1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

I. Succeed as a professional in the area of Artificial Intelligence (AI) and Machine Learning (ML)

II. Develop the ability of innovative thinking, analysis and decision-making for offering techno-commercially feasible and socially acceptable solutions to real life problems by applying AI and ML.

III. To analyze contemporary issues of AI & ML and devise effective solutions through persistent research and continuous learning.

IV. Recognize and incorporate ethical, legal and social implications in the applications and products involving AI and ML.

To practice and promote AI technologies for societal needs and contribute to advancement of ML methods by means of research and development

2. PROGRAM OUTCOMES (POs):

1. An ability to independently carry out research / investigation and development work to solve practical problems.

2. An ability to write and present a substantial technical report/document.

3. Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.

4. To understand and demonstrate the knowledge of human cognition, AI and ML in terms of real world problems to meet the challenges of the future.

5. To develop computational knowledge and project development skills using innovative tools and techniques to solve problems in the areas of Deep Learning, Machine Learning, Artificial Intelligence.

6. To define a new problem, design, model, analyse, and evaluate the solution and report it as a dissertation in the area of AI and ML.
ANNA UNIVERSITY, CHENNAI
NON-AUTONOMOUS COLLEGES AFFILIATED ANNA UNIVERSITY
M.E. COMPUTER SCIENCE AND ENGINEERING (WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING)
REGULATIONS – 2021
CHOICE BASED CREDIT SYSTEM
I TO IV SEMESTERS CURRICULA AND SYLLABI

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### PROFESSIONAL ELECTIVES

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### AUDIT COURSES (AC)

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MA4151  APPLIED PROBABILITY AND STATISTICS FOR
COMPUTER SCIENCE ENGINEERS

COURSE OBJECTIVES:

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

UNIT I  LINEAR ALGEBRA  12

UNIT II  PROBABILITY AND RANDOM VARIABLES  12

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

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

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

TOTAL : 60 PERIODS

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

REFERENCES:

<table>
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<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tr>
<td>RM4151</td>
<td>RESEARCH METHODOLOGY AND IPR</td>
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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

REFERENCES:
4. The Institute of Company Secretaries of India, Statutory body under an Act of parliament,

CP4151 ADVANCED DATA STRUCTURES AND ALGORITHMS L T P C
3 0 0 3

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
Algorithms – Algorithms as a Technology - Time and Space complexity of algorithms- Asymptotic
analysis-Average and worst-case analysis-Asymptotic notation-Importance of efficient algorithms-
Program performance measurement - Recurrences: The Substitution Method – The Recursion-Tree
Method - Data structures and algorithms.

UNIT II HIERARCHICAL DATA STRUCTURES 9
Binary Search Trees: Basics – Querying a Binary search tree – Insertion and Deletion- Red Black
trees: Properties of Red-Black Trees – Rotations – Insertion – Deletion -B-Trees: Definition of B -
trees – Basic operations on B-Trees – Deleting a key from a B-Tree- Heap – Heap Implementation –
Disjoint Sets - Fibonacci Heaps: structure – Mergeable-heap operations- Decreasing a key and
deleting a node-Bounding the maximum degree.

UNIT III GRAPHS 9
Elementary Graph Algorithms: Representations of Graphs – Breadth-First Search – Depth-First
Search – Topological Sort – Strongly Connected Components- Minimum Spanning Trees: Growing a
algorithm – Single-Source Shortest paths in Directed Acyclic Graphs – Dijkstra's Algorithm; Dynamic
Programming - All-Pairs Shortest Paths: Shortest Paths and Matrix Multiplication – The Floyd-
Warshall Algorithm

UNIT IV ALGORITHM DESIGN TECHNIQUES 9
Dynamic Programming: Matrix-Chain Multiplication – Elements of Dynamic Programming – Longest
Common Subsequence- Greedy Algorithms: – Elements of the Greedy Strategy- An Activity-
Selection Problem - Huffman Coding.

UNIT V NP COMPLETE AND NP HARD 9
NP-Completeness: Polynomial Time – Polynomial-Time Verification – NP- Completeness and

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

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

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

UNIT III XML DATABASES

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

UNIT IV NOSQL DATABASES AND BIG DATA STORAGE SYSTEMS

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

UNIT V  DATABASE SECURITY  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
CO1:Convert the ER-model to relational tables, populate relational databases and formulate SQL queries on data.
CO2:Understand and write well-formed XML documents
CO3:Be able to apply methods and techniques for distributed query processing.
CO4:Design and Implement secure database systems.
CO5:Use the data control, definition, and manipulation languages of the NoSQL databases

REFERENCES:

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

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

UNIT II DATA, DATA TYPES, AND BASIC STATEMENTS

UNIT III SUBPROGRAMS AND IMPLEMENTATIONS

UNIT IV OBJECT-ORIENTATION, CONCURRENCY, AND EVENT HANDLING

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

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

TOTAL : 45 PERIODS

REFERENCES:
COURSE OBJECTIVES:

- To understand basic problem solving strategies.
- To outline game theory based search and constraint satisfaction.
- To study knowledge representation techniques.
- To explore reasoning and planning associated with AI.
- To study the techniques of knowledge representation.
- To understand probabilistic and other types of reasoning.
- To discuss ethical and safety issues associated with AI.

UNIT I  INTRODUCTION AND PROBLEM SOLVING  9
Artificial Intelligence - Introduction - Problem-solving - Solving Problems by Searching –
Uninformed Search Strategies - Informed (Heuristic) Search Strategies - Local Search - Search in Partially Observable Environments

UNIT II  ADVERSARIAL SEARCH AND CONSTRAINT SATISFACTION  9
Game Theory - Optimal Decisions in Games - Heuristic Alpha–Beta Tree Search - Monte Carlo
Tree Search - Stochastic Games - Partially Observable Games - Limitations of Game Search
Algorithms Constraint Satisfaction Problems (CSP)– Examples - Constraint Propagation-
Backtracking Search for CSPs - Local Search for CSPs

UNIT III  KNOWLEDGE, REASONING AND PLANNING  9
First Order Logic – Inference in First Order Logic - Using Predicate Logic - Knowledge
Representation - Issues - Ontological Engineering - Categories and Objects – Reasoning
Systems for Categories - Planning - Definition - Algorithms - Heuristics for Planning - Hierarchical
Planning

UNIT IV  UNCERTAIN KNOWLEDGE AND REASONING  9
Quantifying Uncertainty - Probabilistic Reasoning - Probabilistic Reasoning over Time
Based Reasoning – Explanation-Based Learning – Evolutionary Computation

UNIT V  PHILOSOPHY, ETHICS AND SAFETY OF AI  9
The Limits of AI – Knowledge in Learning – Statistical Learning Methods – Reinforcement
Learning - Introduction to Machine Learning and Deep Learning - Can Machines Really Think? -
Distributed AI Artificial Life - The Ethics of AI - Interpretable AI - Future of AI - AI Components - AI
Architectures

TOTAL : 45 PERIODS

SUGGESTED ACTIVITIES:

1. Solve puzzles with uninformed and informed searches.
2. Reasoning methods through puzzles and real life scenarios
3. Ontology creation using Protégé
4. Give example scenarios where probabilistic reasoning and case based reasoning can be applied
5. Discuss some case studies and their ethical issues
COURSE OUTCOMES:
CO1: Implement any three problem solving methods for a puzzle of your choice
CO2: Understand Game playing and implement a two player game using AI techniques
CO3: Design and Implement an example using predicate Logic
CO4: Implement a case based reasoning system
CO5: Discuss some methodologies to design ethical and explainable AI systems

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:

CP4291  INTERNET OF THINGS  L T P C
3 0 2 4

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

UNIT I  INTRODUCTION
Internet of Things- Domain Specific IoTs - IoT and M2M-Sensors for IoT Applications–Structure of IoT– IoT Map Device- IoT System Management with NETCONF-YANG

UNIT II  IoT ARCHITECTURE, GENERATIONS AND PROTOCOLS

UNIT III  IoT PROTOCOLS AND TECHNOLOGY

UNIT IV  CLOUD ARCHITECTURE BASICS
The Cloud types; IaaS, PaaS, SaaS.- Development environments for service development; Amazon, Azure, Google Appcloud platform in industry
UNIT V IOT PROJECTS ON RASPBERRY PI

Building IOT with RASPBERRY PI- Creating the sensor project - Preparing Raspberry Pi - Clayster libraries – Hardware Interacting with the hardware - Interfacing the hardware- Internal representation of sensor values - Persisting data - External representation of sensor values - Exporting sensor data

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

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

TOTAL : 75 PERIODS

REFERENCES:

CP4252 MACHINE LEARNING L T P C
3 0 2 4

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  9

UNIT II  SUPERVISED LEARNING  9

UNIT III  UNSUPERVISED LEARNING AND REINFORCEMENT LEARNING  9

UNIT IV  PROBABILISTIC METHODS FOR LEARNING  9

UNIT V  NEURAL NETWORKS AND DEEP LEARNING  9
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 Neighbours. 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.
REFERENCES

ML4291 NATURAL LANGUAGE PROCESSING L T P C
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  

UNIT V  DISCOURSE ANALYSIS AND SPEECH PROCESSING  

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. Your project proposal should describe the idea behind your project. You should also briefly describe software you will need to write, and papers (2-3) you plan to read.

List of Possible Projects
1. Sentiment Analysis of Product Reviews
2. Information extraction from News articles
3. Customer support bot
4. Language identifier
5. Media Monitor
6. Paraphrase Detector
7. Identification of Toxic Comment
8. Spam Mail Identification
COURSE OUTCOMES:
CO1: Understand basics of linguistics, probability and statistics associated with NLP
CO2: Implement a Part-of-Speech Tagger
CO3: Design and implement a sequence labeling problem for a given domain
CO4: Implement semantic processing tasks and simple document indexing and searching system using the concepts of NLP
CO5: Implement a simple chatbot using dialogue system concepts

TOTAL: 60 PERIODS

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

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 analyse 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

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 analyze the data using statistical methods.
- To understand data analysis tools.
- To learn a Data Mining Tool.
- To learn various data analysis algorithms.
- To learn Data Mining Algorithms.

SUGGESTED ACTIVITIES:
List of Experiments
1. Data Analysis- Getting to know the Data (Using ORANGE, WEKA)
   - Parametric - Means, T-Test, Correlation
   - Prediction for numerical outcomes - Linear regression
   - Correlation analysis
   - Preparing data for analysis
   - Pre-processing techniques
2. Data Mining (Using ORANGE, WEKA or any open source data mining tool)
   - Implement clustering algorithm
   - Implement classification using
     - Decision tree
     - Back propagation
   - Visualization methods.

COURSE OUTCOMES:
CO1: Use statistical techniques to carry out the analysis of data.
CO2: Apply various Data Analysis algorithms.
CO3: Apply Data Mining algorithms
CO4: Use Data Analysis tools
CO5: Use Data Mining tools

TOTAL: 30 PERIODS

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

<table>
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<tr>
<th>Activity</th>
<th>Instructions</th>
<th>Submission week</th>
<th>Evaluation</th>
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<tr>
<td>Selection of area of interest and Topic</td>
<td>You are requested to select an area of interest, topic and state an objective</td>
<td>2nd week</td>
<td>3% Based on clarity of thought, current relevance and clarity in writing</td>
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<td>Stating an Objective</td>
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<tr>
<td>Collecting Information about your area &amp; topic</td>
<td>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.</td>
<td>3rd week</td>
<td>3% (the selected information must be area specific and of international and national standard)</td>
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<tr>
<td>Collection of Journal papers in the context of the objective – collect 20 &amp; then filter</td>
<td>• 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</td>
<td>4th week</td>
<td>6% (the list of standard papers and reason for selection)</td>
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| Reading and notes for first 5 papers | Reading Paper Process | 5th week | 8%  
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<td>For each paper form a Table answering the following questions:</td>
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<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></td>
<td>• What is the main topic of the article?</td>
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<td></td>
<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 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? Conclude with limitations/issues not addressed by the paper (from the perspective of your survey)</td>
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| Reading and notes for next 5 papers | Repeat Reading Paper Process | 6th week | 8%  
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| Reading and notes for final 5 papers | Repeat Reading Paper Process | 7th week | 8%  
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<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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### Draft outline 1 and Linking papers
Prepare a draft Outline, your survey goals, along with a classification / categorization diagram  
8th week  
8%  
( this component will be evaluated based on the linking and classification among the papers)

### Abstract
Prepare a draft abstract and give a presentation  
9th week  
6%  
( Clarity, purpose and conclusion)  
6% Presentation & Viva Voce

### Introduction Background
Write an introduction and background sections  
10th week  
5%  
( clarity)

### Sections of the paper
Write the sections of your paper based on the classification / categorization diagram in keeping with the goals of your survey  
11th week  
10%  
( this component will be evaluated based on the linking and classification among the papers)

### Your conclusions
Write your conclusions and future work  
12th week  
5%  
( conclusions – clarity and your ideas)

### Final Draft
Complete the final draft of your paper  
13th week  
10%  
( formatting, English, Clarity and linking)  
4% Plagiarism Check Report

### Seminar
A brief 15 slides on your paper  
14th & 15th week  
10%  
( based on presentation and Viva-voce)

**TOTAL: 30 PERIODS**

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**IF4071 DEEP LEARNING**

**COURSE OBJECTIVES:**
- Develop and Train Deep Neural Networks.
- Develop a CNN, R-CNN, Fast R-CNN, Faster-R-CNN, Mask-RCNN for detection and recognition
- Build and train RNNs, work with NLP and Word Embeddings
- The internal structure of LSTM and GRU and the differences between them
- The Auto Encoders for Image Processing
UNIT I  DEEP LEARNING CONCEPTS  6

UNIT II  NEURAL NETWORKS  9

UNIT III  CONVOLUTIONAL NEURAL NETWORK  10

UNIT VI  NATURAL LANGUAGE PROCESSING USING RNN  10

UNIT V  DEEP REINFORCEMENT & UNSUPERVISED LEARNING  10

LIST OF EXPERIMENTS:  30
1: Feature Selection from Video and Image Data
2: Image and video recognition
3: Image Colorization
4: Aspect Oriented Topic Detection & Sentiment Analysis
5: Object Detection using Autoencoder

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

TOTAL : 45+30=75 PERIODS
REFERENCES

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

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


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:

1: Twitter Intelligence project performs tracking and analysis of the Twitter
2: Large-Scale Network Embedding as Sparse Matrix Factorization
3: Implement how Information Propagation on Twitter
4: Social Network Analysis and Visualization software application.
5: 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

BD4091  PREDICTIVE MODELLING

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  9

UNIT V  TECHNOLOGIES AND CASE STUDIES  9

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/

MP4391

SMART CONVERGENT TECHNOLOGIES

COURSE OBJECTIVES:
- To learn about Fundamentals of IoT and Security
- To know about IoT applications in Industry
- To learn about RFID Pervasive networks
- To gain fundamental concepts in 5G and Next Gen networks
- To know about IoT implementation

UNIT I

TOWARDS THE IOT UNIVERSE

UNIT II

IOT APPLICATIONS — VALUE CREATION FOR INDUSTRY

UNIT III

RFID PERVERSIVE NETWORKS

UNIT IV

INTRODUCTION TO INDUSTRIAL INTERNET OF THINGS
Industrial Internet- Key IIoT Technologies- Innovation and the IIoT - Key Opportunities and Benefits - The Digital and Human Workforce - Logistics and the Industrial Internet- IOT Innovations in Retail - Cyber Physical Systems (CPS) – IP Mobility – Network Virtualization - SDN (Software Defined Networks)- The Cloud and Fog

UNIT V

IIOT ARCHITECTURE AND DESIGNING INDUSTRIAL INTERNET SYSTEMS
Industrial Internet Architecture Framework (IIAF) -Industrial Internet Viewpoints -. Architectural

COURSE OUTCOMES:
After completion of the course, the student will be able to:

CO1: Describe the core principles of IoT Network Management
CO2: Identify the applications of IoT in Industry
CO3: Explain the basic concepts in RFID and Pervasive Networks
CO4: Discuss the fundamental concepts in IIoT, CPS and Network Virtualization.
CO5: Design Industrial Internet Systems

TOTAL: 45 PERIODS

REFERENCES:
3. Lu Yan, Yan Zhang, Laurence T. Yang and Huansheng Ning “The Internet of Things: From RFID to the Next-Generation Pervasive Networked Systems”, Auerbach Publications, 2019 (Unit III)
4. Gilchrist, Alasdair, “Industry 4.0 The Industrial Internet of Things”, Apress, 2017. (Unit IV and Unit V)

ML4001 PROBABILISTIC GRAPHICAL MODELS

COURSE OBJECTIVES:
- To understand basic concepts of probabilistic graphical models
- To explore different aspects of representation of probabilistic graphical models
- To study different inference techniques
- To apply various inference techniques
- To understand learning associated with probabilistic graphical models

UNIT I INTRODUCTION

UNIT II REPRESENTATION

UNIT III INFERENCE
Exact Inference – Variable Elimination– Conditioning – Clique Trees – Message Passing – Inference as Optimization – Exact Inference as Optimization – Propagation based Approximation
UNIT IV ADVANCED INFERENC 9
Particle Based Approximate Inference – Forward Sampling - Markov Chain Monte Carlo Methods – Map Inference - Variable Elimination for Map – Max-Product in Clique Trees – Exact Inference in Temporal Models

UNIT V LEARNING 9

SUGGESTED ACTIVITIES:
1. Problems in Probability
2. Design examples of Probabilistic Graphical Models
3. Hand simulate all inferences possible with graphical models for examples of your choice
4. Give an example for temporal probabilistic graphical model
5. Discuss pros and cons of different learning techniques

COURSE OUTCOMES:
CO1: Understand basic concepts of probabilistic graphical models
CO2: Automatically convert a problem into a probabilistic graphical model
CO3: Implement a simple graphical model
CO4: Understand issues associated with temporal models
CO5: Design a learning system for the graphical model

TOTAL:45 PERIODS

REFERENCES

AP4093 QUANTUM COMPUTING L T P C 3 0 0 3

COURSE OBJECTIVES:
- To introduce the building blocks of Quantum computers and highlight the paradigm change between conventional computing and quantum computing
- To understand the Quantum state transformations and the algorithms
- To understand entangled quantum subsystems and properties of entangled states
- To explore the applications of quantum computing
UNIT I  QUANTUM BUILDING BLOCKS  9
The Quantum Mechanics of Photon Polarization, Single-Qubit Quantum Systems, Quantum State Spaces, Entangled States, Multiple-Qubit Systems, Measurement of Multiple-Qubit States, EPR Paradox and Bell’s Theorem, Bloch sphere

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

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

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

UNIT V  QUANTUM INFORMATION PROCESSING  9

COURSE OUTCOMES:
At the end of the course, the student will be able to
CO1: Understand the basic principles of quantum computing.
CO2: Gain knowledge of the fundamental differences between conventional computing and quantum computing.
CO3: Understand several basic quantum computing algorithms.
CO4: Understand the classes of problems that can be expected to be solved well by quantum computers.
CO5: Simulate and analyze the characteristics of Quantum Computing Systems.

TOTAL: 45 PERIODS

REFERENCES:
1. John Gribbin, Computing with Quantum Cats: From Colossus to Qubits, 2021
2. William (Chuck) Easttom, Quantum Computing Fundamentals, 2021
3. Parag Lala, Quantum Computing, 2019
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
End To End Solutions – Laissez Faire Approach – Multimedia over TCP – Significance of UDP – Multimedia Streaming – Audio and Video Streaming – Accessing Audio And Video from a Web

**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**  
9

**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.

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:

CP4093 INFORMATION RETRIEVAL TECHNIQUES

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.

TOTAL: 45 PERIODS

REFERENCES

SE4072 IMAGE PROCESSING L T P C 3 0 0 3

COURSE OBJECTIVES:
- To study fundamental concepts of digital image processing.
- To get exposed to simple image enhancement techniques in Spatial and Frequency domain.
- To become familiar with image compression
- To study the image segmentation and Morphological Processing.
- To expose student’s in recognition methods.
UNIT I INTRODUCTION
Examples of fields that use digital image processing, fundamental steps in digital image processing, components of image processing system. Digital Image Fundamentals: A simple image formation model, image sampling and quantization, basic relationships between pixels. Color Image Processing: Color fundamentals, color models, pseudo color image processing, basics of full–color image processing, color transforms, smoothing and sharpening, color segmentation.

UNIT II IMAGE ENHANCEMENT

UNIT III WAVELETS AND IMAGE COMPRESSION
Wavelets and Multiresolution Processing, Fundamentals, image compression models, error-free compression, lossy predictive coding, image compression standards.

UNIT IV IMAGE SEGMENTATION
Detection of Discontinuities, Edge Linking and Boundary Detection, Thresholding, Region-Based Segmentation, Segmentation by Morphological Watersheds, The Use of Motion in Segmentation Morphological Image Processing: Preliminaries, dilation, erosion, open and closing, hit or miss transformation, basic morphologic algorithms.

UNIT V REPRESENTATION AND OBJECT RECOGNITION
Representation, Boundary Descriptors, Regional Descriptors, Use of Principal Components for Description. Object Recognition: Patterns and patterns classes, recognition based on decision–theoretic methods, matching, optimum statistical classifiers, neural networks, structural methods – matching shape numbers, string matching.

COURSE OUTCOMES:
CO1: Apply knowledge of mathematics for image understanding and analysis.
CO2: Design and analysis of techniques / processes for image Enhancement.
CO3: Design and analysis of techniques / processes for image compression.
CO4: Able to expose to current trends in field of image segmentation.
CO5: Design, realize and troubleshoot various algorithms for image processing case studies.

TOTAL: 45 PERIODS

REFERENCES
3. Introduction to Digital Image Processing with Matlab, Alasdair McAndrew, Thomson Course Technology, 2021
4. Computer Vision and Image Processing, Adrian Low, Second Edition,
COURSE OBJECTIVES:
- To impart knowledge on the functional architecture of autonomous vehicles
- To impart knowledge on Localization and mapping fundamentals
- To impart knowledge on process end effectors and robotic controls
- To learn Robot cell design, Robot Transformation and Sensors
- To learn Micro/Nano Robotic Systems

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

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

UNIT III ROBOTICS INTRODUCTION, END EFFECTORS AND CONTROL

UNIT IV ROBOT TRANSFORMATIONS, SENSORS AND ROBOT CELL DESIGN

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

TOTAL: 45 PERIODS

REFERENCES

CP4097 WEB ANALYTICS

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.

REFERENCES:

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

COURSE OBJECTIVES:

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

UNIT I  FOUNDATIONS OF HCI


UNIT II  INTERACTION STYLES


UNIT III  EVALUATION OF INTERACTION

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

UNIT IV  MODELS AND THEORIES

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

UNIT V  WEB AND MOBILE INTERACTION

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

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

TOTAL: 45 PERIODS

REFERENCES

CP4095 PERFORMANCE ANALYSIS OF COMPUTER SYSTEMS

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

UNIT I OVERVIEW OF PERFORMANCE EVALUATION

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

UNIT IV     REAL-WORLD WORKLOADS

UNIT V     SMART SCHEDULING IN THE M/G/1

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

REFERENCES:

CP4092     DATA VISUALIZATION TECHNIQUES
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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
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<th>UNIT I</th>
<th>INTRODUCTION AND DATA FOUNDATION</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>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</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>UNIT II</th>
<th>FOUNDATIONS FOR VISUALIZATION</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
<td></td>
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</tbody>
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<table>
<thead>
<tr>
<th>UNIT III</th>
<th>VISUALIZATION TECHNIQUES</th>
<th>9</th>
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<tr>
<th>UNIT IV</th>
<th>INTERACTION CONCEPTS AND TECHNIQUES</th>
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<tr>
<th>UNIT V</th>
<th>RESEARCH DIRECTIONS IN VISUALIZATIONS</th>
<th>9</th>
</tr>
</thead>
</table>

**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**

**REFERENCES**

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

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

UNIT II  ROBOT KINEMATICS AND DYNAMICS  9

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

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

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

TOTAL: 45 PERIODS

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

REFERENCE:

CP4072 BLOCKCHAIN TECHNOLOGIES L T P C
3 0 2 4

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

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

UNIT II BITCOIN AND CRYPTOCURRENCY

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

UNIT-IV INTRODUCTION TO HYPERLEDGER AND SOLIDITY PROGRAMMING

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

TOTAL: 45 PERIODS

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

TOTAL: 30 PERIODS

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

TOTAL: 75 PERIODS

COURSE OUTCOMES:
After the completion of this course, student will be able to

CO1: Understand and explore the working of Blockchain technology
CO2: Analyze the working of Smart Contracts
CO3: Understand and analyze the working of Hyperledger
CO4: Apply the learning of solidity to build de-centralized apps on Ethereum
CO5: Develop applications on Blockchain

REFERENCES:

MU4291 MIXED REALITY

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

UNIT I INTRODUCTION TO VIRTUAL REALITY
clipping, Colour theory, Simple 3D modelling, Illumination models, Reflection models, Shading algorithms, Radiosity, Hidden Surface Removal, Realism Stereographic image.

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

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

**UNIT II INTERACTIVE TECHNIQUES IN VIRTUAL REALITY**


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

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

**UNIT III VISUAL COMPUTATION IN VIRTUAL REALITY**


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

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

**UNIT IV AUGMENTED AND MIXED REALITY**

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

Suggested Activities:
- External learning - AR Systems

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

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

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

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

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

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

TOTAL: 45 PERIODS

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

TOTAL: 45+30=75 Periods
REFERENCES


CP4071 BIO INFORMATICS L T P C

3 0 2 4

COURSE OBJECTIVES:

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

UNIT I INTRODUCTION

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

UNIT II DATAWAREHOUSING AND DATAMINING IN BIOINFORMATICS

Bioinformatics data – Data warehousing architecture – data quality – Biomedical data analysis – DNA data analysis – Protein data analysis – Machine learning – Neural network architecture and applications in bioinformatics.

UNIT III MODELING FOR BIOINFORMATICS


UNIT IV PATTERN MATCHING AND VISUALIZATION


UNIT V MICROARRAY ANALYSIS

Microarray technology for genome expression study – image analysis for data extraction –

TOTAL: 45 PERIODS

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

TOTAL: 30 PERIODS

COURSE OUTCOMES:
CO1: Understand the different Data formats
CO2: Develop machine learning algorithms.
CO3: Develop models for biological data.
CO4: Apply pattern matching techniques to bioinformatics data – protein data genomic data.
CO5: Apply micro array technology for genomic expression study.

TOTAL: 45+30=75 PERIODS

REFERENCES

MP4292 MOBILE APPLICATION DEVELOPMENT
L T P C
3 0 2 4

COURSE OBJECTIVES:
- To facilitate students to understand android SDK
- To help students to gain basic understanding of Android application development
- To understand how to work with various mobile application development frameworks
- To inculcate working knowledge of Android Studio development tool
- To learn the basic and important design concepts and issues of development of mobile applications
UNIT I  MOBILE PLATFORM AND APPLICATIONS  

UNIT II  INTRODUCTION TO ANDROID  

UNIT III  ANDROID APPLICATION DESIGN ESSENTIALS  

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

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

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

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

TOTAL: 45+30=75 PERIODS

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

IF4073 DEVOPS AND MICROSERVICES

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

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

UNIT II DEVOPS PLATFORM AND SERVICES

UNIT III BUILDING, TESTING AND DEPLOYMENT
Microservices architecture - coordination model - building and testing - Deployment pipeline - Development and Pre-commit Testing - Build and Integration Testing - continuous integration - monitoring - security - Resources to Be Protected - Identity Management

UNIT IV DEVOPS AUTOMATION TOOLS

UNIT V MLOPS
MLOps - Definition - Challenges - Developing Models - Deploying to production - Model Governance - Real world examples
**SUGGESTED ACTIVITIES:**
1: Creating a new Git repository, cloning existing repository, Checking changes into a Git repository, Pushing changes to a Git remote, Creating a Git branch
2: Installing Docker container on windows/Linux, issuing docker commands
3: Building Docker Images for Python Application
4: Setting up Docker and Maven in Jenkins and First Pipeline Run
5: Running Unit Tests and Integration Tests in Jenkins Pipelines

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

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

**TOTAL:75 PERIODS**

**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  
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  

**UNIT III** TITLE WRITING SKILLS  
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:

AX4092  DISASTER MANAGEMENT  L T P C
                     2 0 0 0

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

TOTAL : 30 PERIODS

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

REFERENCES:

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

COURSE OBJECTIVES:
Students will be able to:
- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals’ constitutional
- Role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution 1917 And its impact on the initial drafting of the Indian Constitution.
UNIT I  HISTORY OF MAKING OF THE INDIAN CONSTITUTION
History, Drafting Committee, (Composition & Working)

UNIT II  PHILOSOPHY OF THE INDIAN CONSTITUTION
Preamble, Salient Features

UNIT III  CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES

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

UNIT V  LOCAL ADMINISTRATION

UNIT VI  ELECTION COMMISSION
Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.

TOTAL: 30 PERIODS

COURSE OUTCOMES
Students will be able to:

- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party[ CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

SUGGESTED READING
1. The Constitution of India,1950(Bare Act),Government Publication.
UNIT I

1. கால் விளக்கம் 6
   - புராணம், தொகுதி, பருவம்
2. கால்நிலை (82)
   - புராணம், பருவம்
3. குறியியல் பார்வை பண்பக்காரம்
4. பார்வை (95, 195)
   - புராணம், பருவம்

UNIT II

1. முருகன் விளக்கம் 6
   - புராணம், பருவம்
2. பிற மூலக்கோர் - புராணம்
   - தொகுதி, பருவம், பபொகர்

UNIT III

1. குறியியல் பார்வை 6
   - தொகுதி, பபொகர்
2. சுந்தரசபத்தியம் பார்வை
   - தொகுதி, பபொகர்

UNIT IV

1. சுந்தரசபத்தியம் 6
   - புராணம், பபொகர்
2. குறியியல்
   - புராணம், பபொகர்
3. பிற மூலக்கோர் - புராணம்
4. பார்வை நிலையம், மாகளை வந்தவர்
5. பார்வை
   - புராணம், பபொகர்
6. அகாலாதேசர் (4)
   - புராணம், பபொகர்
1. உகரநகடத் தமிழ்
   - குருதி பெறும் புதுமை
   - குருதி பெறும் விளக்கம்
   - குருதி பெறும் தொகுப்பு
   - பாடல் வேகக்கிளம
   - துரத்த
2. மொன் விடுதாய் சுருக்கம் தமிழ் வேகக்கிளம
3. மொன் விடுதாய் விளக்கம் தமிழ் வேகக்கிளம
4. பல்ய விடுதாய் விளக்கம் விளக்க விளக்கங்கள் நூற்றாவது தமிழ் வேகக்கிளம
5. ஊரியர் வேக
6. கல்வியக்கி வேக
7. புதுமையம் விளக்கங்கள் தமிழ் வேகக்கிளம

TOTAL: 30 PERIODS

தமிழ் முயற்சியும் விளக்கங்கள் / புதுக்காண்பாடுகள்

1. தமிழ் விமானம் குண்டுக்கிளம் (Tamil Virtual University)
   - www.tamilvu.org
2. தமிழ் விக்கிப்பீடியொ விளக்கம் (Tamil Wikipedia)
   - https://ta.wikipedia.org
3. கருப்பு அரசு விளக்கம்
4. மொன் முயற்சி விளக்கம்
   - தமிழ் மொன் முயற்சி விளக்கம்
   - தமிழ் வேகவாப்புகள் விளக்கம்
5. எண்கணத் விளக்கம்
   - எண்கணத் விளக்கம் (thamilvalarchithurai.com)
6. ஊரியர் விளக்கம்
   - ஊரியர் விளக்கம்