெளிப்புத்தியா (thamilvalarchithurai.com)
6. தமிழ் விளக்கத்தில் வெளிப்புத்தியா
   - தமிழ் விளக்கத்தில் வெளிப்புத்தியா