**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**

## 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

Tentative

## 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.

## 2. PROGRAM SPECIFIC OUTCOMES (PSOs):

1. 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.
2. 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.
3. 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.

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**REGULATIONS – 2021**
**CHOICE BASED CREDIT SYSTEM**
**I TO IV SEMESTERS CURRICULA AND SYLLABI**
**SEMESTER I**

| S. NO. | COURSE CODE | COURSE TITLE | CATE-GORY | PERIODS PER WEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| **THEORY** | | | | | | | | |
| 1. | MA4151 | Applied Probability and Statistics for Computer Science Engineers | FC | 3 | 1 | 0 | 4 | 4 |
| 2. | RM4151 | Research Methodology and IPR | RMC | 2 | 0 | 0 | 2 | 2 |
| 3. | CP4151 | Advanced Data Structures and Algorithms | PCC | 3 | 0 | 0 | 3 | 3 |
| 4. | CP4152 | Database Practices | PCC | 3 | 0 | 2 | 5 | 4 |
| 5. | CP4154 | Principles of Programming Languages | PCC | 3 | 0 | 0 | 3 | 3 |
| 6. | ML4151 | Artificial Intelligence | PCC | 3 | 0 | 0 | 3 | 3 |
| 7. | | Audit Course – I* | AC | 2 | 0 | 0 | 2 | 0 |
| **PRACTICALS** | | | | | | | | |
| 8. | CP4161 | Advanced Data Structures and Algorithms Laboratory | PCC | 0 | 0 | 4 | 4 | 2 |
| | | | **TOTAL** | **19** | **1** | **6** | **26** | **21** |

*Audit course is optional

Tentative

**SEMESTER II**

| S. NO. | COURSE CODE | COURSE TITLE | CATE-GORY | PERIODS PER WEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| **THEORY** | | | | | | | | |
| 1. | CP4251 | Internet of Things | PCC | 3 | 0 | 2 | 5 | 4 |
| 2. | CP4252 | Machine Learning | PCC | 3 | 0 | 2 | 5 | 4 |
| 3. | ML4251 | Natural Language Processing | PCC | 2 | 0 | 2 | 4 | 3 |
| 4. | BD4251 | Big Data Mining and Analytics | PCC | 3 | 0 | 0 | 3 | 3 |
| 5. | | Professional Elective I | PEC | 3 | 0 | 0 | 3 | 3 |
| 6. | | Professional Elective II | PEC | 3 | 0 | 0 | 3 | 3 |
| 7. | | Audit Course – II* | AC | 2 | 0 | 0 | 2 | 0 |
| **PRACTICALS** | | | | | | | | |
| 8. | ML4211 | Data Analytics Laboratory | PCC | 0 | 0 | 2 | 2 | 1 |
| 9. | ML4212 | Term Paper and Seminar | EEC | 0 | 0 | 2 | 2 | 1 |
| | | | **TOTAL** | **19** | **0** | **10** | **29** | **22** |

*Audit course is optional

## SEMESTER III

| S. NO. | COURSE CODE | COURSE TITLE | CATE-GORY | PERIODS PER WEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| **THEORY** | | | | | | | | |
| 1. | IF4073 | Deep Learning | PCC | 3 | 0 | 2 | 5 | 4 |
| 2. | | Professional Elective III | PEC | 3 | 0 | 0 | 3 | 3 |
| 3. | | Professional Elective IV | PEC | 3 | 0 | 2 | 5 | 4 |
| 4. | | Open Elective | OEC | 3 | 0 | 0 | 3 | 3 |
| **PRACTICALS** | | | | | | | | |
| 5. | ML4311 | Project Work I | EEC | 0 | 0 | 12 | 12 | 6 |
| | | | **TOTAL** | **12** | **0** | **16** | **28** | **20** |

## SEMESTER IV

| S. NO. | COURSE CODE | COURSE TITLE | CATE-GORY | PERIODS PER WEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| **PRACTICALS** | | | | | | | | |
| 1. | ML4411 | Project Work II | EEC | 0 | 0 | 24 | 24 | 12 |
| | | | **TOTAL** | **0** | **0** | **24** | **24** | **12** |

Tentative

**TOTAL NO. OF CREDITS: 75**

## PROFESSIONAL ELECTIVES
## SEMESTER II, ELECTIVE I

| S. NO. | COURSE CODE | COURSE TITLE | CATE-GORY | PERIODS PER WEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| 1. | IF4079 | Social Network Analysis | PEC | 3 | 0 | 0 | 3 | 3 |
| 2. | BD4072 | Predictive Modeling | PEC | 3 | 0 | 0 | 3 | 3 |
| 3. | MP4351 | Smart Convergent Technologies | PEC | 3 | 0 | 0 | 3 | 3 |
| 4. | ML4001 | Probabilistic Graphical Models | PEC | 3 | 0 | 0 | 3 | 3 |
| 5. | AP4075 | Quantum Computing | PEC | 3 | 0 | 0 | 3 | 3 |

**SEMESTER II, ELECTIVE II**

| S. NO. | COURSE CODE | COURSE TITLE | CATE-GORY | PERIODS PER WEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| 1. | MU4152 | Multimedia Communication Networks | PEC | 3 | 0 | 0 | 3 | 3 |
| 2. | CP4076 | Information Retrieval Techniques | PEC | 3 | 0 | 0 | 3 | 3 |
| 3. | SE4073 | Image Processing | PEC | 3 | 0 | 0 | 3 | 3 |
| 4. | CP4071 | Autonomous Systems | PEC | 3 | 0 | 0 | 3 | 3 |
| 5. | CP4081 | Web Analytics | PEC | 3 | 0 | 0 | 3 | 3 |
| 6. | MP4071 | Cognitive Computing | PEC | 3 | 0 | 0 | 3 | 3 |

**SEMESTER III, ELECTIVE III**

| S. NO. | COURSE CODE | COURSE TITLE | CATE-GORY | PERIODS PER WEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| 1. | MP4073 | Human Computer Interaction | PEC | 3 | 0 | 0 | 3 | 3 |
| 2. | CP4078 | Performance Analysis of Computer Systems | PEC | 3 | 0 | 0 | 3 | 3 |
| 3. | CP4074 | Data Visualization Techniques | PEC | 3 | 0 | 0 | 3 | 3 |
| 4. | AP4076 | Robotics | PEC | 3 | 0 | 0 | 3 | 3 |

Tentative

**SEMESTER III, ELECTIVE IV**

| S. NO. | COURSE CODE | COURSE TITLE | CATE-GORY | PERIODS PER WEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| 1. | CP4073 | Blockchain Technologies | PEC | 3 | 0 | 2 | 5 | 4 |
| 2. | MU4253 | Mixed Reality | PEC | 3 | 0 | 2 | 5 | 4 |
| 3. | CP4072 | Bioinformatics | PEC | 3 | 0 | 2 | 5 | 4 |
| 4. | MP4252 | Mobile Application Development | PEC | 3 | 0 | 2 | 5 | 4 |
| 5. | IF4075 | Devops and Microservices | PEC | 3 | 0 | 2 | 5 | 4 |

**AUDIT COURSES (AC)**

**Registration for any of these courses is optional to students**

| SL. NO | COURSE CODE | COURSE TITLE | PERIODS PER WEEK | | | CREDITS |
|---|---|---|---|---|---|---|
| | | | L | T | P | |
| 1. | AX4091 | English for Research Paper Writing | 2 | 0 | 0 | 0 |
| 2. | AX4092 | Disaster Management | 2 | 0 | 0 | 0 |
| 3. | AX4093 | Constitution of India | 2 | 0 | 0 | 0 |
| 4. | AX4094 | நற்றமிழ் இலக்கியம் | 2 | 0 | 0 | 0 |

## FOUNDATION COURSES (FC)

| S. NO | COURSE CODE | COURSE TITLE | PERIODS PER WEEK | | | CREDITS | SEMESTER |
|---|---|---|---|---|---|---|---|
| | | | Lecture | Tutorial | Practical | | |
| 1. | MA4151 | Applied Probability and Statistics for Computer Science Engineers | 3 | 1 | 0 | 4 | I |

## PROFESSIONAL CORE COURSES (PCC)

| S. NO | COURSE CODE | COURSE TITLE | PERIODS PER WEEK | | | CREDITS | SEMESTER |
|---|---|---|---|---|---|---|---|
| | | | Lecture | Tutorial | Practical | | |
| 1. | CP4151 | Advanced Data Structures and Algorithms | 3 | 0 | 0 | 3 | I |
| 2. | CP4152 | Database Practices | 3 | 0 | 2 | 4 | I |
| 3. | CP4154 | Principles of Programming | 3 | 0 | 0 | 3 | I |
| 4. | ML4151 | Artificial Intelligence | 3 | 0 | 0 | 3 | I |
| 5. | CP4161 | Advanced Data Structures and Algorithms Laboratory | 0 | 0 | 4 | 2 | I |
| 6. | CP4251 | Internet of Things | 3 | 0 | 2 | 4 | I I |
| 7. | CP4252 | Machine Learning | 3 | 0 | 2 | 4 | I I |
| 8. | ML4251 | Natural Language Processing | 2 | 0 | 2 | 4 | I I |
| 9. | BD4251 | Big Data Mining and Analytics | 3 | 0 | 3 | 3 | I I |
| 10. | ML4211 | Data Analytics Laboratory | 0 | 0 | 4 | 2 | I I |
| 11. | IF4073 | Deep Learning | 3 | 0 | 2 | 4 | I I I |

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## RESEARCH METHODOLOGY AND IPR COURSES (RMC)

| S. NO | COURSE CODE | COURSE TITLE | PERIODS PER WEEK | | | CREDITS | SEMESTER |
|---|---|---|---|---|---|---|---|
| | | | Lecture | Tutorial | Practical | | |
| 1. | RM4151 | Research Methodology and IPR | 2 | 0 | 0 | 2 | 1 |

## EMPLOYABILITY ENHANCEMENT COURSES (EEC)

| S. NO | COURSE CODE | COURSE TITLE | PERIODS PER WEEK | | | CREDITS | SEMESTER |
|---|---|---|---|---|---|---|---|
| | | | Lecture | Tutorial | Practical | | |
| 1. | ML4212 | Term Paper and Seminar | 0 | 0 | 2 | 1 | III |
| 2. | ML4311 | Project Work I | 0 | 0 | 12 | 6 | III |
| 3. | ML4411 | Project Work II | 0 | 0 | 24 | 12 | IV |

**SUMMARY**

| Sl. No. | Name of the Programme: M.E. COMPUTER SCIENCE AND ENGINEERING (ARTIFICIAL INTELLIGENCE AND DATA SCIENCE) | | | | | |
|---|---|---|---|---|---|---|
| | **SUBJECT AREA** | **CREDITS PER SEMESTER** | | | | **CREDITS TOTAL** |
| | | **I** | **II** | **III** | **IV** | |
| 1. | FC | 04 | 00 | 00 | 00 | 04 |
| 2. | PCC | 15 | 15 | 04 | 00 | 34 |
| 3. | PEC | 00 | 06 | 07 | 00 | 13 |
| 4. | RMC | 02 | 00 | 00 | 00 | 02 |
| 5. | OEC | 00 | 00 | 03 | 00 | 03 |
| 6. | EEC | 00 | 01 | 06 | 12 | 19 |
| 7. | Non Credit/Audit Course | ✓ | ✓ | 00 | 00 | |
| 8. | **TOTAL CREDIT** | **21** | **22** | **20** | **12** | **75** |

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**MA4151 APPLIED PROBABILITY AND STATISTICS FOR COMPUTER SCIENCE ENGINEERS**

| L | T | P | C |
|---|---|---|---|
| 3 | 1 | 0 | 4 |

**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**

Vector spaces – norms – Inner Products – Eigenvalues using QR transformations – QR factorization – generalized eigenvectors – Canonical forms – singular value decomposition and applications – pseudo inverse – least square approximations.

**UNIT II PROBABILITY AND RANDOM VARIABLES 12**

Probability – Axioms of probability – Conditional probability – Bayes theorem – Random variables – Probability function – Moments – Moment generating functions and their properties – Binomial, Poisson , Geometric, Uniform, Exponential, Gamma and Normal distributions – Function of a random variable.

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**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

- apply the concepts of Linear Algebra to solve practical problems.
- use the ideas of probability and random variables in solving engineering problems.
- be familiar with some of the commonly encountered two dimensional random variables and be equipped for a possible extension to multivariate analysis.
- use statistical tests in testing hypotheses on data.
- develop critical thinking based on empirical evidence and the scientific approach to knowledge development.

**REFERENCES:**


1. Dallas E Johnson, “Applied multivariate methods for data Analysis”, Thomson and Duxbury press, Singapore, 1998.
2. Richard A. Johnson and Dean W. Wichern, “Applied multivariate statistical Analysis”, Pearson Education, Fifth Edition, 6th Edition, New Delhi, 2013.
3. Bronson, R.,”Matrix Operation” Schaum’s outline series, Tata McGraw Hill, New York, 2011.
4. Oliver C. Ibe, “Fundamentals of Applied probability and Random Processes”, Academic Press, Boston, 2014.
5. Johnson R. A. and Gupta C.B., “Miller and Freund’s Probability and Statistics for Engineers”, Pearson India Education, Asia, 9th Edition, New Delhi, 2017.


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

**UNIT I RESEARCH DESIGN 6**

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

**UNIT II DATA COLLECTION AND SOURCES 6**

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

**UNIT III DATA ANALYSIS AND REPORTING 6**

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

**UNIT IV INTELLECTUAL PROPERTY RIGHTS 6**

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

**UNIT V PATENTS 6**

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

**TOTAL : 30 PERIODS**

**REFERENCES:**


1. Cooper Donald R, Schindler Pamela S and Sharma JK, “Business Research Methods”, Tata McGraw Hill Education, 11e (2012).
2. Catherine J. Holland, “Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets”, Entrepreneur Press, 2007.


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3. David Hunt, Long Nguyen, Matthew Rodgers, “Patent searching: tools & techniques”, Wiley, 2007.
4. The Institute of Company Secretaries of India, Statutory body under an Act of parliament, “Professional Programme Intellectual Property Rights, Law and practice”, September 2013.

**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.

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**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 Minimum Spanning Tree – Kruskal and Prim- Single-Source Shortest Paths: The Bellman-Ford 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 Reducibility – NP-Completeness Proofs – NP-Complete Problems.

**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**


1. S.Sridhar," Design and Analysis of Algorithms", Oxford University Press, 1st Edition, 2014.
2. Adam Drozdex, "Data Structures and algorithms in C++", Cengage Learning, 4th Edition, 2013.
3. T.H. Cormen, C.E.Leiserson, R.L. Rivest and C.Stein, "Introduction to Algorithms", Prentice Hall of India, 3rd Edition, 2012.
4. Mark Allen Weiss, "Data Structures and Algorithms in C++", Pearson Education, 3rd Edition, 2009.
5. E. Horowitz, S. Sahni and S. Rajasekaran, "Fundamentals of Computer Algorithms", University Press, 2nd Edition, 2008.
6. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson Education, Reprint 2006.


Tentative

**CP4152 DATABASE PRACTICES L T P C**
**3 0 2 4**

**COURSE OBJECTIVES**

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

**UNIT I RELATIONAL DATA MODEL 12**

Entity Relationship Model – Relational Data Model – Mapping Entity Relationship Model to Relational Model – Relational Algebra – Structured Query Language – Database Normalization.

**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 12**

Distributed Database Architecture – Distributed Data Storage – Distributed Transactions – Distributed Query Processing – Distributed Transaction Management – Event Condition Action Model – Design and Implementation Issues for Active Databases – 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

Tentative

**UNIT III XML DATABASES 12**

Structured, Semi structured, and Unstructured Data – XML Hierarchical Data Model – XML Documents – Document Type Definition – XML Schema – XML Documents and Databases – XML Querying – XPath – XQuery

**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 12**

NoSQL – Categories of NoSQL Systems – CAP Theorem – Document-Based NoSQL Systems and MongoDB – MongoDB Data Model – MongoDB Distributed Systems Characteristics – NoSQL Key-Value Stores – DynamoDB Overview – Voldemort Key-Value Distributed Data Store – Wide Column NoSQL Systems – Hbase Data Model – Hbase Crud Operations – Hbase Storage and Distributed System Concepts – NoSQL Graph Databases and Neo4j – Cypher Query Language of Neo4j – Big Data – MapReduce – Hadoop – YARN.

**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 12**

Database Security Issues – Discretionary Access Control Based on Granting and Revoking Privileges – Mandatory Access Control and Role-Based Access Control for Multilevel Security – SQL Injection – Statistical Database Security – Flow Control – Encryption and Public Key Infrastructures – Preserving Data Privacy – Challenges to Maintaining Database Security – Database Survivability – Oracle Label-Based Security.

**Suggested Activities:**

Implementing Access Control in Relational Databases

**TOTAL : 75 PERIODS**

**COURSE OUTCOMES:**

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

- Convert the ER-model to relational tables, populate relational databases 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

Tentative

**REFERENCES:**


1. R. Elmasri, S.B. Navathe, “Fundamentals of Database Systems”, Seventh Edition, Pearson Education 2016.
2. Henry F. Korth, Abraham Silberschatz, S. Sudharshan, “Database System Concepts”, Seventh Edition, McGraw Hill, 2019.
3. C.J.Date, A.Kannan, S.Swamynathan, “An Introduction to Database Systems, Eighth Edition, Pearson Education, 2006
4. Raghu Ramakrishnan , Johannes Gehrke “Database Management Systems”, Fourth Edition, McGraw Hill Education, 2015.
5. Harrison, Guy, “Next Generation Databases, NoSQL and Big Data” , First Edition, Apress publishers, 2015
6. Thomas Cannolly and Carolyn Begg, “Database Systems, A Practical Approach to Design, Implementation and Management”, Sixth Edition, Pearson Education, 2015


**CP4154 PRINCIPLES OF PROGRAMMING LANGUAGES L T P C**

**3 0 0 3**

**COURSE OBJECTIVES:**

- To understand and describe syntax and semantics of programming languages
- To understand data, data types, and basic statements
- To understand call-return architecture and ways of implementing them
- To understand object-orientation, concurrency, and event handling in
- programming languages
- To develop programs in non-procedural programming paradigms

**UNIT I SYNTAX AND SEMANTICS 9**

Evolution of programming languages – describing syntax – context – free grammars –attribute grammars – describing semantics – lexical analysis – parsing – recursive-descent – bottom- up parsing

**UNIT II DATA, DATA TYPES, AND BASIC STATEMENTS 9**

Names – variables – binding – type checking – scope – scope rules – lifetime and garbage collection –primitive data types–strings–array types– associative arrays–record types– union types – pointers and references – Arithmetic expressions – overloaded operators – type conversions – relational and boolean expressions – assignment statements – mixed- mode assignments – control structures – selection – iterations – branching – guarded statements

**UNIT III SUBPROGRAMS AND IMPLEMENTATIONS 9**

Subprograms – design issues – local referencing – parameter passing – overloaded methods – generic methods – design issues for functions – semantics of call and return – implementing simple subprograms – stack and dynamic local variables – nested subprograms – blocks – dynamic scoping

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

Object-orientation – design issues for OOP languages – implementation of object-oriented constructs – concurrency – semaphores – monitors – message passing – threads – statement level concurrency – exception handling – event handling

Tentative

**UNIT V FUNCTIONAL AND LOGIC PROGRAMMING LANGUAGES 9**

Introduction to lambda calculus – fundamentals of functional programming languages – Programming with Scheme – Programming with ML – Introduction to logic and logic programming – Programming with Prolog – multi-paradigm languages

**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
CO6: Understand and adopt new programming language

**TOTAL : 45 PERIODS**

**REFERENCES:**

1. Robert W. Sebesta, “Concepts of Programming Languages”, Eleventh Edition, Addison Wesley,2012
2. W. F. Clocksin and C. S. Mellish, “Programming in Prolog: Using the ISO Standard”, Fifth Edition, Springer, 2003
3. Michael L.Scott, “Programming Language Pragmatics”, Fourth Edition, Morgan Kaufmann,2009.
4. R.KentDybvig,“TheSchemeprogramminglanguage”,FourthEdition,MITPress,2009
5. Richard A. O'Keefe, “The craft of Prolog”, MIT Press,2009
6. W.F.ClocksinandC.S.Mellish,“ProgramminginProlog:UsingtheISOStandard”,Fifth Edition, Springer,2003

**ML4151** **ARTIFICIAL INTELLIGENCE** **L T P C**
**3 0 0 3**

**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 PROBLEMS 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

Tentative

**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 Probabilistic Programming -Making Simple Decisions - Making Complex Decisions - Case 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:**


1. Stuart Russell, Peter Norvig, “Artificial Intelligence: A Modern Approach”, Pearson, 4th Edition, 2020.
2. Zhongzhi Shi “Advanced Artificial Intelligence”, World Scientific; 2019.
3. Kevin Knight, Elaine Rich, Shivashankar B. Nair, “Artificial Intelligence”, McGraw Hill Education; 3rd edition, 2017
4. Richard E. Neapolitan, Xia Jiang, “Artificial Intelligence with an Introduction to Machine Learning”, Chapman and Hall/CRC; 2nd edition, 2018
5. Dheepak Khemani, “A first course in Artificial Intelligence”, McGraw Hill Education Pvt Ltd., NewDelhi, 2013.
6. Nils J. Nilsson, “Artificial Intelligence: A New Synthesis”, Morgan Kaufmann Publishers Inc; Second Edition, 2003.


Tentative

| CP4161 | ADVANCED DATA STRUCTURES AND ALGORITHMS LABORATORY | L T P C 0 0 4 2 |
|---|---|---|

**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:**


1. Lipschutz Seymour, “Data Structures Schaum's Outlines Series”, Tata McGraw Hill, 3rd Edition, 2014.
2. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, “Data Structures and Algorithms”, Pearson Education, Reprint 2006.
3. http://www.coursera.org/specializations/data-structures-algorithms
4. http://www.tutorialspoint.com/data_structures_algorithms
5. http://www.geeksforgeeks.org/data-structures/


Tentative

**CP4251 INTERNET OF THINGS**

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**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 architectue
- To gain experience in Raspberry PI and experiment simple IoT application on it

**UNIT I INTRODUCTION** **12**

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** **12**

IETF architecture for IoT - IoT reference architecture -First Generation – Description & Characteristics–Advanced Generation – Description & Characteristics–Integrated IoT Sensors – Description & Characteristics

**UNIT III IoT PROTOCOLS AND TECHNOLOGY** **12**

SCADA and RFID Protocols - BACNet Protocol -Zigbee Architecture - 6LowPAN - CoAP -Wireless Sensor Structure–Energy Storage Module–Power Management Module–RF Module–Sensing Module

**UNIT IV CLOUD ARCHITECTURE BASICS** **12**

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** **12**

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

Tentative

**TOTAL PERIODS: 60**

**REFERENCES:**


1. Arshdeep Bahga, Vijay Madisetti, Internet of Things: A hands-on approach, Universities Press, 2015
2. Dieter Uckelmann, Mark Harrison, Florian Michahelles (Eds), Architecting the Internet of Things, Springer, 2011
3. Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015
4. Ovidiu Vermesan Peter Friess, 'Internet of Things – From Research and Innovation to Market Deployment', River Publishers, 2014
5. N. Ida, Sensors, Actuators and Their Interfaces: A Multidisciplinary Introduction, 2nd EditionScitech Publishers, 202014
6. Reese, G. (2009). Cloud Application Architectures: Building Applications and Infrastructure in the Cloud. Sebastopol, CA: O'Reilly Media, Inc. (2009)


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| C02 | 3 | 2 | 1 | 2 | 3 | 2 |
| C03 | 1 | 1 | 2 | 1 | 3 | 3 |
| C04 | 2 | 3 | 2 | 1 | 2 | 2 |
| C05 | 1 | 2 | 1 | 2 | 1 | 1 |
| AVG | 1.60 | 1.80 | 1.60 | 1.40 | 2.00 | 2.20 |

**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**

What is Machine Learning? Need –History – Definitions – Applications - Advantages, Disadvantages & Challenges -Types of Machine Learning Problems – Mathematical Foundations - Linear Algebra & Analytical Geometry -Probability and Statistics- Bayesian Conditional Probability -Vector Calculus & Optimization - Decision Theory - Information theory

**UNIT II SUPERVISED LEARNING 9**

Introduction-Discriminative and Generative Models -Linear Regression - Least Squares -Under-fitting / Overfitting -Cross-Validation – Lasso Regression- Classification - Logistic Regression- Gradient Linear Models -Support Vector Machines –Kernel Methods -Instance based Methods - K-Nearest Neighbours - Tree based Methods –Decision Trees –ID3 – CART - Ensemble Methods –Random Forest - Evaluation of Classification Algorithms

Tentative

**UNIT III UNSUPERVISED LEARNING AND REINFORCEMENT LEARNING 9**

Introduction - Clustering Algorithms -K – Means – Hierarchical Clustering - Cluster Validity - Dimensionality Reduction –Principal Component Analysis – Recommendation Systems - EM algorithm. Reinforcement Learning – Elements -Model based Learning – Temporal Difference Learning

**UNIT IV PROBABILISTIC METHODS FOR LEARNING- 9**

Introduction -Naïve Bayes Algorithm -Maximum Likelihood -Maximum Apriori -Bayesian Belief Networks -Probabilistic Modelling of Problems -Inference in Bayesian Belief Networks – Probability Density Estimation - Sequence Models – Markov Models – Hidden Markov Models

**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

**45 PERIODS**

**SUGGESTED ACTIVITIES:**

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

6. Give at least 5 recent applications of CNN

**PRACTICAL EXERCISES: 30 PERIODS**

1. Implement a Linear Regression with a Real Dataset (https://www.kaggle.com/harrywang/housing). Experiment with different features in building a model. Tune the model's hyperparameters.
2. Implement a binary classification model. That is, answers a binary question such as "Are houses in this neighborhood above a certain price?"(use data from exercise 1). Modify the classification threshold and determine how that modification influences the model. Experiment with different classification metrics to determine your model's effectiveness.
3. Classification with Nearest Neighbours. In this question, you will use the scikit-learn's KNN classifer 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.
8. 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.
1. You can either pick a project of your own design, or you can choose from the set of pre-defined projects.
2. You are free to use any third-party ideas or code that you wish as long as it is publicly available.
3. You must properly provide references to any work that is not your own in the write-up.
4. 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:**

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

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

Tentative

**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.
**C06:** Identify applications suitable for different types of Machine Learning with suitable justification.

**TOTAL PERIODS:75**

**REFERENCES**


1. Stephen Marsland, "Machine Learning: An Algorithmic Perspective", Chapman & Hall/CRC, 2nd Edition, 2014.
2. Kevin Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012
3. Ethem Alpaydin, "Introduction to Machine Learning", Third Edition, Adaptive Computation and Machine Learning Series, MIT Press, 2014
4. Tom M Mitchell, "Machine Learning", McGraw Hill Education, 2013.
5. Peter Flach, "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", First Edition, Cambridge University Press, 2012.
6. Shai Shalev-Shwartz and Shai Ben-David, "Understanding Machine Learning: From Theory to Algorithms", Cambridge University Press, 2015
7. Christopher Bishop, "Pattern Recognition and Machine Learning", Springer, 2007.
8. Hal Daumé III, "A Course in Machine Learning", 2017 (freely available online)
9. Trevor Hastie, Robert Tibshirani, Jerome Friedman, "The Elements of Statistical Learning", Springer, 2009 (freely available online)
10. Aurélien Géron , Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems 2nd Edition, o'reilly, (2017)


Tentative

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| C01 | 1 | 2 | 1 | 3 | 1 | 1 |
| C02 | 2 | 3 | 1 | 2 | 1 | 2 |
| C03 | 1 | 1 | 2 | 1 | | 2 |
| C04 | 2 | 2 | | | | 3 |
| C05 | 3 | 3 | 1 | 1 | 1 | 3 |
| AVG | 1.80 | 2.20 | 1.25 | 1.75 | 1.00 | 2.20 |

**ML4251** **NATURAL LANGUAGE PROCESSING** **L T P C 2 0 2 3**

**COURSE OBJECTIVES:**

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

**UNIT I INTRODUCTION** **6**

Natural Language Processing – Components - Basics of Linguistics and Probability and Statistics – Words-Tokenization-Morphology-Finite State Automata

**UNIT II STATISTICAL NLP AND SEQUENCE LABELING 6**

N-grams and Language models –Smoothing -Text classification- Naïve Bayes classifier – Evaluation - Vector Semantics – TF-IDF - Word2Vec- Evaluating Vector Models -Sequence Labeling **–** Part of Speech – Part of Speech Tagging -Named Entities **–**Named Entity Tagging

**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 Dialogue systems – Frame-based Dialogue Systems – Dialogue–State Architecture

**30 PERIODS**

Tentative

**SUGGESTED ACTIVITIES:**

1. **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. **7.** Give the design of a Chatbot

**PRACTICAL EXERCISES: 30 PERIODS**

1. Download nltk and packages. Use it to print the tokens in a document and the sentences from it.
2. Include custom stop words and remove them and all stop words from a given document using nltk or spaCY package
3. Implement a stemmer and a lemmatizer program.
4. Implement 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. **7.** Implement a semantic language processor that uses WordNet for semantic tagging.
8. **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**

Tentative

**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
4. Christopher Manning, “Foundations of Statistical Natural Language Processing”, MIT Press, 2009.
5. Nitin Indurkhya,Fred J. Damerau, “Handbook of Natural Language Processing”, Second edition, Chapman & Hall/CRC: Machine Learning & Pattern Recognition, Hardcover,2010
6. Deepti Chopra, Nisheeth Joshi, “Mastering Natural Language Processing with Python”, Packt Publishing Limited, 2016
7. Mohamed Zakaria Kurdi “Natural Language Processing and Computational Linguistics: Speech, Morphology and Syntax (Cognitive Science)”, ISTE Ltd., 2016
8. Atefeh Farzindar,Diana Inkpen, “Natural Language Processing for Social Media (Synthesis Lectures on Human Language Technologies)”, Morgan and Claypool Life Sciences, 2015


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

**COURSE OBJECTIVES:**

- To understand the computational approaches to Modeling, Feature Extraction
- To understand the need and application of Map Reduce
- To understand the various search algorithms applicable to Big Data

- To 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 9**

Introduction to Statistical modeling – Machine Learning – Computational approaches to modeling – Summarization – Feature Extraction – Statistical Limits on Data Mining - Distributed File Systems – Map-reduce – Algorithms using Map Reduce – Efficiency of Cluster Computing Techniques.

**UNIT II SIMILAR ITEMS 9**

Nearest Neighbor Search – Shingling of Documents – Similarity preserving summaries – Locality sensitive hashing for documents – Distance Measures – Theory of Locality Sensitive Functions – LSH Families – Methods for High Degree of Similarities.

**UNIT III MINING DATA STREAMS 9**

Stream Data Model – Sampling Data in the Stream – Filtering Streams – Counting Distance Elements in a Stream – Estimating Moments – Counting Ones in Window – Decaying Windows.

**UNITIV LINK ANALYSIS AND FREQUENT ITEMSETS 9**

Page Rank –Efficient Computation - Topic Sensitive Page Rank – Link Spam – Market Basket Model – A-priori algorithm – Handling Larger Datasets in Main Memory – Limited Pass Algorithm – Counting Frequent Item sets.

Tentative

**UNIT V CLUSTERING 9**

Introduction to Clustering Techniques – Hierarchical Clustering –Algorithms – K-Means – CURE – Clustering in Non -– Euclidean Spaces – Streams and Parallelism – Case Study: Advertising on the Web – Recommendation Systems.

**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:**

1. Jure Leskovec, AnandRajaraman, Jeffrey David Ullman, “Mining of Massive Datasets”, Cambridge University Press, 3rd Edition, 2020.
2. Jiawei Han, MichelineKamber, Jian Pei, “Data Mining Concepts and Techniques”, Morgan Kaufman Publications, Third Edition, 2012.
3. Ian H.Witten, Eibe Frank “Data Mining – Practical Machine Learning Tools and Techniques”, Morgan Kaufman Publications, Third Edition, 2011.
4. David Hand, HeikkiMannila and Padhraic Smyth, “Principles of Data Mining”, MIT PRESS, 2001

**WEB REFERENCES**:

1. *https://swayam.gov.in/nd2_arp19_ap60/preview*
2. *https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/106104189/lec1.pdf*

**ONLINE RESOURCES:**

1. *https://examupdates.in/big-data-analytics/*
2. *https://www.tutorialspoint.com/big_data_analytics/index.htm*
3. *https://www.tutorialspoint.com/data_mining/index.htm*

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| **CO2** | 1 | | 1 | 3 | 3 | 1 |
| **CO3** | 1 | | 1 | 3 | 3 | 1 |
| **CO4** | 1 | | 1 | 3 | 3 | 2 |
| **CO5** | 1 | | 1 | 3 | 3 | 1 |
| Avg | 5/5=1 | | 5/5=1 | 15/5=3 | 15/5=3 | 6/5=1.2 |

Tentative

**ML4211** **DATA ANALYTICS LAB** **L T P C**
**0 0 2 1**

**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 PERIODS: 30**

**ML4212** **TERM PAPER WRITING AND SEMINAR** **L T P C**
**0 0 2 1**

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

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

Tentative

Please keep a file where the work carried out by you is maintained.
Activities to be carried out

| Activity | Instructions | Submission week | Evaluation |
|---|---|---|---|
| Selection of area of interest and Topic<br>Stating an Objective | You are requested to select an area of interest, topic and state an objective | 2nd week | **3 %**<br>Based on clarity of thought, current relevance and clarity in writing |
| Collecting Information about your area & topic | 1. List 1 Special Interest Groups or professional society<br>2. List 2 journals<br>3. List 2 conferences, symposia or workshops<br>4. List 1 thesis title<br>5. List 3 web presences (mailing lists, forums, news sites) | 3rd week | **3%**<br>( the selected information must be area specific and of international and national standard) |

| | | | |
|---|---|---|---|
| | 6. List 3 authors who publish regularly in your area<br>7. Attach a call for papers (CFP) from your area. | | |
| 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<br>• When picking papers to read - try to:<br>• 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,<br>• Favour papers from well-known journals and conferences,<br>• Favour "first" or "foundational" papers in the field (as indicated in other people's survey paper),<br>• Favour more recent papers,<br>• Pick a recent survey of the field so you can quickly gain an overview,<br>• Find relationships with respect to each other and to your topic area (classification scheme/categorization)<br>• Mark in the hard copy of papers whether complete work or section/sections of the paper are being considered | 4th week | **6%**<br>( the list of standard papers and reason for selection) |
| Reading and notes for first 5 papers | Reading Paper Process<br>• For each paper form a Table answering the following questions:<br>• What is the main topic of the article?<br>• What was/were the main issue(s) the author said they want to discuss?<br>• Why did the author claim it was important?<br>• How does the work build on other's work, in the author's opinion?<br>• What simplifying assumptions does the author claim to be making?<br>• What did the author do?<br>• How did the author claim they were going to evaluate their work and compare it to others?<br>• What did the author say were the limitations of their research? | 5th week | **8%**<br>( the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper) |

Tentative

| | | | |
|---|---|---|---|
| | • 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) | | |
| Reading and notes for next5 papers | Repeat Reading Paper Process | 6th week | **8%** ( the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper) |
| Reading and notes for final 5 papers | Repeat Reading Paper Process | 7th week | **8%** ( the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper) |
| 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 | 11thweek | **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 |

Tentative

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

**TOTAL: 30 PERIODS**

**IF4073** **DEEP LEARNING** **L T P C**
**3 0 2 4**

**COURSE OBJECTIVES:**

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

**UNIT I DEEP LEARNING CONCEPTS 6**

Fundamentals about Deep Learning. Perception Learning Algorithms. Probabilistic modelling. Early Neural Networks. How Deep Learning different from Machine Learning. Scalars. Vectors. Matrixes, Higher Dimensional Tensors. Manipulating Tensors. Vector Data. Time Series Data. Image Data. Video Data.

Tentative

**UNIT II NEURAL NETWORKS 9**

About Neural Network. Building Blocks of Neural Network. Optimizers. Activation Functions. Loss Functions. Data Pre-processing for neural networks, Feature Engineering. Overfitting and Underfitting. Hyperparameters.

**UNIT III CONVOLUTIONAL NEURAL NETWORK 10**

About CNN. Linear Time Invariant. Image Processing Filtering. Building a convolutional neural network. Input Layers, Convolution Layers. Pooling Layers. Dense Layers. Backpropagation Through the Convolutional Layer. Filters and Feature Maps. Backpropagation Through the Pooling Layers. Dropout Layers and Regularization. Batch Normalization. Various Activation Functions. Various Optimizers. LeNet, AlexNet, VGG16, ResNet. Transfer Learning with Image Data. Transfer Learning using Inception Oxford VGG Model, Google Inception Model, Microsoft ResNet Model. R-CNN, Fast R-CNN, Faster R-CNN, Mask-RCNN, YOLO

**UNIT VI NATURAL LANGUAGE PROCESSING USING RNN 10**

About NLP & its Toolkits. Language Modeling . Vector Space Model (VSM). Continuous Bag of Words (CBOW). Skip-Gram Model for Word Embedding. Part of Speech (PoS) Global Co-occurrence Statistics–based Word Vectors. Transfer Learning. Word2Vec. Global Vectors for Word Representation GloVe. Backpropagation Through Time. Bidirectional RNNs (BRNN) . Long Short Term Memory (LSTM). Bi-directional LSTM. Sequence-to-Sequence Models (Seq2Seq). Gated recurrent unit GRU.

**UNIT V DEEP REINFORCEMENT & UNSUPERVISED LEARNING 10**

About Deep Reinforcement Learning. Q-Learning. Deep Q-Network (DQN). Policy Gradient Methods. Actor-Critic Algorithm. About Autoencoding. Convolutional Auto Encoding. Variational

Auto Encoding. Generative Adversarial Networks. Autoencoders for Feature Extraction. Auto Encoders for Classification. Denoising Autoencoders. Sparse Autoencoders

**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 PERIODS: 45+30 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
3. Deep Learning Projects Using TensorFlow 2, Vinita Silaparasetty, Apress, 2020
4. Deep Learning with Python, FRANÇOIS CHOLLET, MANNING SHELTER ISLAND,2017
5. Pro Deep Learning with TensorFlow, Santanu Pattanayak, Apress,2017


Tentative

**IF4079** **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**

Breadth First Search (BFS) Algorithm. Strongly Connected Components (SCC) Algorithm. Weakly Connected Components (WCC) Algorithm. First Set of Experiments—Degree Distributions. Second Set of Experiments—Connected Components. Third Set of Experiments—Number of Breadth First Searches. Rank Exponent R. Out-Degree Exponent O. Hop Plot Exponent H. Eigen

Exponent E. Permutation Model. Random Graphs with Prescribed Degree Sequences. Switching Algorithms. Matching Algorithm. “Go with the Winners” Algorithm. HyperANF Algorithm. Iterative Fringe Upper Bound (iFUB) Algorithm. Spid. Degree Distribution. Path Length. Component Size. Clustering Coefficient and Degeneracy. Friends-of-Friends. Degree Assortativity. Login Correlation
.

**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**

Strategic network formation: game theoretic models for network creation/ user behavior in social networks. Information diffusion in graphs: Cascading behavior, spreading, epidemics, heterogeneous social network mining, influence maximization, outbreak detection. Opinion analysis on social networks: Contagion, opinion formation, coordination and cooperation.

**UNIT IV CASCADING IN SOCIAL NETWORKS 8**

Cascading in Social Networks. Decision Based Models of Cascade. Collective Action. Cascade Capacity. Co-existence of Behaviours. Cascade Capacity with Bilinguality. Probabilistic Models of Cascade. Branching Process. Basic Reproductive Number. SIR Epidemic Model. SIS Epidemic Model. SIRS Epidemic Model. Transient Contact Network. Cascading in Twitter.

**UNIT V LINK ANALYSIS & COMMUNITY DETECTION 9**

Search Engine. Crawling. Storage. Indexing. Ranking. Google. Data Structures. Crawling. Searching. Web Spam Pages Strength of Weak Ties. Triadic Closure. Detecting Communities in a Network. Girvan-Newman Algorithm. Modularity. Minimum Cut Trees. Tie Strengths in Mobile Communication Network. Exact Betweenness Centrality. Approximate Betweenness Centrality.

Tentative

**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 PERIODS: 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
3. Social Network Analysis: History, Theory and Methodology by Christina Prell, SAGE Publications, 1st edition, 2011
4. Sentiment Analysis in Social Networks, Federico Alberto Pozzi, Elisabetta Fersini, Enza Messina, and Bing. LiuElsevier Inc, 1st edition, 2016
5. Social Network Analysis, John Scott. SAGE Publications, 2012

**BD4072 PREDICTIVE MODELLING L T P C**
**3 0 0 3**

**COURSE OBJECTIVES:**

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

**UNIT I INTRODUCTION TO PREDICTIVE MODELING 9**

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

**UNIT II PREDICTIVE MODELING BASICS 9**

Data splitting – Balancing- Over fitting –Oversampling –Multiple Regression Artificial neural networks (MLP) - Variable importance- Profit/loss/prior probabilities - Model specification - Model selection - Multivariate Analysis.

**UNIT III PREDICTIVE MODELS 9**

Association Rules-Clustering Models –Decision Trees- Ruleset Models- KNearest Neighbors – Naive Bayes - Neural Network Model – Regression Models – Regression Trees – Classification & Regression Trees (CART) – Logistic Regression – Multiple Linear Regression Scorecards – Support Vector Machines – Time Series Models - Comparison between models - Lift chart Assessment of a single model.

**UNIT IV PREDICTIVE MODELING MARKUP LANGUAGE 9**

Introduction to PMML – PMML Converter - PMML Structure – Data Manipulation in PMML – PMML Modeling Techniques - Multiple Model Support – Model Verification.

**UNIT V TECHNOLOGIES AND CASE STUDIES 9**

Weka – RapidMiner – IBM SPSS Statistics- IBM SPSS Modeler – SAS Enterprise Miner – Apache Mahout – R Programming Language.-Real time case study with modeling and analysis.

**TOTAL: 45 PERIODS**

**REFERENCES:**

1. Kattamuri S. Sarma, “Predictive Modeling with SAS Enterprise Miner: Practical Solutions for Business Applications”, 3rd Edition, SAS Publishing, 2017.

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2. Alex Guazzelli, Wen-Ching Lin, Tridivesh Jena, James Taylor, “PMML in Action Unleashing the Power of Open Standards for Data Mining and Predictive Analytics”, 2nd Edition, Create Space Independent Publishing Platform,2012.

3. Ian H. Witten, Eibe Frank , “Data Mining: Practical Machine Learning Tools and Techniques”, Morgan Kaufmann Series in Data Management Systems, Morgan Kaufmann, 3rd Edition, 2011.

4. Eric Siegel , “Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die”, 2nd Edition, Wiley, 2016.

5. Conrad Carlberg, “Predictive Analytics: Microsoft Excel”, 1st Edition, Que Publishing, 2012.

6. Jeremy Howard, Margit Zwemer, Mike Loukides, “Designing Great Data Products- Inside the Drivetrain train Approach, a Four-Step Process for Building Data Products – Ebook”, 1st Edition, O'Reilly Media, March 2012.

**WEB REFERENCES**:

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

**ONLINE RESOURCES:**

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

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**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 .

| | **PO** | | | | | |
|---|---|---|---|---|---|---|
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| **CO1** | 2 | | 1 | 1 | 2 | 1 |
| **CO2** | 2 | 2 | 1 | | | 2 |
| **CO3** | 1 | | 1 | 2 | 3 | 2 |
| **CO4** | 1 | | 1 | 2 | 2 | |
| **CO5** | 1 | | | 2 | 3 | 2 |
| Avg | 7/5=1.4 | 2/1=2 | 4/4=1 | 7/4=1.7 | 10/4=2.5 | 7/4=1.7 |

**MP4351** **SMART CONVERGENCE TECHNOLOGIES** **L T P C**
**3 0 0 3**

**COURSE OBJECTIVE:**

- 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** **9**

Internet of Things Vision - IoT Strategic Research and Innovation Directions - IoT Applications - Internet of Things and Related Future Internet Technologies -Infrastructure - Networks and Communication - Processes - Data Management, Security, Privacy & Trust - Device Level Energy Issues.

**UNIT II IOT APPLICATIONS — VALUE CREATION FOR INDUSTRY** **9**

Introduction - IoT Applications for Industry — Value Creation and Challenges - Future Factory Concepts - Brownfield IoT: Technologies for Retrofitting - Smart Objects, Smart Applications - Four Aspects in your Business to Master IoT - Value Creation from Big Data and Serialization in the Pharmaceutical Industry - IoT for Retailing Industry- IoT for Oil and Gas Industry - Opinions on IoT Application and Value for Industry- Data Aggregation for the IoT in Smart Cities.

**UNIT III RFID PERVASIVE NETWORKS** 9

RFID Tags- RFID Automatic Identification and Data Capture RFID Data Warehousing and analysis,- RFID Data Management Issues, Solutions, and Directions- RFID Security: Threats and Solutions- RFIG Geometric Context of Wireless Tags- RFID Application in Animal Monitoring- RFID Enabled Logistics Services - Location Tracking in an Office Environment: The Nationwide Case Study- Pervasive Computing Security: Bluetooth's Example- Internet of Things: A Context-Awareness Perspective - Index.

Tentative

**UNIT IV 5G AND NEXT GENERATION NETWORK MIGRATION** 9

5G architecture – SDN/NFV review- RAN and Functional Architecture - Introduction to MTC and D2D communication -5G network slicing - 5G research and towards 6G - Overview of TDM to IP network migration - Legacy IPv4 to IPv6 network migration methods and practices -Legacy IPv4 to SDN migration methods and practices - 4G to 5G migration challenges and solutions.

**UNIT V CASE STUDY** 9

Smart Grid &IoT, Commercial building automation using IoT, Recent trends in sensor network and IOT architecture, Automation in Industrial aspect of IOT.

**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 5G concepts and Next Gen Network Migration
CO5: Apply the IoT concepts in smart Buildings

**TOTAL PERIODS: 45**

**REFERENCES:**


1. Ovidiu Vermesan, Peter Friess, “Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems”, River Publishers, 2013.
2. 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.
3. Silvia Hagen, “ IPv6 Essentials”, O’reilly, 3rd Edition, 2014.
4. JIM Doherty, “SDN and NFV Simplified: A Visual Guide to Understanding Software Defined Networks and Network Function Virtualization, Addison-Wesley Professional, 2016.
5. Cuno Pfister, “Getting Started with IoT Connecting Sensors and Microcontrollers the cloud”, 1st Edition O'Reilley, 2011.
6. Devaki Chandramouli, Rainer Liebhart, Juho Pirskanen, “5G for the connected world” Wiley, 2019.
7. Ovidiu Vermesan, Peter Friess, “Internet of Things – From Research and Innovation to Market Deployment”’, River Publishers, 2014
8. Ovidiu Vermesan, Peter Friess, “The Internet of Things: From RFID to the Next-Generation Pervasive Networked Systems”, River Publications, 2013.
9. 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.


Tentative

**ML4001** **PROBABILISTIC GRAPHICAL MODELS** **L T P C**
**3 0 0 3**

**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** **9**

Probabilistic Graphical Models – Motivation –Foundations – Probability Theory –Graphs - Independence Properties - Bayesian Network Representation - Independence in Graphs – From Distribution to Graphs

**UNIT II REPRESENTATION** **9**

Undirected Graphical Models - Parameterization –Markov Network Independencies – Bayesian Networks and Markov Networks – Local Probabilistic Models – Tabular CPDs – Template –Based Representation – Temporal Models- Exponential Family – Entropy and Relative Entropy

**UNIT III INFERENCE** **9**

Exact Inference – Variable Elimination- Conditioning – Clique Trees – Message Passing – Inference as Optimization – Exact Inference as Optimization – Propagation based Approximation

**UNIT IV ADVANCED INFERENCE 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**

Learning Graphical Models – Overview – Goals – Learning Tasks –Maximum Likelihood Estimation for Bayesian Networks – Bayesian Parameter Estimation – Structure Learning in Bayesian Networks -Methods –Learning Undirected Models

**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 PERIODS:45**

Tentative

**REFERENCES**


1. D. Koller and N. Friedman, “Probabilistic Graphical Models: Principles and Techniques”, MIT Press, 2009.
2. Probabilistic Machine Learning: An Introduction by Kevin Patrick Murphy.MIT Press, March 2022.
3. M.I. Jordan, “An Introduction to Probabilistic Graphical Models”, Preprint.
4. C.M. Bishop, “Pattern Recognition and Machine Learning”, Springer, 2006.
5. K.P. Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012.
6. David Barber. “Bayesian Reasoning and Machine Learning”, Cambridge University Press. 2012.
7. David Mackay, “Information Theory, Inference, and Learning Algorithms”, Cambridge university press. 15 February 2010.


**AP4075 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**

Limitations of Quantum Computing, Alternatives to the Circuit Model of Quantum Computation, Quantum Protocols, Building Quantum, Computers, Simulating Quantum Systems, Bell states. Quantum teleportation. Quantum Cryptography, no cloning theorem

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**COURSE OUTCOMES:**

At the end of the coarse, the student will be able to

- Understand the basic principles of quantum computing.
- Gain knowledge of the fundamental differences between conventional computing and quantum computing.
- Understand several basic quantum computing algorithms.
- Understand the classes of problems that can be expected to be solved well by quantum computers.

**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
4. Eleanor Rieffel and Wolfgang Polak, QUANTUM COMPUTING A Gentle Introduction, 2011
5. Nielsen M. A., Quantum Computation and Quantum Information, Cambridge University Press.2002
6. Benenti G., Casati G. and Strini G., Principles of Quantum Computation and Information, Vol. I: Basic Concepts, Vol II: Basic Tools and Special Topics, World Scientific. 2004
7. Pittenger A. O., An Introduction to Quantum Computing Algorithms 2000

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

**COURSE OBJECTIVES:**

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

**UNIT I INTRODUCTION 9**

Switched Networks and Shared media Networks – Circuit Switching, Packet Switching and Virtual Circuits – Flow Control and Congestion Control – TCP/IP reference model – Network Externalities – Service Integration – Elastic and Inelastic Traffic – Playback Applications – Additional Requirements For Inelastic Traffic – Core Networks And Access/Edge Networks.

**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.

Tentative

**UNIT II GUARANTEED SERVICE MODEL 9**

Best Effort Service Model and Its Limitations – Qos Metrics – Diffserv and Intserv Networks – Queuing Techniques – WFQ and Its Variants – RED – Qos Aware Routing – Call Admission Control – RSVP – Policing and Traffic Shaping Algorithms – Multicast Routing – IGMP, Protocol Independent Multicast – PIM SM and PIM DM Variants.

**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 9**

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

Server And Media Server – Removing Jitter at the Receiver – Recovering from Packet Loss – Forward Error Correction and Interleaving – Interactive And Non-Interactive Multimedia – Transcoding – RTSP – RTP/RTCP.

**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**

Architecture of IP Multimedia Subsystem in 3G Networks – Application, Control and Data Planes in IMS Networks – Session Control, AAA, Real Time Data Transfer and Policy Control Protocols of IMS Networks – Relay Node and Multiple Radio Access Technologies in LTE – Voice Over IP Basics – IMS Volte Architecture – IP Multimedia Service Identity Module, Private Identity, Public Identity (ISIM, IMPI And IMPU) – SIP User Agent (SIP UAC And SIP UAE) – Real Time Polling Service and Extended Real Time Polling Service in IEEE 802.16/Wimax Networks.

Tentative

**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**

H.322 Standard – Protocol Stack And Call Setup – Session Initiation Protocol – Components, Messages And Operation – Supporting Protocols For SIP – Media Gateway Access Protocol, Resource Reservation Protocol, Session Description Protocol – Case Study – Video Conferencing – Military Surveillance – Interactive TV – Video On Demand – Smart Phone.

**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:**


1. Mario Marques da Silva, “Multimedia Communications and Networking”, CRC Press, 2012
2. K. R. Rao, Zoron S. Bojkovic, Bojan M. Bakmaz, “Wireless Multimedia Communication Systems: Design, Analysis and Implementation”, CRC Press, 2017
3. Jim Kurose, Keith Ross, “Computer Networking: A Top Down Approach”, Pearson Education, 2017
4. K. R. Rao, Zoran S. Bojkovic, Dragorad A. Milovanovic, “Introduction to Multimedia Communications Applications, Middleware, Networking”, John Wiley and Sons, 2009


Tentative

**CP4076 INFORMATION RETRIEVAL TECHNIQUES**

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**COURSE OBJECTIVES:**

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

**UNIT I INTRODUCTION: MOTIVATION** **9**

Basic Concepts – Practical Issues - Retrieval Process – Architecture - Boolean Retrieval –Retrieval Evaluation – Open-Source IR Systems–History of Web Search – Web Characteristics–The impact of the web on IR ––IR Versus Web Search–Components of a Search engine.

**UNIT II MODELING** **9**

Taxonomy and Characterization of IR Models – Boolean Model – Vector Model - Term Weighting – Scoring and Ranking –Language Models – Set Theoretic Models - Probabilistic Models – Algebraic Models – Structured Text Retrieval Models – Models for Browsing

**UNIT III INDEXING** **9**

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

**UNIT IV EVALUATION AND PARALLEL INFORMATION RETRIEVAL** **9**

Traditional Effectiveness Measures – Statistics in Evaluation – Minimizing Adjudication Effect – Nontraditional Effectiveness Measures – Measuring Efficiency – Efficiency Criteria –Queueing Theory – Query Scheduling – Parallel Information Retrieval – Parallel Query Processing – MapReduce

**UNIT V SEARCHING THE WEB** **9**

Searching the Web –Structure of the Web –IR and web search – Static and Dynamic Ranking – Web Crawling and Indexing – Link Analysis - XML Retrieval Multimedia IR: Models and Languages – Indexing and Searching Parallel and Distributed IR – Digital Libraries.

**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 PERIODS: 45**

Tentative

**REFERENCES**

1. Christopher D. Manning, Prabhakar Raghavan, Hinrich Schutze, “Introduction to Information Retrieval, Cambridge University Press, First South Asian Edition, 2008.
2. Stefan Buttcher, Implementing and Evaluating Search Engines, The MIT Press, Cambridge, Massachusetts London, England, 2016.
3. Ricardo Baeza – Yates, Berthier Ribeiro – Neto, “Modern Information Retrieval: The concepts and Technology behind Search (ACM Press Books), Second Edition, 2011.
4. Stefan Buttcher, Charles L. A. Clarke, Gordon V. Cormack, “Information Retrieval

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| C02 | 1 | 1 | 1 | 3 | 2 | 1 |
| C03 | 2 | 1 | 2 | 3 | 3 | 3 |
| C04 | 1 | 2 | 2 | 1 | 2 | 3 |
| C05 | 2 | 2 | 3 | 3 | 1 | 3 |
| AVG | 1.60 | 1.60 | 1.80 | 2.60 | 2.20 | 2.40 |

**SE4073** **L T P C**

**IMAGE PROCESSING** **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** **9**

Examples of fields that use digital image processing, fundamental steps in digital image processing, components of image processing system. Digital Image Fundamentals: A simple image formation model, image sampling and quantization, basic relationships between pixels. 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** **9**

Image enhancement in the spatial domain: Basic gray-level transformation, histogram processing, enhancement using arithmetic and logic operators, basic spatial filtering, smoothing, and sharpening spatial filters, combining the spatial enhancement methods. Filtering in the Frequency Domain: Preliminary Concepts, Extension to functions of two variables, Image Smoothing, Image Sharpening, Homomorphic filtering. A model of the image degradation/restoration process, noise models, restoration in the presence of noise–only spatial filtering,

Tentative

**UNIT III *WAVELETS* AND IMAGE COMPRESSION** **9**

Wavelets and Multiresolution Processing. Fundamentals, image compression models, error-free compression, lossy predictive coding, image compression standards

**UNIT IV IMAGE SEGMENTATION** **9**

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** **9**

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 PERIODS: 45**

**REFERENCES**


1. Digital Image Processing, Rafeal C.Gonzalez, Richard E.Woods, fourth Edition, Pearson Education/PHI, 2018
2. Image Processing, Analysis, and Machine Vision, Milan Sonka, Vaclav Hlavac and Roger Boyle, fourth Edition, Thomson Learning, 2015
3. Introduction to Digital Image Processing with Matlab, Alasdair McAndrew, Thomson Course Technology, 2021
4. Computer Vision and Image Processing, Adrian Low, Second Edition, B.S.Publications,2022
5. Digital Image Processing using Matlab, Rafeal C.Gonzalez, Richard E.Woods, Steven L. Eddins, Pearson Education,2006.


Tentative

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| **CO3** | 3 | - | 2 | 3 | - | - |
| **CO4** | 2 | - | 2 | - | - | - |
| **CO5** | 3 | - | 2 | 3 | - | - |
| Avg | 2.6 | - | 2 | 2.4 | - | - |

**CP4071** **AUTONOMOUS SYSTEMS** **L T P C**
**3 0 0 3**

**COURSE OBJECTIVES:**

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

**UNIT I INTRODUCTION AND FUNCTIONAL ARCHITECTURE 9**

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

**UNIT II PERCEPTION FOR AUTONOMOUS SYSTEMS 9**

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

**UNIT III ROBOTICS INTRODUCTION, END EFFECTORS AND CONTROL 9**

Robot anatomy-Definition, law of robotics, Simple problems Specifications of Robot-Speed of Robot-Robot joints and links-Robot classifications-Architecture of robotic systems, Mechanical grippers-Slider crank mechanism, Screw type, Rotary actuators, cam type-Magnetic grippers-Vacuum grippers-Air operated grippers-Gripper force analysis-Gripper design-Simple problems-Robot controls-Point to point control, Continuous path control, Intelligent robotControl system for robot joint-Control actions-Feedback devices-Encoder, Resolver, LVDTMotion Interpolations-Adaptive control.

**UNIT IV ROBOT TRANSFORMATIONS, SENSORS AND ROBOT CELL DESIGN 9**

Robot kinematics-Types- 2D, 3D Transformation-Scaling, Rotation, Translation- Homogeneous coordinates, multiple transformation-Simple problems. Sensors in robot – Touch sensors-Tactile, Robot work cell design and control-Sequence control, Operator interface, Safety monitoring devices in Robot-Mobile robot working principle, actuation using MATLAB, NXT Software.

Tentative

**UNIT V MICRO/NANO ROBOTICS SYSTEM 9**

Micro/Nano robotics system overview-Scaling effect-Top down and bottom up approach Actuators of Micro/Nano robotics system-Nano robot communication techniques-Fabrication of micro/nano grippers-Wall climbing micro robot working principles-Biomimetic robot-Swarm robot-Nano robot in targeted drug delivery system.

**COURSE OUTCOMES:**

CO1: Understand architecture and modeling of autonomous systems.
CO2: Employ localization mapping techniques for autonomous systems
CO3: Design solutions for autonomous systems control.
CO4: Analyze Robot Transformations, Sensors and Cell Design
CO5: Explain the working principles of Micro/Nano Robotic system

**TOTAL PERIODS: 45**

**REFERENCES**

1. S.R. Deb, Robotics Technology and flexible automation, Tata McGraw-Hill Education.,2009
2. Mikell P Groover & Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, Industrial Robotics, Technology programming and Applications, McGraw Hill, 2012.
3. Karsten Berns, Ewald Puttkamer, Springer, Autonomous Land Vehicles: Steps towards Service Robots, 2009
4. Sebastian Thrun, Wolfram Burgard, Dieter Fox., Probabilistic robotics. MIT Press, 2005
5. Steven M. LaValle., Planning algorithms, Cambridge University Press, 2006

6. Daniel Watzenig and Martin Horn (Eds.), Automated Driving: Safer and More Efficient Future Driving, Springer, 2017
7. Markus Maurer, Autonomous driving: technical, legal and social aspects. Springer, 2016
8. Jha, Theory, Design and Applications of Unmanned Aerial Vehicles, CRC Press, 2016

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| C02 | 2 | 1 | 2 | 3 | 2 | 2 |
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| AVG | 1.80 | 1.50 | 2.25 | 2.00 | 2.00 | 2.00 |

**CP4081 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**

Common metrics: Hits, Page views, Visits, Unique visitors, Unique page views, Bounce, Bounce rate, Page/visit, Average time on site, New visits; Optimization (e-commerce, non e-commerce sites): Improving bounce rates, Optimizing adwords campaigns; Real time report, Audience report, Traffic source report, Custom campaigns, Content report, Google analytics, Introduction to KPI, characteristics, Need for KPI, Perspective of KPI, Uses of KPI. Relevant Technologies: Internet & TCP/IP, Client / Server Computing, HTTP (Hypertext Transfer Protocol), Server Log Files & Cookies, Web Bugs.

**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.

Tentative

**REFERENCES:**


1. Clifton B., Advanced Web Metrics with Google Analytics, Wiley Publishing, Inc.2nd ed, 2012.
2. Kaushik A., Web Analytics 2.0, The Art of Online Accountability and Science of Customer Centricity, Wiley Publishing, Inc. 1st ed, 2010.
3. Sterne J., Web Metrics: Proven methods for measuring web site success, John Wiley and Sons, 2002


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| C03 | 3 | | 3 | 2 | 2 | 2 |
| C04 | 1 | 2 | 3 | 1 | 1 | 1 |
| C05 | 2 | | 3 | 2 | 2 | 1 |
| AVG | 2.20 | 2.00 | 3.00 | 1.60 | 1.80 | 1.40 |

**MP4071** **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 9**

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 9**

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

Tentative

**UNIT III BIG DATA AND COGNITIVE COMPUTING 9**

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 9**

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 9**

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 PERIODS:45**

**REFERENCES**


1. Judith H Hurwitz, Marcia Kaufman, Adrian Bowles, “Cognitive computing and Big Data Analytics”, Wiley, 2015
2. Robert A. Wilson, Frank C. Keil, “The MIT Encyclopedia of the Cognitive Sciences”, The MIT Press, 1999.
3. Noah D. Goodman, Joshua B. Tenenbaum, The ProbMods Contributors, “Probabilistic Models of Cognition”, Second Edition, 2016, https://probmods.org/.


Tentative

**MP4073 HUMAN COMPUTER INTERACTION L T P C 3 0 0 3**

**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 9**

Context of Interaction –Ergonomics - Designing Interactive systems – Understanding Users-cognition and cognitive frameworks, User Centred approaches Usability, Universal Usability, Understanding and conceptualizing interaction, Guidelines, Principles and Theories. Importance of User Interface: Definition-Importance of good design-Benefits of good design-Human-centered development and Evaluation-Human Performance models-A Brief history of screen design.

**UNIT II INTERACTION STYLES 9**

GUI: Popularity of graphics - The concept of direct manipulation - Graphical system - Characteristics - Web user - Interface Popularity - Characteristics and Principles of User Interface. Understanding interaction styles, Direct Navigation and Immersive environments, Fluid navigation, Expressive Human and Command Languages, Communication and Collaboration Advancing the user experience, Timely user Experience, Information search, Data Visualization Design process: Human Interaction with computers - Importance of Human Characteristics - Human Consideration - Human Interaction Speeds and Understanding Business Junctions.

**UNIT III EVALUATION OF INTERACTION 9**

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 9**

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

**UNIT V WEB AND MOBILE INTERACTION 9**

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 PERIODS: 45**

Tentative

**REFERENCES**

1. Ben Shneiderman, Catherine Plaisant, Maxine Cohen, Steven Jacobs, NiklasElmqvist, “Designing the User Interface: Strategies for Effective Human-Computer Interaction”, Sixth Edition, Pearson Education, 2016.
2. Alan Dix, Janet Finlay, G D Abowd and Russel Beale, "Human Computer Interaction", Pearson Education, Third Edition, 2004.
3. Helen Sharp Jennifer Preece Yvonne Rogers, “Interaction Design: Beyond Human-Computer Interaction”, Wiley, 5th Edition, 2019.
4. Alan Cooper,RobertReimann, David Cronin, Christopher Noessel,“About Face: The Essentials of Interaction Design”, 4th Edition, Wiley, 2014.
5. Donald A. Norman, “Design of Everyday Things”, MIT Press, 2013.
6. Wilbert O Galitz, "The Essential Guide to User Interface Design", Third Edition, Wiley India Pvt., Ltd., 2007.

**CP4078 PERFORMANCE ANALYSIS OF COMPUTER SYSTEMS L T P C**
**3 0 0 3**

**COURSE OBJECTIVES:**

- To understand the mathematical foundations needed for performance evaluation of computer systems
- To understand the metrics used for performance evaluation
- To understand the analytical modeling of computer systems

- To enable the students to develop new queuing analysis for both simple and complex systems
- To appreciate the use of smart scheduling and introduce the students to analytical techniques for evaluating scheduling policies

**UNIT I OVERVIEW OF PERFORMANCE EVALUATION 9**

Need for Performance Evaluation in Computer Systems – Overview of Performance Evaluation Methods – Introduction to Queuing – Probability Review – Generating Random Variables for Simulation – Sample Paths, Convergence and Averages – Little‘s Law and other Operational Laws – Modification for Closed Systems.

**UNIT II MARKOV CHAINS AND SIMPLE QUEUES 9**

Discrete-Time Markov Chains – Ergodicity Theory – Real World Examples – Google, Aloha – Transition to Continuous-Time Markov Chain – M/M/1.

**UNIT III MULTI-SERVER AND MULTI-QUEUE SYSTEMS 9**

Server Farms: M/M/k and M/M/k/k – Capacity Provisioning for Server Farms – Time Reversibility and Burke‘s Theorem – Networks of Queues and Jackson Product Form – Classed and Closed Networks of Queues.

**UNIT IV REAL-WORLD WORKLOADS 9**

Case Study of Real-world Workloads – Phase-Type Distributions and Matrix-Alalytic Methods – Networks with Time-Sharing Servers – M/G/1 Queue and the Inspection Paradox – Task Assignment Policies for Server Farms.

**UNIT V SMART SCHEDULING IN THE M/G/1 9**

Performance Metrics – Scheduling Non-Preemptive and Preemptive Non-Size-Based Policies - . Scheduling Non-Preemptive and Preemptive Size-Based Policies – Scheduling - SRPT and Fairness.

**TOTAL : 45 PERIODS**

**COURSE OUTCOMES:**

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

CO1: Identify the need for performance evaluation and the metrics used for it

CO2: Distinguish between open and closed queuing networks

CO3: Apply Little‘e 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:**


1. K. S. Trivedi, “Probability and Statistics with Reliability, Queueing and Computer Science Applications‖, John Wiley and Sons, 2001.
2. Krishna Kant, “Introduction to Computer System Performance Evaluation‖, McGraw-Hill, 1992.
3. Lieven Eeckhout, “Computer Architecture Performance Evaluation Methods‖, Morgan and Claypool Publishers, 2010.
4. Mor Harchol - Balter, “Performance Modeling and Design of Computer Systems – Queueing Theory in Action‖, Cambridge University Press, 2013.

5. Paul J. Fortier and Howard E. Michel, “Computer Systems Performance Evaluation and Prediction‖, Elsevier, 2003.
6. Raj Jain, “The Art of Computer Systems Performance Analysis: Techniques for Experimental Design, Measurement, Simulation and Modeling‖, Wiley-Interscience, 1991.
7. Raj Jain, Art of Computer Systems Performance Analysis: Techniques For Experimental Design Measurements Simulation and Modeling,2nd edition, wiley, 2015

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| C03 | 2 | 2 | 2 | | 2 | |
| C04 | 1 | | 3 | | 3 | 1 |
| C05 | 2 | 2 | 2 | 1 | 2 | |
| AVG | 1.60 | 1.75 | 2.20 | 1.33 | 2.00 | 1.00 |

**CP4074 DATA VISUALIZATION TECHNIQUES** **L T P C 3 0 0 3**

**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

Tentative

**UNIT I INTRODUCTION AND DATA FOUNDATION 9**

Basics - Relationship between Visualization and Other Fields -The Visualization Process - Pseudo code Conventions - The Scatter plot. Data Foundation - Types of Data - Structure within and between Records - Data Preprocessing - Data Sets

**UNIT II FOUNDATIONS FOR VISUALIZATION 9**

Visualization stages - Semiology of Graphical Symbols - The Eight Visual Variables – Historical Perspective - Taxonomies - Experimental Semiotics based on Perception Gibson‘s Affordance theory – A Model of Perceptual Processing.

**UNIT III VISUALIZATION TECHNIQUES 9**

Spatial Data: One-Dimensional Data - Two-Dimensional Data – Three Dimensional Data - Dynamic Data - Combining Techniques. Geospatial Data : Visualizing Spatial Data - Visualization of Point Data -Visualization of Line Data - Visualization of Area Data – Other Issues in Geospatial Data Visualization Multivariate Data : Point-Based Techniques - LineBased Techniques - Region-Based Techniques - Combinations of Techniques – Trees Displaying Hierarchical Structures – Graphics and Networks- Displaying Arbitrary Graphs/Networks.

**UNIT IV INTERACTION CONCEPTS AND TECHNIQUES 9**

Text and Document Visualization: Introduction - Levels of Text Representations - The Vector Space Model - Single Document Visualizations -Document Collection Visualizations – Extended

Text Visualizations Interaction Concepts: Interaction Operators - Interaction Operands and Spaces - A Unified Framework. Interaction Techniques: Screen Space - Object-Space –Data Space - Attribute Space- Data Structure Space - Visualization Structure – Animating Transformations - Interaction Control.

**UNIT V RESEARCH DIRECTIONS IN VISUALIZATIONS 9**

Steps in designing Visualizations – Problems in designing effective Visualizations- Issues of Data. Issues of Cognition, Perception, and Reasoning. Issues of System Design Evaluation , Hardware and Applications

**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 PERIODS: 45**

**REFERENCES**


1. Matthew Ward, Georges Grinstein and Daniel Keim, “Interactive Data Visualization Foundations, Techniques, Applications”, 2010.
2. Colin Ware, “Information Visualization Perception for Design”, 4th edition, Morgan Kaufmann Publishers, 2021.
3. Robert Spence “Information visualization – Design for interaction”, Pearson Education, 2nd Edition, 2007.
4. Alexandru C. Telea, “Data Visualization: Principles and Practice,” A. K. Peters Ltd, 2008.


Tentative

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| C03 | 1 | | 2 | 2 | 1 | 1 |
| C04 | 3 | 1 | 3 | 3 | 2 | 2 |
| C05 | 2 | 1 | 3 | 2 | 1 | 1 |
| AVG | 2.20 | 1.00 | 2.40 | 2.40 | 1.40 | 1.60 |

**AP4076 ROBOTICS L T P C**
**3 0 0 3**

**COURSE OBJECTIVES:**

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

**UNIT I INTRODUCTION TO ROBOTICS 9**

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

**UNIT II ROBOT KINEMATICS AND DYNAMICS 9**

Kinematic Modelling: Translation and Rotation Representation, Coordinate transformation, DH parameters, Forward and inverse kinematics, Jacobian, Dynamic Modelling: Forward and inverse dynamics, Equations of motion using Euler-Lagrange formulation, Newton Euler formulation.

**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.

Tentative

**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:**


1. John J. Craig, 'Introduction to Robotics (Mechanics and Control)', Addison-Wesley, 2nd Edition, 2004.
2. Richard D. Klafter, Thomas A. Chmielewski, Michael Negin, 'Robotics Engineering: An Integrated Approach', PHI Learning, New Delhi, 2009.
3. K.S.Fu, R.C.Gonzalez and C.S.G.Lee, 'Robotics Control, Sensing, Vision and Intelligence', Tata McGraw Hill, 2nd Reprint,2008.
4. Reza N.Jazar, 'Theory of Applied Robotics Kinematics, Dynamics and Control', Springer, 1st Indian Reprint, 2010.
5. Mikell. P. Groover, Michell Weis, Roger. N. Nagel, Nicolous G.Odrey, 'Industrial Robotics Technology, Programming and Applications ', McGraw Hill, Int 2012.

**CP4073** **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 9**

What is 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 9**

What is Bitcoin, The Bitcoin Network, The Bitcoin Mining Process, Mining Developments, Bitcoin Wallets, Decentralization and Hard Forks, Ethereum Virtual Machine (EVM), Merkle Tree, Double-Spend Problem, Blockchain and Digital Currency, Transactional Blocks, Impact of Blockchain Technology on Cryptocurrency.

**UNIT III INTRODUCTION TO ETHEREUM 9**

What is Ethereum, Introduction to Ethereum, Consensus Mechanisms, Metamask Setup, Ethereum Accounts, Transactions, Receiving Ethers, Smart Contracts.

Tentative

**UNIT-IV INTRODUCTION TO HYPERLEDGER AND SOLIDITY PROGRAMMING 10**

What is Hyperledger? Distributed Ledger Technology & its Challenges, Hyperledger & Distributed Ledger Technology, Hyperledger Fabric, Hyperledger Composer. Solidity - Language of Smart Contracts, Installing Solidity & Ethereum Wallet, Basics of Solidity, Layout of a Solidity Source File & Structure of Smart Contracts, General Value Types.

**UNIT V BLOCKCHAIN APPLICATIONS 8**

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

**TOTAL: 45 PERIODS**

**LIST OF EXPERIMENTS:**

1. Create a Simple Blockchain in any suitable programming language.
2. Use Geth to Implement Private Ethereum Block Chain.
3. Build Hyperledger Fabric Client Application.
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 NO OF HOURS: 30**

**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

**COURSE OUTCOMES:**

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

CO1:Understand and explore the working of Blockchain technology (Understanding)

CO2:Analyze the working of Smart Contracts (Analyze)

CO3:Understand and analyze the working of Hyperledger (Analyze).

CO4:Apply the learning of solidity to build de-centralized apps on Ethereum (Apply)

CO5:Develop applications on Blockchain

**REFERENCES:**


1. Imran Bashir, “Mastering Blockchain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained”, Second Edition, Packt Publishing, 2018.
2. Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, “Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction” Princeton University Press, 2016
3. Antonopoulos, Mastering Bitcoin, O’Reilly Publishing, 2014. .
4. Antonopoulos and G. Wood, “Mastering Ethereum: Building Smart Contracts and Dapps”, O’Reilly Publishing, 2018.
5. D. Drescher, Blockchain Basics. Apress, 2017.


Tentative

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| C01 | 2 | 1 | 3 | 2 | 2 | 3 |
| C02 | 2 | 1 | 2 | 3 | 2 | 2 |
| C03 | 2 | 1 | 3 | 1 | 2 | 1 |
| C04 | 2 | 1 | 2 | 3 | 2 | 2 |
| C05 | 1 | 1 | 2 | 3 | 3 | 3 |
| AVG | 2.00 | 1.00 | 2.4 | 2.4 | 2.2 | 2.2 |

**MU4253** **MIXED REALITY** **L T P C**
**3 0 2 4**

**COURSE OBJECTIVES:**

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

**UNIT I INTRODUCTION TO VIRTUAL REALITY 9**

Introduction, Fundamental Concept and Components of Virtual Reality. Primary Features and Present Development on Virtual Reality. Computer graphics, Real time computer graphics, Flight Simulation, Virtual environment requirement, benefits of virtual reality, Historical development of VR, Scientific Landmark 3D Computer Graphics: Introduction, The Virtual world space, positioning the virtual observer, the perspective projection, human vision, stereo perspective projection, 3D 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 9**

Introduction, from 2D to 3D, 3D spaces curves, 3D boundary representation Geometrical Transformations: Introduction, Frames of reference, Modeling transformations, Instances, Picking, Flying, Scaling the VE, Collision detection Generic VR system: Introduction, Virtual environment, Computer environment, VR technology, Model of interaction, VR Systems.

**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.

Tentative

**UNIT III VISUAL COMPUTATION IN VIRTUAL REALITY 9**

Animating the Virtual Environment: Introduction, The dynamics of numbers, Linear and Nonlinear interpolation, the animation of objects, linear and non-linear translation, shape & object inbetweening, free from deformation, particle system. Physical Simulation: Introduction, Objects falling in a gravitational field, Rotating wheels, Elastic collisions, projectiles, simple pendulum, springs, Flight dynamics of an aircraft.

**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 9**

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 9**

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.

Tentative

**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 PERIODS: 45**

**PRACTICALS: (Syllabus Needed)**

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.

9. Develop MR enabled simple applications like human anatomy visualization, DNA/RNA structure visualization and surgery simulation.
10. Develop simple MR enabled gaming applications.

**REFERENCES**


1. Burdea, G. C. and P. Coffet. Virtual Reality Technology, Second Edition. Wiley-IEEE Press, 2003/2006.
2. Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann,First Edition 2013.
3. Alan Craig, William Sherman and Jeffrey Will, Developing Virtual Reality Applications, Foundations of Effective Design, Morgan Kaufmann, 2009.
4. John Vince, “Virtual Reality Systems “, Pearson Education Asia, 2007.
5. Adams, “Visualizations of Virtual Reality”, Tata McGraw Hill, 2000.
6. Grigore C. Burdea, Philippe Coiffet , “Virtual Reality Technology”, Wiley Inter Science, 2nd Edition, 2006.
7. William R. Sherman, Alan B. Craig, “Understanding Virtual Reality: Interface, Application and Design”, Morgan Kaufmann, 2008


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| **CO1** | | 2 | 1 | 2 | 1 | |
| **CO2** | 1 | 2 | 3 | 2 | | 2 |
| **CO3** | 2 | 3 | 2 | 2 | 2 | 1 |
| **CO4** | 2 | 2 | 2 | 3 | 3 | 3 |
| **CO5** | 3 | 1 | 1 | 1 | 1 | 2 |
| Avg | | | | | | |

Tentative

**CP4072** **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** **9**

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** **9**

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 9**

Hidden Markov modeling for biological data analysis – Sequence identification – Sequence classification – multiple alignment generation – Comparative modeling –Protein modeling – genomic modeling – Probabilistic modeling – Bayesian networks – Boolean networks – Molecular modeling – Computer programs for molecular modeling.

**UNIT IV PATTERN MATCHING AND VISUALIZATION 9**

Gene regulation – motif recognition – motif detection – strategies for motif detection – Visualization – Fractal analysis – DNA walk models – one dimension – two dimension – higher dimension – Game representation of biological sequences – DNA, Protein, Amino acid sequences.

**UNIT V MICROARRAY ANALYSIS 9**

Microarray technology for genome expression study – image analysis for data extraction – preprocessing – segmentation – gridding – spot extraction – normalization, filtering – cluster analysis – gene network analysis – Compared Evaluation of Scientific Data Management Systems – Cost Matrix – Evaluation model – Benchmark – Tradeoffs.

**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

Tentative

**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 PERIODS**

**REFERENCES**

1. Yi-Ping Phoebe Chen (Ed), “BioInformatics Technologies”, First Indian Reprint, Springer Verlag, 2007.
2. Bryan Bergeron, “Bio Informatics Computing”, Second Edition, Pearson Education, 2015.
3. Arthur M Lesk, “Introduction to Bioinformatics”, Second Edition, Oxford University Press, 2019

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| C01 | 1 | 1 | | | | 3 |
| C02 | 1 | 1 | 2 | 2 | 1 | 2 |
| C03 | 1 | 2 | 1 | 1 | 3 | 3 |
| C04 | 1 | 2 | 2 | 2 | 2 | 2 |
| C05 | 1 | 2 | 1 | | 2 | 3 |
| AVG | 1.00 | 1.60 | 1.50 | 1.67 | 2.00 | 2.60 |

**MP4252** **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

Tentative

**UNIT I MOBILE PLATFORM AND APPLICATIONS 9**

Mobile Device Operating Systems — Special Constraints & Requirements — Commercial Mobile Operating Systems — Software Development Kit: iOS, Android, BlackBerry, Windows Phone — MCommerce — Structure — Pros & Cons — Mobile Payment System — Security Issues

**UNIT II INTRODUCTION TO ANDROID 9**

Introduction to Android: The Android Platform, Android SDK, Eclipse Installation, Android Installation, Building you First Android application, Understanding Anatomy of Android Application, Android Manifest file.

**UNIT III ANDROID APPLICATION DESIGN ESSENTIALS 9**

Anatomy of Android applications, Android terminologies, Application Context, Activities, Services, Intents, Receiving and Broadcasting Intents, Android Manifest File and its common settings, Using Intent Filter, Permissions.

**UNIT IV ANDROID USER INTERFACE DESIGN & MULTIMEDIA 9**

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 9**

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:** **(30)**

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

Tentative

**TOTAL PERIODS: 75**

**REFERENCES**


1. Lauren Darcey and Shane Conder, “Android Wireless Application Development”, Pearson Education, 2nd ed. (2011)
2. Google Developer Training, "Android Developer Fundamentals Course – Concept Reference”, Google Developer Training Team, 2017.
3. Prasanth Kumar Pattnaik,Rajib Mall,”Fundamentals of Mobile Computing”,PHI Learning Pvt.Ltd,New Delhi-2012
4. Reto Meier, “Professional Android 2 Application Development”, Wiley India Pvt Ltd, 2010
5. Mark L Murphy, “Beginning Android”, Wiley India Pvt Ltd, 2009
6. Dawn Griffiths and David Griffiths, “Head First Android Development”, 1st Edition, O‟Reilly SPD Publishers, 2015. ISBN-13: 978-9352131341
7. Erik Hellman, “Android Programming – Pushing the Limits”, 1st Edition, Wiley India Pvt Ltd, 2014. ISBN-13: 978-8126547197.
8. Bill Phillips, Chris Stewart and Kristin Marsicano, “Android Programming: The Big Nerd Ranch Guide”, 4th Edition, Big Nerd Ranch Guides, 2019. ISBN-13: 978-0134706054

**IF4075** **DEVOPS AND MICROSERVICES** **L T P C**
**3 0 2 4**

**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 12**

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

**UNIT II DEVOPS PLATFORM AND SERVICES 12**

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

**UNIT III BUILDING , TESTING AND DEPLOYMENT 12**

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

Tentative

**UNIT IV DEVOPS AUTOMATION TOOLS 12**

Infrastructure Automation- Configuration Management - Deployment Automation - Performance Management - Log Management -Monitoring.

**UNIT V Mlops 12**

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

**SUGGESTED ACTIVITIES:**

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

**COURSE OUTCOMES:**

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

**TOTAL PERIODS:60**

**REFERENCES**


1. Len Bass, Ingo Weber and Liming Zhu, —"DevOps: A Software Architect's Perspective", Pearson Education, 2016
2. Joakim Verona - "Practical DevOps" - Packet Publishing , 2016
3. Viktor Farcic -"The DevOps 2.1 Toolkit: Docker Swarm" - Packet Publishing, 2017
4. Mark Treveil, and the Dataiku Team-"Introducing MLOps" - O'Reilly Media- 2020


## AUDIT COURSES

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

**COURSE OBJECTIVES**

- Teach how to improve writing skills and level of readability
- Tell about what to write in each section
- Summarize the skills needed when writing a Title
- Infer the skills needed when writing the Conclusion
- Ensure the quality of paper at very first-time submission

**UNIT I INTRODUCTION TO RESEARCH PAPER WRITING 6**

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

**UNIT II PRESENTATION SKILLS 6**

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction

**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

Tentative

**REFERENCES:**


1. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011
2. Day R How to Write and Publish a Scientific Paper, Cambridge University Press 2006
3. Goldbort R Writing for Science, Yale University Press (available on Google Books) 2006
4. Highman N, Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book 1998.


**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

Tentative

**UNIT I INTRODUCTION 6**

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

**UNIT II REPERCUSSIONS OF DISASTERS AND HAZARDS 6**

Economic Damage, Loss of Human and Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

**UNIT III DISASTER PRONE AREAS IN INDIA 6**

Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides And Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics

**UNIT IV DISASTER PREPAREDNESS AND MANAGEMENT 6**

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

**UNIT V RISK ASSESSMENT 6**

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

**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:**


1. Goel S. L., Disaster Administration And Management Text And Case Studies",Deep & Deep Publication Pvt. Ltd., New Delhi,2009.
2. NishithaRai, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'NewRoyal book Company,2007.
3. Sahni, Pradeep Et.Al. ," Disaster Mitigation Experiences And Reflections", Prentice Hall OfIndia, New Delhi,2001.


**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.

Tentative

**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**

Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental 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**

District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation. Pachayati raj: Introduction, PRI: Zila

Panchayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy(Different departments), Village level:Role of Elected and Appointed officials, Importance of grass root democracy.

**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.
2. Dr.S.N.Busi, Dr.B. R.Ambedkar framing of Indian Constitution,1st Edition, 2015.
3. M.P. Jain, Indian Constitution Law, 7th Edn., LexisNexis,2014.
4. D.D. Basu, Introduction to the Constitution of India, LexisNexis, 2015.


Tentative

**AX4094** **நற்றமிழ் இலக்கியம்** **L T P C**
**2 0 0 0**

**UNIT I** **சங்க இலக்கியம்** **6**

1. தமிழின் துவக்க நூல் தொல்காப்பியம்
   – எழுத்து, சொல், பொருள்
2. அகநானூறு (82)
   - இயற்கை இன்னிசை அரங்கம்
3. குறிஞ்சிப் பாட்டின் மலர்க்காட்சி
4. புறநானூறு (95,195)
   - போரை நிறுத்திய ஔவையார்

**UNIT II** **அறநெறித் தமிழ்** **6**

1. அறநெறி வகுத்த திருவள்ளுவர்
   - அறம் வலியுறுத்தல், அன்புடைமை, ஒப்புறவு அறிதல், ஈகை, புகழ்
2. பிற அறநூல்கள் - இலக்கிய மருந்து
   – ஏலாதி, சிறுபஞ்சமூலம், திரிகடுகம், ஆசாரக்கோவை (தூய்மையை

வலியுறுத்தும் நூல் )

**UNIT III** **இரட்டைக் காப்பியங்கள்** **6**

1. கண்ணகியின் புரட்சி
   - சிலப்பதிகார வழக்குரை காதை
2. சமூகசேவை இலக்கியம் மணிமேகலை
   - சிறைக்கோட்டம் அறக்கோட்டமாகிய காதை

**UNIT IV** **அருள்நெறித் தமிழ்** **6**

1. சிறுபாணாற்றுப்படை
   - பாரி முல்லைக்குத் தேர் கொடுத்தது, பேகன் மயிலுக்குப் போர்வை கொடுத்தது, அதியமான் ஔவைக்கு நெல்லிக்கனி கொடுத்தது, அரசர் பண்புகள்
2. நற்றிணை
   - அன்னைக்குரிய புன்னை சிறப்பு
3. திருமந்திரம் (617, 618)
   - இயமம் நியமம் விதிகள்
4. தர்மச்சாலையை நிறுவிய வள்ளலார்
5. புறநானூறு
   - சிறுவனே வள்ளலானான்
6. அகநானூறு (4) - வண்டு
   நற்றிணை (11) - நண்டு
   கலித்தொகை (11) - யானை, புறா
   ஐந்திணை 50 (27) - மான்
   ஆகியவை பற்றிய செய்திகள்

Tentative

**UNIT V** **நவீன தமிழ் இலக்கியம்** **6**

1. உரைநடைத் தமிழ்,
   - தமிழின் முதல் புதினம்,
   - தமிழின் முதல் சிறுகதை,
   - கட்டுரை இலக்கியம்,
   - பயண இலக்கியம்,
   - நாடகம்,
2. நாட்டு விடுதலை போராட்டமும் தமிழ் இலக்கியமும்,
3. சமுதாய விடுதலையும் தமிழ் இலக்கியமும்,
4. பெண் விடுதலையும் விளிம்பு நிலையினரின் மேம்பாட்டில் தமிழ் இலக்கியமும்,
5. அறிவியல் தமிழ்,
6. இணையத்தில் தமிழ்,
7. சுற்றுச்சூழல் மேம்பாட்டில் தமிழ் இலக்கியம்.

**TOTAL: 30 PERIODS**

**தமிழ் இலக்கிய வெளியீடுகள் / புத்தகங்கள்**

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   - www.tamilvu.org
2. தமிழ் விக்கிப்பீடியா (Tamil Wikipedia)
   -https://ta.wikipedia.org
3. தர்மபுர ஆதீன வெளியீடு
4. வாழ்வியல் களஞ்சியம்
   - தமிழ்ப் பல்கலைக்கழகம், தஞ்சாவூர்
5. தமிழ்கலைக் களஞ்சியம்
   - தமிழ் வளர்ச்சித் துறை (thamilvalarchithurai.com)
6. அறிவியல் களஞ்சியம்
   - தமிழ்ப் பல்கலைக்கழகம், தஞ்சாவூர்

Tentative