**ANNA UNIVERSITY**
**AFFILIATED INSTITUTIONS**
**REGULATIONS – 2017**
**CURRICULUM AND SYLLABUS I TO IV SEMESTERS (FULL TIME)**
**MASTER OF COMPUTER APPLICATIONS**

**PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):**
I. To prepare students to pursue lifelong learning and do research in computing field by providing solid technical foundations.
II. To provide students with various computing skills like analysis, design and development of innovative software products to meet the industry needs and excel as software professionals.
III. To prepare students to communicate and function effectively in teams in multidisciplinary fields within the global, societal and environmental context

**PROGRAM OUTCOMES (POS) :**
**On successful completion of the program:**

1. **Computational knowledge:** Apply knowledge of computing fundamentals, computing specialisation, mathematics, and domain knowledge appropriate for the computing specialisation to the solution of complex problems.

2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex computing problems reaching substantiated conclusions using first principles of mathematics, computing sciences, and relevant domain disciplines.

3. **Design/development of solutions:** Design solutions for complex computing problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern computing and IT tools including prediction and modeling to complex computing systems with an understanding of the limitations

6. **Research Aptitude:** Ability to independently carry out research / investigations, identify problems and develop solutions to solve practical problems.

7. **Innovation and Entrepreneurship:** Identify a timely opportunity and using innovation to pursue that opportunity to create value and wealth for the betterment of the individual and society at large.

8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the professional computing practice.

9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication:** Communicate effectively on complex system building activities with the stake holders and with society at large, such as, being able to comprehend

and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance**: Demonstrate knowledge and understanding of the  management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

## PROGRAM SPECIFIC OBJECTIVES (PSO)

**PSO 1:**  Able to select suitable data model, appropriate architecture, platform to implement a system with good performance.

**PSO 2:** Able to design and integrate various system based components to provide user interactive solutions for various challenges.

**Mapping Of Programme Educational Objectives With Programme Outcomes And Programme Specific Objectives**

| Programme Educational Objectives | Programme Outcomes | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| 1 | √ | √ | √ | √ | √ | √ | √ | | | | √ | | | √ |
| 2 | | √ | √ | √ | √ | √ | √ | √ | √ | | √ | | √ | |
| 3 | | √ | | √ | √ | √ | | | √ | √ | √ | √ | √ | √ |

## 3. SEMESTER COURSE WISE PEO MAPPING

| YEAR | SEMESTER | SUBJECT NAME | PEO1 | PEO2 | PEO3 |
|---|---|---|---|---|---|
| YEAR 1 | SEM 1 | Matrices, Probability and Statistics | √ | | |
| | | Advanced Data Structures and Algorithms | √ | √ | |
| | | Advanced Database Technology | √ | √ | |
| | | Object Oriented Software Engineering | √ | √ | √ |
| | | Python Programming | √ | √ | |
| | | Research Methodology and Intellectual Property Rights | √ | | |
| | | Advanced Database Technology Lab | √ | √ | |
| | | Advanced Data Structures and Python Programming Lab | √ | √ | |
| | | Communication Skills Enhancement – I | | | √ |
| | SEM 2 | Internet Programming | √ | √ | |
| | | Cloud Computing Technologies | √ | √ | |
| | | Artificial Intelligence and Machine Learning | √ | √ | |
| | | Mobile Application Development | √ | √ | √ |
| | | Cyber Security | √ | √ | √ |
| | | **Elective I** | | | |
| | | 1. Software Project Management | √ | √ | √ |
| | | 2. Agile Methodologies | √ | √ | √ |
| | | 3. E Learning | √ | √ | √ |
| | | 4. Software Quality and Testing | √ | √ | √ |
| | | 5. Advances in Operating Systems | √ | √ | |
| | | 6. Digital Image Processing | √ | √ | |
| | | Internet Programming Laboratory | √ | √ | |
| | | Artificial Intelligence and Machine Learning Laboratory | √ | √ | |
| | | Communication Skills Enhancement– II | | | √ |

| YEAR | SEMESTER | SUBJECT NAME | PEO1 | PEO2 | PEO3 |
|---|---|---|---|---|---|
| YEAR 2 | SEM 3 | Data Science | √ | √ | √ |
| | | Embedded Systems and Internet of Things | √ | √ | √ |
| | | Accounting and Financial Management for Application Development | √ | √ | √ |
| | | **Elective II** | | | |
| | | 1. Compiler Optimization Techniques | √ | √ | |
| | | 2. C# and .NET programming | | √ | |
| | | 3. Wireless Networking | √ | √ | |

| | | | Col1 | Col2 | Col3 |
|---|---|---|---|---|---|
| | | 4. Web Design | √ | √ | √ |
| | | 5. Network Programming and Security | √ | √ | |
| | | 6. Microservices and Devops | √ | √ | |
| | | **Elective III** | | | |
| | | 1. Social Network Analytics | √ | √ | √ |
| | | 2. Bio Inspired Computing | √ | √ | |
| | | 3. Information Retrieval Techniques | √ | √ | |
| | | 4. Software Architecture | √ | √ | |
| | | 5. Digital Forensics | √ | √ | |
| | | 6. Data Mining and Data Warehousing Techniques | √ | √ | |
| | | **Elective IV** | | | |
| | | 1. Data Visualization Techniques | √ | √ | |
| | | 2. Operations Research | √ | √ | |
| | | 3. Professional Ethics in IT | √ | √ | √ |
| | | 4. Marketing Management | | | √ |
| | | 5. Organizational Behavior | √ | √ | √ |
| | | 6. Business Data Analytics | | √ | |
| | | **Elective V** | | | |
| | | 1. Cryptocurrency and Blockchain Technologies | √ | √ | |
| | | 2. Advances in Networking | √ | √ | |
| | | 3. Soft Computing Techniques | √ | √ | |
| | | 4. Deep Learning | √ | √ | |
| | | 5. Big Data Processing | √ | √ | |
| | | 6. Natural Language Processing | √ | √ | |
| | | Data Science Laboratory | √ | √ | |
| | | Internet of Things Laboratory | √ | √ | |
| | **SEM 4** | Project Work | √ | √ | √ |

## SEMESTER I

| SL. NO. | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT HOURS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1. | MA5101 | Matrices, Probability and Statistics | FC | 5 | 3 | 2 | 0 | 4 |
| 2. | MC5301 | Advanced Data Structures and Algorithms | PC | 3 | 3 | 0 | 0 | 3 |
| 3. | MC5105 | Advanced Database Technology | PC | 3 | 3 | 0 | 0 | 3 |
| 4. | MC5106 | Object Oriented Software Engineering | PC | 3 | 3 | 0 | 0 | 3 |
| 5. | MC5107 | Python Programming | PC | 3 | 3 | 0 | 0 | 3 |
| 6. | MC5108 | Research Methodology and Intellectual Property Rights | PC | 2 | 2 | 0 | 0 | 2 |
| **PRACTICALS** | | | | | | | | |
| 7. | MC5114 | Advanced Database Technology Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| 8. | MC5115 | Advanced Data Structures and Python Programming Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| 9. | MC5116 | Communication Skills Enhancement – I | EEC | 2 | 0 | 0 | 2 | 1 |
| | | | **TOTAL** | **29** | **17** | **2** | **10** | **23** |

## SEMESTER II

| SL. NO. | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT HOURS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1. | MC5206 | Internet Programming | PC | 3 | 3 | 0 | 0 | 3 |
| 2. | MC5207 | Cloud Computing Technologies | PC | 3 | 3 | 0 | 0 | 3 |
| 3. | MC5208 | Artificial Intelligence and Machine Learning | PC | 3 | 3 | 0 | 0 | 3 |
| 4. | MC5209 | Mobile Application Development | PC | 4 | 2 | 0 | 2 | 3 |
| 5. | MC5210 | Cyber Security | PC | 3 | 3 | 0 | 0 | 3 |
| 6. | | Professional Elective I | PEC | 3 | 3 | 0 | 0 | 3 |
| **PRACTICALS** | | | | | | | | |
| 7. | MC5214 | Internet Programming Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| 8. | MC5215 | Artificial Intelligence and Machine Learning Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| 9. | MC5216 | Communication Skills Enhancement– II | EEC | 2 | 0 | 0 | 2 | 1 |
| | | | **TOTAL** | **29** | **17** | **0** | **12** | **23** |

**SEMESTER III**

| SL. NO. | COURSE CODE | COURSE TITLE | CATE GORY | CONTACT HOURS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1. | MC5306 | Data Science | PC | 3 | 3 | 0 | 0 | 3 |
| 2. | MC5307 | Embedded Systems and Internet of Things | PC | 3 | 3 | 0 | 0 | 3 |
| 3. | MC5308 | Accounting and Financial Management for Application Development | PC | 3 | 3 | 0 | 0 | 3 |
| 4. | | Professional Elective II | PE | 3 | 3 | 0 | 0 | 3 |
| 5. | | Professional Elective III | PE | 3 | 3 | 0 | 0 | 3 |
| 6. | | Professional Elective IV | PE | 3 | 3 | 0 | 0 | 3 |
| 7. | | Professional Elective V: | PE | 3 | 3 | 0 | 0 | 3 |
| **PRACTICALS** | | | | | | | | |
| 1. | MC5314 | Data Science Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| 2. | MC5315 | Internet of Things Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| | | | **TOTAL** | **29** | **21** | **0** | **8** | **25** |

**SEMESTER IV**

| SL. NO. | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT HOURS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **PRACTICALS** | | | | | | | | |
| 1. | MC5414 | Project Work | PC | 24 | 0 | 0 | 24 | 12 |
| | | | **TOTAL** | **24** | **0** | **0** | **24** | **12** |

**TOTAL CREDITS: 83**

# PROFESSIONAL ELECTIVES

| Sl. No | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| | | **PROFESSIONAL ELECTIVE - I , Semester 2** | | | | | | |
| 1. | MC5003 | Software Project Management | PE | 3 | 3 | 0 | 0 | 3 |
| 2. | MC5016 | Agile Methodologies | PE | 3 | 3 | 0 | 0 | 3 |
| 3. | MC5017 | E Learning | PE | 3 | 3 | 0 | 0 | 3 |
| 4. | MC5018 | Software Quality and Testing | PE | 3 | 3 | 0 | 0 | 3 |
| 5. | MC5019 | Advances in Operating Systems | PE | 3 | 3 | 0 | 0 | 3 |
| 6. | MC5020 | Digital Image Processing | PE | 3 | 3 | 0 | 0 | 3 |
| | | **PROFESSIONAL ELECTIVE – II, Semester 3** | | | | | | |
| 1. | MC5021 | Compiler Optimization Techniques | PE | 3 | 3 | 0 | 0 | 3 |
| 2. | MC5022 | C# and .NET programming | PE | 3 | 3 | 0 | 0 | 3 |
| 3. | MC5023 | Wireless Networking | PE | 3 | 3 | 0 | 0 | 3 |
| 4. | MC5024 | Web Design | PE | 3 | 3 | 0 | 0 | 3 |
| 5. | MC5025 | Network Programming and Security | PE | 3 | 3 | 0 | 0 | 3 |
| 6. | MC5026 | Microservices and Devops | PE | 3 | 3 | 0 | 0 | 3 |
| | | **PROFESSIONAL ELECTIVE – III, Semester 3** | | | | | | |
| 1. | MC5027 | Social Network Analytics | PE | | 3 | 0 | 0 | 3 |
| 2. | MC5028 | Bio Inspired Computing | PE | | 3 | 0 | 0 | 3 |
| 3. | MC5029 | Information Retrieval Techniques | PE | | 3 | 0 | 0 | 3 |
| 4. | MC5030 | Software Architecture | PE | | 3 | 0 | 0 | 3 |
| 5. | MC5031 | Digital Forensics | PE | 3 | 3 | 0 | 0 | 3 |
| 6. | MC5032 | Data Mining and Data Warehousing Techniques | PE | 3 | 3 | 0 | 0 | 3 |
| | | **PROFESSIONAL ELECTIVE – IV, Semester 3** | | | | | | |
| 1. | MC5033 | Data Visualization Techniques | PE | 3 | 3 | 0 | 0 | 3 |
| 2. | MC5034 | Operations Research | PE | 3 | 3 | 0 | 0 | 3 |
| 3. | MC5035 | Professional Ethics in IT | PE | 3 | 3 | 0 | 0 | 3 |
| 4. | MC5036 | Marketing Management | PE | 3 | 3 | 0 | 0 | 3 |
| 5. | MC5037 | Organizational Behavior | PE | 3 | 3 | 0 | 0 | 3 |
| 6. | MC5038 | Business Data Analytics | PE | 3 | 3 | 0 | 0 | 3 |

| | | **PROFESSIONAL ELECTIVE – V, Semester 3** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1. | MC5039 | Cryptocurrency and Blockchain Technologies | PE | 3 | 3 | 0 | 0 | 3 |
| 2. | MC5040 | Advances in Networking | PE | 3 | 3 | 0 | 0 | 3 |
| 3. | MC5041 | Soft Computing Techniques | PE | 3 | 3 | 0 | 0 | 3 |
| 4. | MC5042 | Deep Learning | PE | 3 | 3 | 0 | 0 | 3 |
| 5. | MC5043 | Big Data Processing | PE | 3 | 3 | 0 | 0 | 3 |
| 6. | MC5044 | Natural Language Processing | PE | 3 | 3 | 0 | 0 | 3 |

## FOUNDATION COURSES (FC)

| SL. NO | COURSE CODE | COURSE TITLE | CATE GORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| 1. | MA5101 | Matrices, Probability and Statistics | FC | 5 | 3 | 2 | 0 | 4 |

## PROFESSIONAL CORE (PC)

| SL. NO | COURSE CODE | COURSE TITLE | CATE GORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| 1. | MC5301 | Advanced Data Structures and Algorithms | PC | 3 | 3 | 0 | 0 | 3 |
| 2. | MC5105 | Advanced Database Technology | PC | 3 | 3 | 0 | 0 | 3 |
| 3. | MC5106 | Object Oriented Software Engineering | PC | 3 | 3 | 0 | 0 | 3 |
| 4. | MC5107 | Python Programming | PC | 3 | 3 | 0 | 0 | 3 |
| 5. | MC5108 | Research Methodology and Intellectual Property Rights | PC | 2 | 2 | 0 | 0 | 2 |
| 6. | MC5114 | Advanced Database Technology Lab | PC | 4 | 0 | 0 | 4 | 2 |
| 7. | MC5115 | Advanced Data Structures and Python Programming Lab | PC | 4 | 0 | 0 | 4 | 2 |
| 8. | MC5206 | Internet Programming | PC | 3 | 3 | 0 | 0 | 3 |
| 9. | MC5207 | Cloud Computing Technologies | PC | 3 | 3 | 0 | 0 | 3 |
| 10 | MC5208 | Artificial Intelligence and Machine Learning | PC | 3 | 3 | 0 | 0 | 3 |
| 11 | MC5209 | Mobile Application Development | PC | 4 | 2 | 0 | 2 | 3 |
| 12 | MC5210 | Cyber Security | PC | 3 | 3 | 0 | 0 | 3 |
| 13 | MC5214 | Internet Programming Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| 14 | MC5215 | Artificial Intelligence and Machine Learning Laboratory | PC | 4 | 0 | 0 | 4 | 2 |

| 15 | MC5306 | Data Science | PC | 3 | 3 | 0 | 0 | 3 |
|----|--------|--------------|----|---|---|---|---|---|
| 16 | MC5307 | Embedded Systems and Internet of Things | PC | 3 | 3 | 0 | 0 | 3 |
| 17 | MC5308 | Accounting and Financial Management for Application Development | PC | 3 | 3 | 0 | 0 | 3 |
| 18 | MC5314 | Data Science Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| 19 | MC5315 | Internet of Things Laboratory | PC | 4 | 0 | 0 | 4 | 2 |

## EMPLOYABILITY ENHANCEMENT COURSE (EEC)

| SL. NO | COURSE CODE | COURSE TITLE | CATE GORY | CONTACT PERIODS | L | T | P | C |
|--------|-------------|--------------|-----------|-----------------|---|---|---|---|
| 1. | MC5116 | Communication Skills Enhancement – I | EEC | 2 | 0 | 0 | 2 | 1 |
| 2. | MC5216 | Communication Skills Enhancement– II | EEC | 2 | 0 | 0 | 2 | 1 |
| 3. | MC5414 | Project Work | EEC | 24 | 0 | 0 | 24 | 12 |

## BRIDGE COURSES

| SL. NO. | COURSE CODE | COURSE TITLE | CONTACT PERIODS | L | T | P | C |
|---------|-------------|--------------|-----------------|---|---|---|---|
| | | **Semester I** | | | | | |
| 1. | MA5102 | Mathematical Foundations of Computer Science | 3 | 3 | 0 | 0 | 3 |
| 2. | BX5001 | Problem Solving And Programming In C | 5 | 3 | 0 | 2 | 4 |
| 3. | BX5002 | Digital logic and Computer Organization | 3 | 3 | 0 | 0 | 3 |
| 4. | BX5003 | Operating Systems | 3 | 3 | 0 | 0 | 3 |
| 5. | BX5004 | Data Structures and Algorithms | 3 | 3 | 0 | 0 | 3 |
| 6. | BX5005 | Programming and Data structures using C lab | 4 | 0 | 0 | 4 | 2 |
| | | **Semester II** | | | | | |
| 7. | BX5006 | Data Base Management Systems | 3 | 3 | 0 | 0 | 3 |
| 8. | BX5007 | Java Programming | 3 | 3 | 0 | 0 | 3 |
| 9 | BX5008 | Software Engineering | 3 | 3 | 0 | 0 | 3 |
| 10. | BX5009 | Basics of Computer Networks | 3 | 3 | 0 | 0 | 3 |
| 11 | BX5010 | Java Programming Lab | 4 | 0 | 0 | 4 | 2 |
| 12 | BX5011 | Data Base Management Systems Lab | 4 | 0 | 0 | 4 | 2 |

**MA5101**        **MATRICES, PROBABILITY AND STATISTICS**     **L T  P C**
                                                                                       **3 2 0 4**

**OBJECTIVES:**

- To provide methods for understanding the consistency and solving the equation as well as for finding the Eigenvalues and Eigenvectors of square matrix.
- To provide foundation on Applied Probability
- To introducethe concepts of correlation and regression of random variables
- To use various statistical techniques in Application problems
- To introduce the concept of Design of Experiments for data analysis

**UNIT - I       MATRICES AND EIGENVALUE PROBLEMS              5**
Matrices - Rank of a Matrix - Consistently of a system of linear equations - Solution of the matrix equation $\Delta x = b$ - Row - reduced Echelon Form - Eigenvalues and Eigenvectors - Properties - Cayley - Hamilton Theorem - Inverse of a matrix.

**UNIT - II      PROBABILITY AND RANDOM VARIABLES             15**
Probability - Axioms of Probability - Conditional Probability - Addition and multiplication laws of Probability - Baye's theorem - Random Variables  - Discrete and continuous random variables - Probability mass function and Probability density functions - Cumulative distribution function - Moments and variance of random variables - Properties - Binomial, Poisson, Geometric, Uniform, Exponential, Normal distributions and their properties.

**UNIT -  III      TWO-DIMENTIONAL RANDOM VARIABLES           15**
Joint probability distributions - Marginal and conditional probability distributions - Covariance - Correlation - Linear regression lines - Regression curves - Transform of random variables - Central limit theorem  (for independent identically random variables).

**UNIT - IV      TESTING OF HYPOTHESIS                        15**
Sampling distributions - Tests based on small and large samples -   Normal, Student's t, Chi-square and F distributions for testing of mean, variance and proportion and testing of difference of means variances and proportions - Tests for independence of attributes and goodness of fit.

**UNIT - V       DESIGN OF EXPERIMENTS                         15**
Analysis of variance - Completely randomized design - Random block design (One-way and Two-way classifications) - Latin square design  -$2^2$ Factorial design.

                                                     **TOTAL PERIODS:75**

**OUTCOMES:**
After the completion of the course the student will be able to
- Test the consistency and solve system of linear equations as well as find the Eigenvalues and Eigenvector.
- Apply the Probability axioms as well as rules and the distribution of discrete and continuous ideas in solving real world problems.
- Apply the concepts of correlation and regression of random variables in solving application problems.
- Use statistical techniques in testing hypothesis on data analysis.
- Use the appropriate statistical technique of design of experiments in data analysis.

**REFERENCE BOOKS:**
1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 43rd Edition, New Delhi, 2015.
2. R.K. Jain and S.R.K Iyenger, Advanced Engineering Mathematics, Narosa Publishing House, New Delhi,   2002.
3. Devore, J.L, Probability and Statistics for Engineering and Sciences, Cengage Learning,
   8th Edition,  New Delhi, 2014.
4. Miller and M. Miller, Mathematical Statistics, Pearson Education Inc., Asia 7th Edition, New Delhi,  2011.
5. Richard Johnson, Miller and Freund's Probability and Statistics for Engineer, Prentice Hall of India Private Ltd., 8th Edition, New Delhi, 2011.

| CO/POs & PSOs | PO | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO1 | √ | √ | - | | | | | | | | | | | |
| CO2 | √ | √ | - | - | | | | | | | | | √ | |
| CO3 | √ | √ | √ | √ | | | | | | | | | √ | |
| CO4 | √ | √ | √ | √ | √ | √ | | | | | | | √ | |
| CO5 | √ | √ | √ | √ | √ | √ | | | | | | | √ | |

**Mapping of COs with POs and PSOs**

**MC5301        ADVANCED DATA STRUCTURES AND ALGORITHMS      L T  P C**
                                                            **3 0 0 3**

**OBJECTIVES:**
- Understand and apply linear data structures-List, Stack and Queue
- Understand the graph algorithms.
- Learn different algorithm analysis techniques.
- Apply data structures and algorithms in real time applications
- Analyze the efficiency of an algorithm

**UNIT I        LINEAR DATA STRUCTURES                                        9**
Introduction - Abstract Data Types (ADT) – Stack – Queue – Circular Queue - Double Ended Queue - Applications of stack – Evaluating Arithmetic Expressions - Other Applications - Applications of Queue - Linked Lists - Singly Linked List - Circularly Linked List - Doubly Linked lists – Applications of linked list – Polynomial Manipulation.

**UNIT II        NON-LINEAR DATA STRUCTURES                                   9**
Binary Tree – expression trees – Binary tree traversals – applications of trees – Huffman Algorithm - Binary search tree - Balanced Trees - AVL Tree - B-Tree - Splay Trees – Heap-Heap operations- -Binomial Heaps - Fibonacci Heaps- Hash set.

**UNIT III          GRAPHS                                                                9**

Representation of graph - Graph Traversals - Depth-first and breadth-first traversal - Applications of graphs - Topological sort – shortest-path algorithms - Dijkstra's algorithm – Bellman-Ford algorithm – Floyd's Algorithm - minimum spanning tree – Prim's and Kruskal's algorithms.

**UNIT IV          ALGORITHM DESIGN AND ANALYSIS                            9**

Algorithm Analysis – Asymptotic Notations - Divide and Conquer – Merge Sort – Quick Sort - Binary Search - Greedy Algorithms – Knapsack Problem – Dynamic Programming – Optimal Binary Search Tree - Warshall's Algorithm for Finding Transitive Closure.

**UNIT V          ADVANCED ALGORITHM DESIGN AND ANALYSIS             9**

Backtracking – N-Queen's Problem - Branch and Bound – Assignment Problem - P & NP problems – NP-complete problems – Approximation algorithms for NP-hard problems – Traveling salesman problem-Amortized Analysis.

**TOTAL: 45 PERIODS**

**OUTCOMES:**
- Implement a program using stack, queue, linked list data structures
- Design and Implement Tree data structures and Sets
- Apply the Graph Data structure and to find shortest path among the several possibilities
- Perform analysis of various algorithms
- Analyze and design algorithms to appreciate the impact of algorithm design in practice.

**REFERENCES:**
1. AnanyLevitin "Introduction to the Design and Analysis of Algorithms" 3rd EditionPearson Education, 2015.
2. Jean Paul Tremblay and Paul G. Sorensen. "An Introduction to Data Structures with Applications", 2nd Edition, Tata McGraw Hill, New Delhi, 2017
3. Peter Drake, "Data Structures and Algorithms in Java", 4th Edition, Pearson Education 2014
4. T. H. Cormen, C. E. Leiserson, R. L. Rivest, and C. Stein, "Introduction to algorithms", 3rd Edition, PHI Learning Private Ltd, 2012
5. V. Aho, J. E. Hopcroft, and J. D. Ullman, "Data Structures and Algorithms", 1st Edition,Pearson Education, 1983.
6. Michael T.Goodrich, "Algorithm Design: Foundations, Analysis and Internet Examples", 2nd Edition, Wiley India Pvt. Ltd, 2006.

| Mapping of COs with POs and PSOs | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COs/POs & PSOs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | √ | √ | √ | √ | | | | | | | | | | |
| CO2 | √ | √ | √ | √ | | | | | | | | | √ | |
| CO3 | √ | √ | √ | √ | | | | | | | | | √ | |
| CO4 | √ | √ | √ | √ | | | | | | | | | √ | |
| CO5 | √ | √ | √ | √ | | | | | | | | | √ | |

**MC5105**                    **ADVANCED DATABASE TECHNOLOGY**           **L T P C**
                                                                        **3 0 0 3**

**OBJECTIVES:**
- To learn the fundamentals of data modeling and design in advanced databases.
- To study the working principles of distributed databases.
- To have an introductory knowledge about the query processing in object-based databases and its usage.
- To understand the basics of spatial, temporal and mobile databases and their applications.
- To learn emerging databases such as XML, Data warehouse and NoSQL.

**UNIT I        DISTRIBUTED DATABASES                                          9**
Distributed Systems – Introduction – Architecture – Distributed Database Concepts – DistributedData Storage – Distributed Transactions – Commit Protocols – Concurrency Control – DistributedQuery Processing

**UNIT II       NOSQL DATABASES                                                9**
NoSQL – CAP Theorem – Sharding - Document based – MongoDB Operation: Insert, Update, Delete, Query, Indexing, Application, Replication, Sharding, Deployment – Using MongoDB with PHP / JAVA – Advanced MongoDB Features – Cassandra: Data Model, Key Space, Table Operations, CRUD Operations, CQL Types – HIVE: Data types, Database Operations, Partitioning – HiveQL – OrientDB Graph database – OrientDB Features

**UNIT III      ADVANCED DATABASE SYSTEMS                                      9**
Object Oriented Databases-Need for Complex Data Types - The Object-Oriented Data Model-Object-Oriented Languages-Spatial Databases: Spatial Data Types, Spatial Relationships, Spatial Data Structures, Spatial Access Methods – Temporal Databases: Overview – Active Databases – Deductive Databases – RecursiveQueries in SQL – Mobile Databases: Location and Handoff Management, Mobile TransactionModels, Concurrency – Transaction Commit Protocols – Multimedia Databases.

**UNIT IV       XML AND DATAWAREHOUSE                                          9**
XML Database: XML – XML Schema – XML DOM and SAX Parsers – XSL – XSLT – XPath and XQuery – Data Warehouse: Introduction – Multidimensional Data Modeling – Star and SnowflakeSchema – Architecture – OLAP Operations and Queries.

**UNIT V        INFORMATION RETRIEVAL AND WEB SEARCH                           9**
IR concepts – Retrieval Models – Queries in IR system – Text Preprocessing – Inverted Indexing – Evaluation Measures – Web Search and Analytics – Ontology based Search - Current trends.

                                                                **TOTAL: 45 PERIODS**

**OUTCOMES:**
On completion of the course, the student will be able to:
1. Design a distributed database system and execute distributed queries.
2. Use NoSQL database systems and manipulate the data associated with it.
3. Design a data warehouse system and apply OLAP operations.
4. Design XML database systems and validating with XML schema.
5. Apply knowledge of information retrieval concepts on web databases.

**REFERENCES:**
1. Henry F Korth, Abraham Silberschatz, S. Sudharshan, "Database System Concepts", 6th Edition, McGraw Hill, 2011.
2. R. Elmasri, S.B. Navathe, "Fundamentals of Database Systems", Seventh Edition, Pearson Education/Addison Wesley, 2017.
3. C. J. Date, A. Kannan, S. Swamynathan, "An Introduction to Database Systems", Eighth Edition, Pearson Education, 2006.
4. Jiawei Han, MichelineKamber ,Jian Pei, "Data Mining: Concepts and Techniques", Third Edition, Morgan Kaufmann, 2012.
5. Brad Dayley, "Teach Yourself NoSQL with MongoDB in 24 Hours", Sams Publishing, First Edition, 2014.
6. ShashankTiwari, "Professional NoSQL", O'Reilly Media, First Edition, 2011.
7. Vijay Kumar, "Mobile Database Systems", John Wiley & Sons, First Edition, 2006

| Mapping of COs with POs and PSOs | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COs/POs & PSOs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**MC5106**　　　　**OBJECT ORIENTED SOFTWARE ENGINEERING**　　**L T P C**
　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　**3 0 0 3**

**OBJECTIVES:**
● To understand the phases in object oriented software development
● To gain fundamental concepts of requirements engineering and analysis.
● To know about the different approach for object oriented design and its methods
● To learn about how to perform object oriented testing and how to maintain software
● To provide various quality metrics and to ensure risk management.

**UNIT I　　　SOFTWARE DEVELOPMENT LIFE CYCLE　　　　　　　　9**
Introduction – Object Orientation - Object Oriented Methodologies – Terminologies - Software Development Life Cycle – Conventional Software Life Cycle Models – Build and Fix Model – Waterfall Model – Prototyping Model – Iterative Enhancement Model – Spiral Model – Extreme Programming - Object Oriented Software Life Cycle Models – Selection of Software Development Life Cycle Models

**UNIT II　　　OBJECT ORIENTED REQUIREMENTS ELICITATION & ANALYSIS　　9**
Software Requirement - Requirements Elicitation Techniques – Initial Requirements Document – Use Case Approach – Characteristics of a Good Requirement – SRS Document – Requirements Change Management – Object Oriented Analysis : Identification of Classes

and Relationships, Identifying State and Behavior – Case Study LMS - Managing Object Oriented Software Engineering:   Projection Selection and Preparation – Product Development Organization – Project Organization and Management – Project Staffing

**UNIT III        OBJECT ORIENTED SOFTWARE DESIGN                                 9**
Object Oriented Design – Interaction Diagrams – Sequence Diagram – Collaboration Diagrams – Refinement of   Use Case Description – Refinement of Classes and Relationships – Construction of Detailed Class Diagram – Development of Detailed Design & Creation of Software Design Document - Object Oriented Methods : Object Oriented Analysis (OOA / Coad-Yourdon), Object Oriented Design (OOD/Booch) , Hierarchical Object Oriented Design (HOOD), Object Modeling Technique (OMT), Responsibility – Driven Design Case Studies : Warehouse Management System, Telecom

**UNIT IV        OBJECT ORIENTED TESTING AND MAINTENANCE                    9**
Software testing: Software Verification Techniques – Object Oriented Checklist :-  Functional Testing – Structural Testing – Class Testing – Mutation Testing – Levels of Testing – Static and Dynamic Testing Tools -  Software Maintenance – Categories – Challenges of Software Maintenance – Maintenance of Object Oriented Software – Regression Testing

**UNIT V        SOFTWARE QUALITY & METRICS                                          9**
Need of   Object Oriented Software Estimation – Lorenz and Kidd Estimation – Use Case Points Method – Class Point Method – Object Oriented Function Point – Risk Management – Software Quality Models – Analyzing the Metric Data – Metrics for Measuring Size and Structure – Measuring Software Quality -  Object Oriented Metrics

**TOTAL: 45 PERIODS**

**OUTCOMES:**
* Able to identify the appropriate process model to develop the object oriented software
* Gain knowledge about requirement elicitation and analyzing techniques
* Able to choose and design suitable UML diagrams and methods
* Able to apply correct testing methods and maintain software systems.
* Able to estimate the object oriented application by applying metric data.

**REFERENCES:**
1. Yogesh Singh,  RuchikaMalhotra, " Object – Oriented Software Engineering",  PHI Learning Private Limited ,First edition,2012
2. Ivar Jacobson. Magnus Christerson, PatrikJonsson, Gunnar Overgaard, "Object Oriented Software Engineering, A Use Case Driven Approach", Pearson Education, Seventh Impression, 2009
3. Craig Larman, "Applying UML and Patterns, an Introduction to Object-Oriented Analysis and Design and Iterative Development", Pearson Education, Third Edition, 2008.
4. Grady Booch, Robert A. Maksimchuk, Michael W. Engle, Bobbi J. Young, Jim Conallen, Kelli A. Houston,  "Object Oriented Analysis & Design with Applications, Third Edition, Pearson Education,2010
5. Roger S. Pressman, "Software Engineering: A Practitioner's Approach, Tata McGraw-Hill Education, 8th Edition, 2015.
6. Timothy C. Lethbridge  and Robert Laganiere, "Object – Oriented Software Engineering, Practical Software Development using UML and Java", Tata  McGraw Hill Publishing Company Limited, Second Edition, 2004

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**MC5107**　　　　　　　　**PYTHON PROGRAMMING**　　　　**L T P C**
　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　**3 0 0 3**

**OBJECTIVES:**
- To develop Python programs with conditionals and loops.
- To define Python functions and use function calls.
- To use Python data structures – lists, tuples, dictionaries.
- To do input/output with files in Python.

**UNIT I　　　PYTHON BASICS　　　　　　　　　　　　　　　　　　10**
Introduction to Python Programming – Python Interpreter and Interactive Mode– Variables and Identifiers – Arithmetic Operators – Values and Types – Statements. Operators – Boolean Values – Operator Precedence – Expression – Conditionals: If-Else Constructs – Loop Structures/Iterative Statements – While Loop – For Loop – Break Statement-Continue statement – Function Call and Returning Values – Parameter Passing – Local and GlobalScope – Recursive Functions.

**UNIT II　　　DATA TYPES IN PYTHON　　　　　　　　　　　　10**
Lists, Tuples, Sets, Strings, Dictionary, Modules: Module Loading and Execution – Packages – Making Your OwnModule – The Python Standard Libraries

**UNIT III　　　FILE HANDLING AND EXCEPTION HANDLING　　　　8**
Files: Introduction – File Path – Opening and Closing Files – Reading and Writing Files –File Position – Exception: Errors and Exceptions, Exception Handling, Multiple Exceptions

**UNIT IV　　　MODULES, PACKAGES　　　　　　　　　　　　　9**
Modules: Introduction – Module Loading and Execution – Packages – Making Your OwnModule – The Python Libraries for data processing, data mining and visualization- NUMPY, Pandas, Matplotlib, Plotly

**UNIT V　　　OBJECT ORIENTED PROGRAMMING IN PYTHON　　　8**
Creating a Class, Class methods, Class Inheritance, Encapsulation, Polymorphism, class method vs. static methods, Python object persistence
　　　　　　　　　　　　　　　　　　　　　　**TOTAL: 45 PERIODS**

**OUTCOMES:**
Upon completion of the course, students will be able to
- Develop algorithmic solutions to simple computational problems
- Structure simple Python programs for solving problems.

- Read and write data from/to files in Python Programs.
- Represent compound data using Python lists, tuples, dictionaries.
- Decompose a Python program into functions.

**REFERENCES:**

1. ReemaThareja, "Python Programming using Problem Solving Approach", Oxford University Press, First edition, 2017
2. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", Second Edition, Shroff,O'Reilly Publishers, 2016 (http://greenteapress.com/wp/thinkpython/)
3. Guido van Rossum, Fred L. Drake Jr., "An Introduction to Python – Revised andUpdated forPython 3.2, Network Theory Ltd., First edition, 2011
4. John V Guttag, "Introduction to Computation and Programming Using Python",Revised and Expanded Edition, MIT Press, 2013
5. Charles Dierbach, "Introduction to Computer Science using Python", Wiley IndiaEdition, First Edition, 2016
6. Timothy A. Budd, "Exploring Python", Mc-Graw Hill Education (India) Private Ltd.,First edition,2011
7. Kenneth A. Lambert, "Fundamentals of Python: First Programs", Cengage Learning, second edition,2012

| COs/POs & PSOs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**Mapping of COs with POs and PSOs**

**MC5108    RESEARCH METHODOLOGY AND INTELLECTUAL PROPERTY RIGHTS**

**L T P C**
**2 0 0 2**

**COURSE OBJECTIVES:**
The course should enable the students to:
- Identify an appropriate research problem in their interesting domain.
- Understand ethical issues; understand the Preparation of a research project thesis report.
- Understand the Preparation of a research project thesis report
- Understand the law of patent and copyrights.
- Acquire adequate knowledge of IPR.

**UNIT I    RESEARCH METHODOLOGY    6**
**Research Methodology –** An Introduction, Objectives, Types of research, Research approaches, Significance, Research methods versus Methodology, Research and Scientific method, Importance, Research process, Criteria, Problems encountered by researchers.

**Defining the research problem –** Research problem, Selecting the problem, Necessity, Technique involved, An illustration.

**Reviewing the Literature –** The place of the literature review in research, How to review the Literature, Writing about the literature reviewed.

**UNIT II        RESEARCH DESIGN                                              6**

**Research Design –** Meaning, Need, Features, Different research design, Basic principles of experimental designs, Important experimental designs.

**Measurement & Scaling techniques –** Sampling Design, Measurement in research, Measurement scales, Error, Measurement tools, Scaling, Meaning, Scale classification, Scale construction techniques

**Data Collection –** Collection of primary data, Collection of secondary data, Selection of appropriate method for data collection.

**UNIT III        RESEARCH TECHNIQUE AND TOOLS                              6**

**Testing of Hypothesis –** Basic concepts, Procedure, Test of Hypothesis, Important parametric Tests, Hypothesis Testing unifications.

**Interpretation & Report writing –** Meaning, techniques, Precaution in Interpretation, Significance of Report writing, steps, Layout, types, mechanics, precautions.

**Use of Tools/ Techniques for research –** Use of Encyclopedias, Research Guides, Handbook etc., Academic Databases for Computer Science Discipline, Use of tools / techniques for Research methods to search required information effectively, Reference Management Software like Zotero/Mendeley, Software for paper formatting like LaTeX/MS Office, Software for detection of Plagiarism

**UNIT IV        IINTELLECTUAL PROPERTY RIGHTS                              6**

**Intellectual Property –** The concept, IPS in India, development, Trade secrets, utility Models, IPR & Bio diversity, CBD, WIPO, WTO, Right of Property, Common rules, PCT, Features of Agreement, Trademark, UNESCO.

**UNIT V        PATENTS                                                      6**

**Patents –** Learning objectives, Concept, features, Novelty, Inventive step, Specification, Types of patent application, E-filling, Examination, Grant of patent, Revocation, Equitable Assignments, Licences, Licencing of related patents, patent agents, Registration of patent agents.

**TOTAL: 30 PERIODS**

**REFERENCE BOOKS:**
1. Research Methodology: Methods and Techniques by C.R.Kothari, GauravGarg, New Age International 4$^{th}$ Edition 2018 (UNIT I to UNIT III)
2. Research Methodology a step-by-step guide for beginners by Ranjit Kumar, SAGE publications Ltd 3$^{rd}$ Edition 2011 (For the topic Reviewing the Literature under Unit I)
3. Stuart Melville and Wayne Goddard, "Research Methodology: An Introduction for Science & engineering students.Juta and Co., Limited, 1996, First edition
4. Research methods: The concise knowledge base-Trochim, Atomic Dog publishing, First edition,2005..
5. John W. Best & James V. Khan, "Research in Education", Pearson 8$^{th}$Edition'year.
6. Professional Programme Intellectual Property Rights, Law and practice, The Institute of Company Secretaries of India, Statutory body under an Act of parliament, September 2013 (UNIT IV & UNIT V)

**OUTCOMES: (Cos)**

**On completion of the course the student would be able to :**

CO1: Understand the research problem and Literature review.

CO2: Understand the various research designs and their characteristics.

CO3: Prepare a well-structured research paper and scientific presentations.

CO4: Explore on various IPR Components and process of filing.

CO5 Develop awareness the patent law and procedural mechanismin obtaining a patent.

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**MC5114    ADVANCED DATABASE TECHNOLOGY LABORATORY    L T P C**
**0 0 4 2**

**OBJECTIVES:**

The student should be able:

- To understand the concepts of Open Source DBMS.
- To understand the process of distributing tables across multiple systems
- To understand the process of storing, retrieving spatial and temporal data
- To understand the process of storing, retrieving objects in a database
- To understand the process of storing and retrieving data from a XML Database
- To use the open source database for building a mobile application

**EXPERIMENTS IN THE FOLLOWING TOPICS:**

1. NOSQL Exercises
    a. MongoDB – CRUD operations,Indexing, Sharding, Deployment
    b. Cassandra: Table Operations, CRUD Operations, CQL Types
    c. HIVE: Data types, Database Operations, Partitioning – HiveQL
    d. OrientDB Graph database – OrientDB Features
2. MySQL Database Creation, Table Creation, Query
3. MySQL Replication – Distributed Databases
4. Spatial data storage and retrieval in MySQL
5. Temporal data storage and retrieval in MySQL
6. Object storage and retrieval in MySQL
7. XML Databases , XML table creation, XQuery FLWOR expression
8. Mobile Database Query Processing using open source DB (MongoDB/MySQL etc)

**TOTAL: 60 PERIODS**

**OUTCOMES:**

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

- Design and Implement databases.

- Formulate complex queries using SQL
- Design and Implement applications that have GUI and access databases for backend connectivity
- To design and implement Mobile Databases
- To design and implement databases to store spatial and temporal data objects

| COs/POs & PSOs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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| **Mapping of COs with POs and PSOs** | | | | | | | | | | | | | | |
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**MC5115 ADVANCED DATA STRUCTURES AND PYTHON PROGRAMMING LABORATORY**

**L T P C**
**0 0 4 2**

**OBJECTIVES:**
- To learn the basic programming constructs in Python.
- To implement Recursive programming in Python
- To implement Divide and Conquer algorithmic technique in Python
- To implement Tree Data structures in Python
- To implement Graphs in Python
- To deploy the standard libraries in Python

**EXPERIMENTS:**
1. Towers of Hanoi using Recursion
2. To implement Binary Search
3. Merge Sort
4. To implement AVL Trees using Python
5. To implement Splay Trees using Python
6. To implement Red black Trees using Python
7. To implement Graphs using Python
8. Implementing programs using written modules and Python Standard Libraries.
9. Implementing real-time/technical applications using Files and Exception handling.

**TOTAL: 60 PERIODS**

**OUTCOMES:**
On completion of the course, students will be able to:
1. Develop algorithmic solutions to simple computational problems
2. Develop and execute Python programs.
3. Decompose a Python program into functions.

4. Represent compound data using Python data structures.
5. Apply Python features in developing software applications.

<table>
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**MC5116**     **COMMUNICATION SKILLS - I**     **L  T  P  C**
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**OBJECTIVES:**
- To provide opportunities to learners to practice English and thereby make them proficient users of the language.
- To enable learners to fine-tune their linguistic skills (LSRW) with the help of Technology.
- To enhance the performance of students listening, speaking, reading and writing and thereby develop their career opportunities.

**LIST OF ACTIVITIES:**
1. Listening:
    - Listening and practicing neutral accents
    - Listening to short talks and lectures and completing listening comprehension exercises
    - Listening to TED Talks
2. Speaking:
    - Giving one minute talks
    - Participating in small Group Discussions
    - Making Presentations
3. Reading:
    - Reading Comprehension
    - Reading subject specific material
    - Technical Vocabulary
4. Writing:
    - Formal vs Informal Writing
    - Paragraph Writing
    - Essay Writing
    - Email Writing

**TOTAL: 30 PERIODS**

**REFERENCES / MANUALS / SOFTWARE**: Open Sources / websites
**OUTCOMES:**
On completion of the course the students will be able to:

- Listen and comprehend Lectures in English
- Articulate well and give presentations clearly
- Participate in Group Discussions successfully
- Communicate effectively in formal and informal writing
- Write proficient essays and emails

| COs/POs & PSOs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**Mapping of COs with POs and PSOs**

**MC5206**                    **INTERNET PROGRAMMING**                    **L T P C**
                                                                          **3 0 0 3**

**COURSE OBJECTIVES:**
- To understand the fundamentals of web programming and client side scripting.
- To learn the server side development using servlets, websocket.
- To learn the Spring framework and build applications using Spring.
- To learn and implement the concept of Java Persistence API.
- To learn the advanced client side scripting and framework.

**UNIT I       INTRODUCTION TO WEB & CLIENT SIDE PROGRAMMING       9**
Introduction to Web: Server - Client - Communication Protocol (HTTP), JavaScript: Data Types and Variables - Expressions - Operators and Statements -  Objects and Arrays - Functions - Classes - Modules - DOM - Events - Storage: LocalStorage, Cookies, IndexedDB, JSON, AJAX

**UNIT II       SERVER SIDE PROGRAMMING       9**
Web Server: Web Containers - Web Components, Servlet: Lifecycle - Request - Servlet Context - Response - Filter - Session - Dispatching Requests, WebSocket, Logging - Log4j2, Build tool - Gradle. Introduction to Spring: IoC Container and Dependency Injection (DI)

**UNIT III       SPRING       9**
Spring Configuration and Spring Boot, Spring MVC: DispatcherServlet and Configuration - Interceptors - Controllers - Views - Input Validation -  File Upload, Building RESTful Web Services, Spring Security Architecture, Spring Cache.

**UNIT IV       JAVA PERSISTENCE API AND HIBERNATE       9**
Entity: Basic, Embeddable and Collection Types - Identifiers - Entity Relationship - Inheritance, Persistence Context and Entity Manager, JPQL, Criteria API, Spring Data JPA - Specification and Projection.

**UNIT V          ADVANCED CLIENT SIDE PROGRAMMING                    9**

Asynchronous JavaScript: Callbacks - Promises - async and await, React JS: ReactDOM - JSX - Components - Properties - State and Lifecycle - Events - Lifting State Up - Composition and Inheritance - Higher Order Components.

**TOTAL: 45 PERIODS**

**Course Outcomes:**

Upon completion of the course the students should be able to:

- To write client side scripting.
- To implement the server side of the web application.
- To implement Web Application using Spring.
- To implement a Java application using Java Persistence API.
- To implement a full-stack Single Page Application using React, Spring and JPA.

**REFERENCE BOOKS**

1. David Flanagan, "Java Script: The Definitive Guide", O'Reilly Media, Inc, 7th Edition, 2020
2. Matt Frisbie, "Professional JavaScript for Web Developers", Wiley Publishing, Inc, 4th Edition, ISBN: 978-1-119-36656-0, 2019
3. Alex Banks, Eve Porcello, "Learning React", O'Reilly Media, Inc, 2nd Edition, 2020 https://reactjs.org/docs
4. David R. Heffelfinger, "Java EE 8 Application Development", Packt Publishing, First edition2017
5. Benjamin Muschko, "Gradle in Action", Manning Publications, First edition2014
6. IulianaCosmina, Rob Harrop, Chris Schaefer, Clarence Ho, "Pro Spring 5: An In-Depth Guide to the Spring Framework and Its Tools", Apress, Fifth edition2017
7. Christian Bauer, Gavin King, and Gary Gregory, "Java Persistence with Hibernate", Manning Publications, \r, 2nd Edition, 2015

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**MC5207          CLOUD COMPUTING TECHNOLOGIES          L T  P C**
**                                                      3 0  0 3**

**OBJECTIVES:**

- To understand the basic concepts of Distributed systems
- To learn about the current trend and basics of Cloud computing
- To be familiar with various Cloud concepts
- To expose with the Server, Network and storage virtualization
- To be aware of Microservices and DevOps

**UNIT I**         **DISTRIBUTED SYSTEMS**         **9**

Introduction to Distributed Systems – Characterization of Distributed Systems – Distributed Architectural Models –Remote Invocation – Request-Reply Protocols – Remote Procedure Call – Remote Method Invocation – Group Communication – Coordination in Group Communication – Ordered Multicast – Time Ordering – Physical Clock Synchronization – Logical Time and Logical Clocks

**UNIT II**         **INTRODUCTION TO CLOUD COMPUTING**         **9**

Cloud Computing Basics – Desired features of Cloud Computing – Elasticity in Cloud – On demand provisioning - Applications – Benefits – Cloud Components: Clients, Datacenters & Distributed Servers – Characterization of Distributed Systems – Distributed Architectural Models - Principles of Parallel and Distributed computing - Applications of Cloud computing – Benefits – Cloud services – Open source Cloud Software: Eucalyptus, Open Nebula, Open stack, Aneka, Cloudsim.

**UNIT III**         **CLOUD INFRASTRUCTURE**         **9**

Cloud Architecture and Design – Architectural design challenges – Technologies for Network based system - NIST Cloud computing Reference Architecture – Public, Private and Hybrid clouds – Cloud Models : IaaS, PaaS and SaaS – Cloud storage providers - Enabling Technologies for the Internet of Things – Innovative Applications of the Internet of Things.

**UNIT IV**         **CLOUD ENABLING TECHNOLOGIES**         **9**

Service Oriented Architecture – Web Services – Basics of Virtualization – Emulation – Types of Virtualization – Implementation levels of Virtualization – Virtualization structures – Tools & Mechanisms – Virtualization of CPU, Memory & I/O Devices – Desktop Virtualization – Server Virtualization – Google App Engine – Amazon AWS - Federation in the Cloud.

**UNIT V**         **MICROSERVICES AND DEVOPS**         **9**

Defining Microservices - Emergence of Microservice Architecture – Design patterns of Microservices – The Mini web service architecture – Microservice dependency tree – Challenges with Microservices - SOA vsMicroservice – Microservice and API – Deploying and maintaining Microservices – Reason for having DevOps – Overview of DevOps – History of DevOps – Concepts and terminology in DevOps – Core elements of DevOps – Life cycle of DevOps – Adoption of DevOps - DevOps Tools – Build, Promotion and Deployment in DevOps - DevOps in Business Enterprises.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

Upon completion of the course, the students will be able to
- Use Distributed systems in Cloud Environment
- Articulate the main concepts, key technologies, strengths and limitations of Cloud computing
- Identify the Architecture, Infrastructure and delivery models of Cloud computing
- Install, choose and use the appropriate current technology for the implementation of Cloud
- Adopt Microservices and DevOps in Cloud environment

**REFERENCES:**
1. Kai Hwang, Geoffrey C. Fox & Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, First Edition, 2012
2. Andrew S. Tanenbaum& Maarten Van Steen, "Distributed Systems - Principles and Paradigms", Second Edition, Pearson Prentice Hall, 2006
3. Thomas Erl, ZaighamMahood& Ricardo Puttini, "Cloud Computing, Concept, Technology & Architecture", Prentice Hall, SecondEdition,2013
4. Richard Rodger, "The Tao of Microservices", ISBN 9781617293146, Manning Publications, First Edition,December 2017.
5. Magnus Larsson, "Hands-On Microservices with Spring Boot and Spring Cloud: Build and deploy microservices using spring cloud, Istio and kubernetes", Packt Publishing Ltd, First Edition,September 2019.
6. Jim Lewis, "DEVOPS: A complete beginner's guide to DevOps best practices", ISBN-13:978-1673259148, ISBN-10: 1673259146, First Edition, 2019.

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO 1 | √ | √ | √ | | | | | √ | | | √ | √ | √ | |
| CO 2 | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | | √ | √ | √ |
| CO 3 | √ | | √ | | √ | √ | | √ | √ | √ | √ | √ | | √ |
| CO 4 | √ | | | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ |
| CO 5 | √ | √ | | | √ | √ | | √ | | | √ | √ | √ | √ |

**MC5208**             **ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING**    **L T P C**
                                                                              **3 0 0 3**

**OBJECTIVES:**
● To familiarize with the principles of Artificial intelligence like problem solving, inference, perception, knowledge representation, and learning.
● To understand the various characteristics of Intelligent agents
● To design and implement the machine learning techniques for real world problems
● To gain experience in doing research using Artificial intelligence and Machine learning techniques.

**UNIT  I      ARTIFICIAL INTELLIGENCE                                        9**
Foundation of AI-History of AI-State of Art.-Intelligent Agents: Agents and Environments-Concepts of Rationality-Nature of Environments-Structure of Agents. Problem Solving: Problem Solving by Search: Problem Solving Agents-Searching for Solutions-Uniform Search Strategies-Heuristic Search Strategies- local Search Algorithms and Optimization Problems.

**UNIT  II      KNOWLEDGE AND REASONING                                       9**
Logical Agents: Knowledge Based Agents-Logic-Propositional Logic-Propositional Theorem Proving-Model Checking-Agent based on Propositional Logic. First-Order Logic: Syntax and Semantics- Using First-Order Logic-Knowledge Engineering. Inference in First-Order Logic:

Prepositional Vs. First-Order Inference-Unification and Lifting-Forward Chaining-Backward Chaining –Resolution.

**UNIT III          BAYESIAN LEARNING                                                    9**
Basic Probability Notation- Inference – Independence - Bayes' Rule. Bayesian Learning: Maximum Likelihood and Least Squared error hypothesis-Maximum Likelihood hypotheses for predicting probabilities- Minimum description Length principle -Bayes optimal classifier - Naïve Bayes classifier - Bayesian Belief networks -EM algorithm.

**UNIT IV          PARAMETRIC MACHINE LEARNING                                     9**
Logistic Regression: Classification and representation – Cost function – Gradient descent – Advanced optimization – Regularization - Solving the problems on overfitting. Perceptron – Neural Networks – Multi – class Classification - Backpropagation – Non-linearity with activation functions (Tanh, Sigmoid, Relu, PRelu) - Dropout as regularization.

**UNIT V          NON PARAMETRIC MACHINE LEARNING                               9**
k- Nearest Neighbors- Decision Trees – Branching – Greedy Algorithm - Multiple Branches – Continuous attributes – Pruning.  Random Forests:ensemble learning. Boosting – Adaboost algorithm.  Support Vector Machines – Large Margin Intuition – Loss Function - Hinge Loss – SVM Kernels.

**TOTAL: 45 PERIODS**

**REFERENCES:**
1. Stuart  Russell and Peter  Norvig, "Artificial  Intelligence: A  Modern Approach" , Third Edition Pearson  Education Limited, 2015
2. CalumChace , "Surviving AI: The Promise and Peril of Artificial Intelligence", Three CS publication, Second Edition, 2015.
3. Christopher M Bishop, "Pattern Recognition and Machine Learning", Spring 2011 Edition.
4. Trevor  Hastie,  Robert  Tibshirani,  Jerome  Friedman,  "The  Elements  of  Statistical Learning: Data Mining, Inference and Prediction", Springer 2$^{nd}$ Edition
5.  EthemAlpaydin, "Introduction to Machine Learning", Second Edition, MIT Press, 2010.
6.  Tom M. Mitchell, "Machine Learning", India Edition, 1$^{st}$ Edition, McGraw-Hill Education Private Limited, 2013
7.  Elaine  Rich,  Kevin  Knight,  Shivashankar  B. Nair,  "Artificial  Intelligence",  Third  Edition, Tata McGraw-Hill Education, 2012
8. Elaine  Rich,  Kevin  Knight,  Shivashankar  B. Nair,  "Artificial  Intelligence",  Third  Edition, Tata McGraw-Hill Education, 2012

**OUTCOME:**
 ● Apply the techniques of Problem Solving in Artificial Intelligence.
 ● Implement Knowledge and Reasoning for real world problems.
 ● Model  the various Learning features of Artificial Intelligence
 ● Analyze  the working model and  features of Decision tree
 ● Apply k-nearest algorithm for appropriate research problem.

| Mapping of COs with POs and PSOs | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COs/POs & PSOs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | 1 | 2 | 2 | 3 | | | | | | | | | | |
| CO2 | 1 | 3 | 3 | 2 | 1 | | | | | | | | 1 | |
| CO3 | 1 | 2 | 3 | 2 | | | | | | | | | 1 | |
| CO4 | 1 | 3 | 1 | 1 | | | | | | | | | 1 | |
| CO5 | 1 | 3 | 1 | | | | | | | | | | 1 | |

1 – Slight, 2 – Moderate, 3 – Substantial.

**MC5209**         **MOBILE APPLICATION DEVELOPMENT**        **L T P C**
                                                 **2 0 2 3**

**OBJECTIVES:**
- To understand the need and characteristics of mobile applications.
- To design the right user interface for mobile application.
- To understand the design issues in the development of mobile applications.
- To understand the development procedure for mobile application.
- To develop mobile applications using various tools and platforms.

**UNIT I      INTRODUCTION                                   12**
Mobile Application Model – Infrastructure andManaging Resources – Mobile Device Profiles – Frameworks and Tools.

**UNIT II      USER INTERFACE                                   12**
Generic UI Development - Multimodal and Multichannel UI –Gesture Based UI – Screen Elements and Layouts – Voice XML.

**Lab Component:**
    i.     Implement mobile application using UI toolkits and frameworks.
    ii.    Design an application that uses Layout Managers and event listeners.

**UNIT III     APPLICATION DESIGN                             12**
Memory Management – Design Patterns for Limited Memory – Work Flow for Applicationdevelopment – Java API – Dynamic Linking – Plugins and rule of thumb for using DLLs –Concurrency and Resource Management.

**Lab Component:**
    i.     Design a mobile application that is aware of the resource constraints of mobile devices.
    ii.    Implement an android application that writes data into the SD card.

**UNIT IV     MOBILE OS     12**

Mobile OS: Android, iOS – Android Application Architecture – Android basic components – Intents and Services – Storing and Retrieving data – Packaging and Deployment – Security and Hacking.

**Lab Component:**
   i.     Develop an application that makes use of mobile database
   ii.    Implement an android application that writes data into the SD card.

**UNIT V     APPLICATION DEVELOPMENT     12**

Communication via the Web – Notification and Alarms – Graphics and Multimedia: Layer Animation, Event handling and Graphics services – Telephony – Location based services

**Lab Component:**
   i.     Develop web based mobile application that accesses internet and location data.
   ii.    Develop an android application using telephony to send SMS.

**TOTAL: 60 PERIODS**

**OUTCOMES**

On completion of the course, the student will be able to
   ● Understand the basics of mobile application development frameworks and tools
   ● To be able to develop a UI for mobile application
   ● To design mobile applications that manages memory dynamically
   ● To build applications based on mobile OS like Android, iOs
   ● To build location based services

**REFERENCES:**

1. Reto Meier, "Professional Android 4 Application Development", Wiley, First Edition, 2012
2. ZigurdMednieks, Laird Dornin, G. Blake Meike, Masumi Nakamura, "ProgrammingAndroid", O'Reilly, 2nd Edition, 2012.
3. Alasdair Allan, "iPhone Programming", O'Reilly, First Edition, 2010.

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO2 |
|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------|-------|-------|-------|------|
| CO 1 |     | √   |     |     | √   | √   |     |     | √   |       | √     |       | √     |      |
| CO 2 | √   | √   | √   |     | √   |     |     |     | √   | √     | √     |       | √     |      |
| CO 3 | √   | √   |     | √   |     |     |     |     |     |       | √     | √     | √     |      |
| CO 4 | √   | √   | √   | √   |     |     |     |     |     |       | √     | √     |       | √    |
| CO 5 |     | √   | √   | √   |     | √   |     |     |     |       | √     | √     | √     |      |

**MA5210**                     **CYBER SECURITY**                    **L  T  P  C**
                                                                      **3  0  0  3**

**OBJECTIVES**
- To learn the principles of cyber security and to identify threats and risks.
- To learn how to secure physical assets and develop system security controls.
- To understand how to apply security for Business applications and Network Communications.
- To learn the technical means to achieve security.
- To learn to monitor and audit security measures.

**UNIT I          PLANNING FOR CYBER SECURITY                              9**
Best Practices-Standards and a plan of Action-Security Governance Principles, components and Approach-Information Risk Management-Asset Identification-Threat Identification-Vulnerability Identification-Risk Assessment Approaches-Likelihood and Impact Assessment-Risk Determination, Evaluation and Treatment-Security Management Function-Security Policy-Acceptable Use Policy-Security Management Best Practices.

**UNIT II         SECURITY CONTROLS                                        9**
People Management-Human Resource Security-Security Awareness and Education-Information Management- Information Classification and handling-Privacy-Documents and Record Management-Physical Asset Management-Office Equipment-Industrial Control Systems-Mobile Device Security- System Development-Incorporating Security into SDLC-Case study on information security policies.

**UNIT III        CYBER SECURITY FOR BUSINESS APPLICATIONS AND NETWORKS**
                                                                            **9**
Business Application Management-Corporate Business Application Security-End user Developed Applications-System Access- Authentication Mechanisms-Access Control-System Management-Virtual Servers-Network Storage Systems-Network Management Concepts-Firewall-IP Security-Electronic Communications – Case study on OWASP vulnerabilities using OWASP ZAP tool.

**UNIT IV         TECHNICAL SECURITY                                       9**
Supply Chain Management-Cloud Security-Security Architecture-Malware Protection-Intrusion Detection-Digital Rights Management-Cryptographic Techniques-Threat and Incident Management-Vulnerability Management-Security Event Management-Forensic Investigations-Local Environment Management-Business Continuity. – Case study on cloud and cryptographic vulnerabilities.

**UNIT V          SECURITY ASSESSMENT                                      9**
Security Monitoring and Improvement-Security Audit-Security Performance-Information Risk Reporting-Information Security Compliance Monitoring-Security Monitoring and Improvement Best Practices. – Case study on vulnerability assessment using ACUNETIX.

                                                            **TOTAL: 45 PERIODS**
**OUTCOMES**
**On completion of the course, the student will be able to**
- Develop a set of risk and security requirements to ensure that there are no gaps in an organization's security practices.
- Achieve management, operational and technical means for effective cyber security.
- Audit and monitor the performance of cyber security controls.
- To spot gaps in the system and devise improvements.

- Identify and report vulnerabilities in the system

**REFERENCES:**

1. William Stallings, "Effective Cyber Security- A guide to using Best Practices and Standards", Addison-Wesley Professional, First Edition,2018.
2. Adam Shostack, "Threat Modelling- Designing for Security", Wiley Publications,First Edition,2014.
3. Gregory J. Touhill and C. Joseph Touhill, "Cyber Security for Executives- A Practical guide", Wiley Publications, First Edition,2014.
4. RaefMeeuwisse, "Cyber Security for Beginners", Second Edition, Cyber Simplicity Ltd, 2017.
5. Patrick Engebretson, "The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy", 2nd Edition, Syngress, 2013.
6. OWASP ZAP : https://owasp.org/www-project-zap/
7. ACUNETIX: https://www.acunetix.com/

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO 1 | | √ | | | √ | √ | | | √ | | √ | | √ | |
| CO 2 | √ | √ | √ | | √ | | | | √ | √ | √ | | √ | |
| CO 3 | √ | √ | | √ | | | | | | | √ | √ | √ | |
| CO 4 | √ | √ | √ | √ | | | | | | | √ | √ | | √ |
| CO 5 | | √ | √ | √ | | √ | | | | | √ | √ | | |

**MC5214**        **INTERNET PROGRAMMING LABORATORY**        **L T P C**
                                                                                    **0 0 4 2**

**Course Objectives:**
1. To implement the client side of the web application using javascript.
2. To implement the server side of the web application using Servlets and WebSockets.
3. To develop a web application using Spring.
4. To implement a Persistence layer using Hibernate and Spring Data JPA.
5. To develop a full stack single page application using React, Spring and Hibernate.

1. Create an event registration application using javascript. It should implement different widgets for registration form and registered records view using tabs. It should perform the form validation.

2. Create a javascript application in an Object Oriented way using Classes and Modules. It should also use browser storage for persistence.

3. Build a web application using Gradle. The server side of the application should implement RESTful APIs using Servlet and do necessary logging. The client side of the application should be a single page application which consumes the RESTful APIs through AJAX.

4. Build a chat application using WebSocket.

5. Create a Spring MVC application. The application should handle form validation, file upload, session tracking.

6. Implement a RESTful Spring Boot application using Spring REST, Spring Security and Spring Cache.

7. Design a complex system using JPA and Hibernate. The system should have multiple entities and relationships between the entities. The database schema should be generated through Hibernate. Provide RESTful endpoints for CRUD operations for the defined entities. Also, support pagination and searching using JPA's JPQL and Criteria API.

8. Create a Spring RESTful Application with Spring Data JPA. Support pagination and searching using Specifications.

9. Create a React application with different components and interactions between the components.

10. Develop a full-stack application using React and Spring. Make use of Spring REST, Spring Security, Spring Data JPA, Hibernate, Spring Boot, Gradle and React's higher order component.

**TOTAL : 60 PERIODS**

**Course Outcomes:**
1. To implement client and server side of the web application.
2. To implement a real time application using WebSocket.
3. To use Spring framework in web development.
4. To implement applications using Java Persistence API.
5. To implement applications using the JavaScript framework React.

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO 2 |
|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO 1 | √ | √ | √ | √ | √ | √ | √ | √ | √ | | | | √ | √ |
| CO 2 | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | | √ | √ |
| CO 3 | √ | √ | √ | √ | √ | | | | √ | | | √ | √ | √ |
| CO 4 | √ | √ | √ | √ | √ | | | | √ | | | √ | √ | √ |
| CO 5 | √ | √ | √ | √ | √ | | √ | | √ | √ | √ | √ | √ | √ |

**MC5215    ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING LABORATORY**

**L  T  P C**
**0  0  4  2**

**OBJECTIVES:**

- To familiarize with the machine learning algorithms and implement in practical situations.
- To involve the students to practice AI algorithms and techniques.
- Learn to use different algorithms for real time data sets.

**List of Experiments :**

1. Write a program to illustrate problem solving as a search.
2. Write a program to illustrate local search algorithms.
3. Write a program to demonstrate logical agents.
4. Evaluate forward chainer and rule base on at least four different databases. Try to create at least one database that demonstrates an interesting feature of the domain, or an interesting feature of forward chaining in general.
5. Demonstrate agent based on propositional logic.
6. Write a program to implement the naïve Bayesian classifier for a sample training data set. Compute the accuracy of the classifier, considering few test data sets.
7. Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set.
8. Apply EM algorithm to cluster a set of data stored in a .CSV file.
9. Write a program to implement k-Nearest Neighbor algorithm to classify the data set.
10. Apply the technique of pruning for a noisy data monk2 data, and derive the decision tree from this data.  Analyze the results by comparing the structure of pruned and unpruned tree.
11. Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets
12. Implement Support Vector Classification for linear kernel.
13. Implement Logistic Regression to classify the problems such as spam detection. Diabetes predictions so on.

**Total: 60 Periods**

**OUTCOMES:**

- Apply the techniques of Problem Solving in Artificial Intelligence.
- Implement Knowledge and Reasoning for real world problems.
- Model  the various Learning features of Artificial Intelligence
- Analyze  the working model and  features of Decision tree
- Apply k-nearest algorithm for appropriate research problem.

| COs/POs & PSOs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mapping of COs with POs and PSOs** | | | | | | | | | | | | | | |
| CO1 | √ | √ | √ | √ | √ | √ | | | | | | | | |
| CO2 | √ | √ | √ | √ | √ | | | | | | | | √ | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO3 | √ | √ | √ | √ | | | | | | | | | √ | |
| CO4 | √ | √ | √ | √ | | | | | | | | | √ | √ |
| CO5 | √ | √ | √ | √ | | | | | | | | | √ | √ |

**MC5216**        **COMMUNICATION SKILLS ENHANCEMENT II**      **L T P C**
                                                             **0 0 2 1**

**OBJECTIVES:**
- To provide opportunities to learners to practice their communication skills to make them become proficient users of English.
- To enable learners to fine-tune their linguistic skills (LSRW) with the help of Technology to communicate globally.
- To enhance the performance of learners at placement interviews and group discussions and other recruitment procedures

1. **SOFT SKILLS**
   - People skills
   - Interpersonal skills
   - Team building skills
   - Leadership skills
   - Problem solving skills

2. **PRESENTATION SKILLS**
   - Preparing slides with animation related to the topic
   - Introducing oneself to the audience
   - Introducing the topic
   - Presenting the visuals effectively – 5 minute presentation

3. **GROUP DISCUSSION SKILLS**
   - Participating in group discussions
   - Brainstorming the topic
   - Activities to improve GD skills.

4. **INTERVIEW SKILLS**
   - Interview etiquette – dress code – body language
   - Attending job interviews
   - Answering questions confidently
   - Technical interview – telephone/Skype interview
   - Emotional and cultural intelligence
   - Stress Interview

                                              **TOTAL:  30 PERIODS**

**REFERENCES / MANUALS / SOFTWARE**: Open Sources / websites
**OUTCOMES:**
**Upon Completion of the course, the students will be able to:**
- Students will be able to make presentations and participate in Group discussions withconfidence.
- Students will be able to perform well in theinterviews.

- Students will make effective presentations.

| COs/POs & PSOs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mapping of COs with POs and PSOs** | | | | | | | | | | | | | | |
| CO1 | | | | | | | | | √ | √ | | | | |
| CO2 | | | | | | | | | √ | √ | | | | |
| CO3 | | | | | | | | | √ | √ | | | | |
| CO4 | | | | | | | | | | √ | | | | |
| CO5 | | | | | | | | | | √ | | | | |

**MC5306**                                   **DATA SCIENCE**                              **L  T  P  C**
                                                                                          **3  0  0 3**

**OBJECTIVES:**
- To know the fundamental concepts of data science and analytics.
- To learn fundamental data analysis using R.
- To understand various data modeling techniques.
- To learn the basic and advanced features of open source big data tools and frameworks.
- To study various analytics on stream data.

**UNIT I          INTRODUCTION TO DATA SCIENCE AND BIG DATA          9**
Introduction to Data Science – Data Science Process – Exploratory Data analysis – Big data: Definition, Risks of Big Data, Structure of Big Data – Web Data: The Original Big Data – Evolution Of Analytic Scalability – Analytic Processes and Tools – Analysis versus Reporting – Core Analytics versus Advanced Analytics– Modern Data Analytic Tools – Statistical Concepts: Sampling Distributions – Re-Sampling – Statistical Inference – Introduction to Data Visualization.

**UNIT II          DATA ANALYSIS USING R          9**
Univariate Analysis: Frequency, Mean, Median, Mode, Variance, Standard Deviation, Skewness and Kurtosis – Bivariate Analysis: Correlation – Regression Modeling: Linear and Logistic Regression – Multivariate Analysis – Graphical representation of Univariate, Bivariate and Multivariate Analysis in R: Bar Plot, Histogram, Box Plot, Line Plot, Scatter Plot, Lattice Plot, Regression Line, Two-Way cross Tabulation.

**UNIT III          DATA MODELING          9**
Bayesian Modeling – Support Vector and Kernel Methods – Neuro – Fuzzy Modeling – Principal Component Analysis – Introduction to NoSQL: CAP Theorem, MongoDB: RDBMS VsMongoDB, Mongo DB Database Model, Data Types and Sharding – Data Modeling in HBase: Defining Schema – CRUD Operations

**UNIT IV          DATA ANALYTICAL FRAMEWORKS          10**
Introduction to Hadoop: Hadoop Overview – RDBMS versus Hadoop – HDFS (Hadoop Distributed File System): Components and Block Replication – Introduction to MapReduce –

Running Algorithms Using MapReduce – Introduction to HBase: HBase Architecture, HLog and HFile, Data Replication – Introduction to Hive, Spark and Apache Sqoop.

**UNIT V          STREAM ANALYTICS                                                8**
Introduction To Streams Concepts – Stream Data Model and Architecture – Stream Computing – Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating Moments – Counting Oneness in a Window – Decaying Window.

**TOTAL: 45 PERIODS**

**OUTCOMES:**
On completion of the course, the students will be able to:
1. Convert real world problems to hypothesis and perform statistical testing.
2. Perform data analysis using R.
3. Design efficient modeling of very large data and work with big data platforms..
4. Implement suitable data analysis for stream data.
5. Write efficient MapReduce programs for small problem solving methods.

**REFERENCES:**
1. Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", John Wiley & sons, First Edition,2013.
2. Umesh R Hodeghatta, UmeshaNayak, "Business Analytics Using R – A Practical Approach", Apress, First Edition,2017.
3. J. Leskowec, AnandRajaraman, Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, Second Edition,2014.
4. NishantGarg, "HBase Essentials", Packt, First Edition, 2014.
5. Rachel Schutt, Cathy O'Neil, "Doing Data Science", O'Reilly, First Edition,2013
6. Foster Provost, Tom Fawcet, "Data Science for Business", O'Reilly, First Edition,2013.
7. Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications", Wiley, First Edition,2014.
8. https://www3.cs.stonybrook.edu/~skiena/519/

| COs/POs & PSOs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mapping of COs with POs and PSOs** | | | | | | | | | | | | | | |
| CO1 | √ | √ | √ | √ | √ | | | | √ | √ | | | √ | √ |
| CO2 | √ | √ | √ | √ | √ | | | | √ | √ | | | √ | √ |
| CO3 | √ | √ | √ | √ | √ | | | | √ | √ | | | √ | √ |
| CO4 | √ | √ | √ | √ | √ | | | | √ | √ | | | √ | √ |
| CO5 | √ | √ | √ | √ | √ | | | | √ | √ | | | √ | √ |

**MC5307          EMBEDDED SYSTEMS AND INTERNET OF THINGS          L  T  P  C**
**                                                                3  0  0  3**

**OBJECTIVES:**
- To learn the internal architecture and programming of an embedded processor.

- To introduce interfacing I/O devices to the processor and to run, debug programs in an IDE.
- To build a small low cost embedded system using Open Hardware Platforms.
- To apply the concept of Internet of Things in real world scenario.
- To deploy IoT application and connect to the cloud.

## UNIT I    EMBEDDED CONTROLLER                                    9
Microcontrollers and Embedded Processors, Introduction to 8051, PSW and Flag Bits, 8051 Register Banks and Stack, Internal Memory Organization of 8051, IO Port Usage in 8051, Types of Special Function Registers and their uses in 8051, Pins Of 8051. Memory Address Decoding, 8031/51 Interfacing With External ROM And RAM. 8051 Addressing Modes.

## UNIT II    EMBEDDED C PROGRAMMING                                9
Memory and I/O Devices Interfacing – Programming Embedded Systems in C – Need for RTOS – Multiple Tasks and Processes – Context Switching – Priority Based Scheduling Policies.

## UNIT III    FUNDAMENTALS OF IOT                                  9
Introduction and Characteristics – Physical and Logical Design – IoT Protocols: Link Layer Protocols, Network Layer Protocols, Transport Layer and Application Layer Protocols – IoT Levels – IoT versus M2M – Sensors and Actuators – Power Sources.

## UNIT IV    BUILDING IOT                                          9
Open Hardware Platforms: Interfaces, Programming, APIs and Hacks – Web Services – Integration of Sensors and Actuators with Arduino/ Raspberry Pi/ Other Light Weight Boards.

## UNIT V    APPLICATIONS                                           9
Complete Design of Embedded Systems – Smart Cities: Smart Parking, Smart Traffic Control, Surveillance – Home Automation: Smart Appliances, Intrusion Detection, Smoke/Gas Detectors – Cloud Storage and Communication APIs: WAMP, Xively, Django – Data and Analytics for IoT.

**TOTAL: 45 PERIODS**

**OUTCOMES:**
On completion of the course, the students will be able to:
- Analyze architecture of embedded processors and micro controllers.
- Design and deploy timers and interrupts.
- Design and develop the prototype of embedded and IoTsystems.
- Design portable IoT using Arduino/Raspberry Pi /equivalent boards.
- Analyze and develop applications of IoT in real time scenario.

**REFERENCES:**
1. Wayne Wolf, "Computers as Components: Principles of Embedded Computer System Design", Elsevier, First Edition, 2006.
2. Muhammad Ali Mazidi, Janice GillispieMazidi, Rolin D. McKinlay, "The 8051 Microcontroller and Embedded Systems", Pearson Education, Second Edition, 2007.
3. ArshdeepBahga, Vijay Madisetti, "Internet of Things: A Hands-on-Approach**",** VPT First Edition, 2014.

4. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton, Jerome Henry, "IoT Fundamentals, Networking Technologies, Protocols, and Use cases for the Internet of Thing", Cisco Press, First Edition,2017.

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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| CO 1 |     | √   | √   | √   | √   |     |     |     | √   |      |      | √    | √    |      |
| CO 2 |     | √   | √   |     | √   |     |     |     |     |      | √    | √    | √    |      |
| CO 3 | √   | √   | √   |     |     |     |     |     |     |      |      |      | √    | √    |
| CO 4 | √   | √   | √   |     |     | √   |     |     |     |      |      |      | √    |      |
| CO 5 | √   | √   | √   | √   |     |     |     |     | √   |      | √    |      | √    |      |

**MC5308    ACCOUNTING AND FINANCIAL MANAGEMENT FOR APPLICATION DEVELOPMENT**

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

**OBJECTIVES:**
- To understand the basic principles of Double entry system and preparation of balance sheet.
- To understand partnership accounts
- To understand the process of estimating the depreciation of a particular asset.
- To understand single entry accounting

**UNIT I        INTRODUCTION TO ACCOUNTING        9**
Meaning and scope of Accounting, Basic Accounting Concepts and Conventions – Objectives of Accounting – Accounting Transactions – Double Entry Book Keeping – Journal, Ledger, Preparation of Trial Balance – Preparation of Cash Book.

**UNIT II        FINAL ACCOUNTS        9**
Preparation of Final Accounts of a Sole Trading Concern – Adjustments Receipts and Payments Account, Income & Expenditure Account and Balance Sheet of Non Trading Organizations

**UNIT III        PARTNERSHIP ACCOUNTS        9**
Partnership Accounts-Final accounts of partnership firms – Basic concepts of admission, retirement and death of a partner including treatment of goodwill - rearrangement of capitals. (Simple problems on Partnership Accounts).

**UNIT IV        DEPRECIATION        9**
Depreciation – Meaning, Causes, Types – Straight Line Method – Written Down Value Method, Insurance Policy Method, Sinking Fund Method & Annuity Method. Insurance claims – Average Clause (Loss of stock & Loss of Profit)

## UNIT V        SINGLE ENTRY ACCOUNTING                                    9

Single Entry – Meaning, Features, Defects, Differences between Single Entry and Double Entry System – Statement of Affairs Method – Conversion Method

**TOTAL: 45 PERIODS**

**OUTCOMES:**
- Able to understand the basics of accounting
- Able to understand  balance sheet preparation and do analysis
- Able to understand the partnership accounts
- Able to appreciate and depreciate the assets of an organization in accounting
- Able to understand Single Entry Accounting

**REFERENCES:**
1. R.L.Gupta & V.K.Gupta,Advanced Accounting - Sultan Chand& Sons - New Delhi. Fourteenth Revised and Enlarged Edition,2019
2. Jain &Narang, Financial Accounting - Kalyani Publishers - New Delhi, Twelfth edition - 2014
3. T.S. Reddy & A.Murthy, Financial Accounting - Margham Publications –Chennai-17. 6thEdition,2012
4. Shukla&Grewal, Advanced Accounting – S Chand - New Delhi,19thEdition,2017
5. Nirmal Gupta, Financial Accounting-Ane Books India – New Delhi.Fifth Edition,2012

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO 1 |  |  |  | √ |  |  |  |  |  | √ | √ | √ |  |  |
| CO 2 |  |  |  | √ |  |  |  |  |  | √ | √ | √ |  |  |
| CO 3 |  |  |  | √ |  |  |  |  |  | √ | √ | √ |  |  |
| CO 4 |  |  |  | √ |  |  |  |  |  | √ | √ | √ |  |  |
| CO 5 |  |  |  | √ |  |  |  |  |  | √ | √ | √ |  |  |

**MC5314**            **DATA SCIENCE LABORATORY**        **L  T  P  C**
                                                         **0  0  4  2**

**OBJECTIVES:**
- To provide hands-on cloud and data analytics frameworks and tools.
- To use the Python/R packages for performing analytics.
- To learn using analytical tools for real world problems.
- To familiarize the usage of distributed frameworks for handling voluminous data.
- To write and deploy analytical algorithms as MapReduce tasks.

**EXPERIMENTS:**

Do the following experiments using R/Python:

**1.** Download, install and explore the features of R/Python for data analytics.

2. Use the Diabetes data set from UCI and Pima Indians Diabetes data set forperforming the following:

a.  Univariate  Analysis:  Frequency,  Mean,  Median,  Mode,  Variance, StandardDeviation, Skewness and Kurtosis.

b. Bivariate Analysis: Linear and logistic regression modeling.

c. Multiple Regression Analysis

d. Also compare the results of the above analysis for the two data sets.

3. Apply Bayesian and SVM techniques on Iris and Diabetes data set.

4. Apply and explore various plotting functions on UCI data sets.

Implement the following using Hadoop, Map Reduce, HDFS, Hive:

1. Perform setting up and Installing Hadoop in its two operating modes: pseudo-distributed and fully distributed.

2. Implement the following file management tasks in Hadoop: adding files anddirectories, Retrieving files and Deleting files

3.

(i) Performing a MapReduce Job for word search count (look for specific keywords ina file)

(ii) Implement stop word elimination problem: Input a large textual file containing onesentence per line and a small file containing a set of stop words (one stop word perline) and save the results in an output textual file containing the same sentences ofthe large input file without the words appearing in the small file.

4. Implement a MapReduce program that processes a weather data set to:

(i) Find average, max and min temperature for each year in National Climate DataCentre data set.

(ii) Filter the readings of a set based on value of the measurement. The programmust save the line of input files associated with a temperature value greater than30.0 and store it in a separate file.

5. Install, deploy & configure Apache Spark cluster. Run Apache Spark applicationsusing Scala.

6. Install and run Hive then use Hive to create, alter, and drop databases, tables, views,functions, and indexes.

7. Mini projects on the following:

(i) Simulate a simple recommender system with Amazon product dataset, Socialtweet data set etc. on Hadoop.

(ii) Perform a very large text classification run on Hadoop.

**TOTAL: 60 PERIODS**

**OUTCOMES:**

On completion of the course, the students will be able to:

1. Install analytical tools and configure distributed file system.
2. Have skills in developing and executing analytical procedures in various distributedframeworks and databases.
3. Develop, implement and deploy simple applications on very large datasets.
4. Implement simple to complex data modeling in NoSQL databases.
5. Develop and deploy simple applications in cloud.

**MC5315**        **INTERNET OF THINGS LABORATORY**      **L T P C**
                                                           **0 0 4 2**

**OBJECTIVES:**

● To learn tools relevant to embedded system and IoT development.

- To write simple assembly programs that uses various features of the processor.
- To design and develop IoT application Arduino/Raspberry pi for real world scenario.

**EXPERIMENTS:**
**PART I:**
1. Implement assembly and Interfacing Programs Using Embedded C.
2. Embedded Application Development
    (i) Using Arduino and Raspberry Pi
    (ii) Using Bluemix platform
3. IoT Application Development
    (i) Using sensors and actuators (temperature sensor, light sensor, infraredsensor)
    (ii) Interfacing sensors with Arduino/Raspberry Pi/other equivalent boards
    (iii) Reading data from sensors
4. Explore different communication methods with IoT devices.
5. Collecting and processing data from IoT systems in the cloud using XivelyPaaS.
6. Develop IoT applications using Django Framework and Firebase/ Bluemix platform.

**TOTAL: 60 PERIODS**

**OUTCOMES:**
On completion of the course, the students will be able to:
1. Write and implement simple assembly programs that use various features of theprocessor.
2. Test and experiment different sensors for application development Arduino/Raspberry Pi/ Equivalent boards.
3. Develop IOT applications with different platform and frameworks.


| MC5003 | SOFTWARE PROJECT MANAGEMENT | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES:**
- To know of how to do project planning for the software process.
- To learn the cost estimation techniques during the analysis of the project.
- To understand the quality concepts for ensuring the functionality of the software

**UNIT I        SOFTWARE PROJECT MANAGEMENT CONCEPTS        9**
Introduction to Software Project Management: An Overview of Project Planning: Select Project, Identifying Project scope and objectives, infrastructure, project products and Characteristics. Estimate efforts, Identify activity risks, and allocate resources- TQM, Six Sigma, Software Quality: defining software quality, ISO9126, External Standards.

**UNIT II        SOFTWARE EVALUATION AND COSTING        9**
Project Evaluation: Strategic Assessment, Technical Assessment, cost-benefit analysis, Cash flow forecasting, cost-benefit evaluation techniques, Risk Evaluation. Selection of Appropriate Project approach: Choosing technologies, choice of process models, structured methods.

**UNIT III        SOFTWARE ESTIMATION TECHNIQUES        9**
Software Effort Estimation: Problems with over and under estimations, Basis of software

Estimation, Software estimation techniques, expert Judgment, Estimating by analogy. Activity Planning: Project schedules, projects and activities, sequencing and scheduling Activities, networks planning models, formulating a network model.

**UNIT IV          RISK MANAGEMENT                                                    9**
Risk Management: Nature of Risk, Managing Risk, Risk Identification and Analysis, Reducing the Risk. Resource Allocation: Scheduling resources, Critical Paths, Cost scheduling, Monitoring and Control: Creating Framework, cost monitoring, prioritizing monitoring.

**UNIT V          GLOBALIZATION ISSUES IN PROJECT MANAGEMENT          9**
Globalization issues in project management: Evolution of globalization- challenges in building global teams-models for the execution of some effective management techniques for managing global teams. Impact of the internet on project management: Introduction – the effect of internet on project management – managing projects for the internet – effect on project management activities.  Comparison of project management software's: dot Project, Launch pad, openProj. Case study: PRINCE2.

**TOTAL :    45    PERIODS**

**OUTCOMES:**
- Understand the activities during the project scheduling of any software application.
- Learn the risk management activities and the resource allocation for the projects.
- Can apply the software estimation and recent quality standards for evaluation of the software projects
- Acquire knowledge and skills needed for the construction of highly reliable software project
- Able to create reliable, replicable cost estimation that links to the requirements of project planning and managing.

**REFERENCES:**
1. Bob Hughes & Mike Cotterell, "Software Project Management", Tata McGraw- Hill Publications, Fifth Edition 2012
2. Futrell , "Quality Software Project Management", Pearson Education India, 2008
3. Gobalswamy Ramesh, "Managing Global Software Projects", Tata McGraw Hill Publishing Company, 2003
4. Richard H.Thayer "Software Engineering Project Management", IEEE Computer Society
5. S. A. Kelkar," Software Project Management" PHI, New Delhi, Third Edition ,2013
6. http://en.wikipedia.org/wiki/Comparison_of_project_management_software
7. http://www.ogc.gov.uk/methods_prince_2.asp

**MC5016                          AGILE METHODOLOGIES                    L  T  P  C**
**                                                                          3  0 0 3**
**OBJECTIVES:**
- To provide students with a theoretical as well as practical understanding of agile software development practices and how small teams can apply them to create high-quality software.

- To provide a good understanding of software design and a set of software technologies and APIs.
- To do a detailed examination and demonstration of Agile development and testing techniques.
- To understand the benefits and pitfalls of working in an Agile team.
- To understand Agile development and testing

**UNIT I          AGILE METHODOLOGY                                                    9**

Theories for Agile Management – Agile Software Development – Traditional Model vs. Agile Model - Classification of Agile Methods – Agile Manifesto and Principles – Agile Project Management – Agile Team Interactions – Ethics in Agile Teams - Agility in Design, Testing – Agile Documentations – Agile Drivers, Capabilities and Values

**UNIT II         AGILE PROCESSES                                                       9**

Lean Production - SCRUM, Crystal, Feature Driven Development- Adaptive Software Development - Extreme Programming: Method Overview – Lifecycle – Work Products, Roles and Practices

**UNIT III        AGILITY AND KNOWLEDGE MANAGEMENT                       9**

Agile Information Systems – Agile Decision Making – Earl's Schools of KM – Institutional Knowledge Evolution Cycle – Development, Acquisition, Refinement, Distribution, Deployment, Leveraging – KM in Software Engineering – Managing Software Knowledge – Challenges of Migrating to Agile Methodologies – Agile Knowledge Sharing – Role of Story-Cards – Story-Card Maturity Model (SMM)

**UNIT IV        AGILITY AND REQUIREMENTS ENGINEERING                9**

Impact of Agile Processes in RE–Current Agile Practices – Variance – Overview of RE Using Agile – Managing Unstable Requirements – Requirements Elicitation – Agile Requirements Abstraction Model – Requirements Management in Agile Environment, Agile Requirements Prioritization – Agile Requirements Modeling and Generation – Concurrency in Agile Requirements Generation

**UNIT V         AGILITY AND QUALITY ASSURANCE                             9**

Agile Product Development – Agile Metrics – Feature Driven Development (FDD) – Financial and Production Metrics in FDD – Agile Approach to Quality Assurance - Test Driven Development – Agile Approach in Global Software Development - Agile Scrum - Scrum Master – Scaling Projects using Scrum

**TOTAL: 45 PERIODS**

**OUTCOMES:**
- Realize the importance of interacting with business stakeholders in determining the requirements for a software system
- Perform iterative software development processes: how to plan them, how to execute them.
- Point out the impact of social aspects on software development success.
- Develop techniques and tools for improving team collaboration and software quality.
- Show how agile approaches can be scaled up to the enterprise level

**REFERENCES**
1. David J. Anderson and Eli Schragenheim,, "Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results", Illustrated Edition, Prentice Hall PTR, 2004
2. Orit Hazza and Yaepl Dubinsky, "Agile Software Engineering,: Undergraduate Topics in Computer Science, Springer Verlag, First Edition,2009
3. Craig Larman, "Agile and Iterative Development: A Manager's Guide", Pearson Education, Second Impression, 2007
4. Kevin C. Desouza, "Agile Information Systems: Conceptualization, Construction, and Management", Elsevier, Butterworth-Heinemann, First Edition,2007
5. Ken Schwaber, "Agile Project Management with Scrum", Illustrated, Revised Edition Microsoft Press, 2004
6. KonnorCluster, "Agile Project Management: Learn How To Manage a Project With Agile Methods, Scrum, Kanban and Extreme Programming", Independently Published,First Edition,2019

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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| CO 1 |     | √   | √   | √   | √   |     |     |     |     | √    | √    |      | √    |      |
| CO 2 | √   | √   |     | √   | √   |     |     |     | √   |      | √    |      | √    |      |
| CO 3 |     | √   |     |     |     | √   | √   | √   |     |      |      |      |      | √    |
| CO 4 |     |     |     | √   | √   |     |     |     | √   | √    |      |      |      | √    |
| CO 5 | √   |     |     | √   |     | √   | √   |     | √   | √    |      | √    |      | √    |

**MC5017**                               **E- LEARNING**                        **L T P C**
                                                                             **3 0 0 3**

**OBJECTIVES:**
- To learn the various E-learning approaches and Components.
- To explore Design Thinking.
- To understand the types of design models of E-learning.
- To learn about E-learning Authoring tools.
- To know about evaluation and management of E-learning solutions

**UNIT I        INTRODUCTION                                                      9**
Need for E-Learning – Approaches of E-Learning – Components of E-Learning – synchronous and Asynchronous Modes of Learning – Quality of E-Learning – Blended Learning: Activities, Team and Technology – Work Flow to Produce and Deliver E-Learning Content – Design Thinking: Introduction – Actionable Strategy – Act to Learn – Leading Teams to Win.

**UNIT II       DESIGNING E-LEARNINGCOURSECONTENT                                 9**
Design Models of E-Learning – Identifying and Organizing E-Learning Course Content: Needs Analysis – Analyzing the Target Audience – Identifying Course Content – Defining Learning Objectives – Defining the Course Sequence – Defining Instructional Methods – Defining Evaluation and Delivery Strategies – Case Study.

**UNIT III          CREATINGINTERACTIVECONTENT                    9**
Preparing Content: Tips for Content Development and Language Style – Creating Storyboards: Structure of an Interactive E-Lesson – Techniques for Presenting Content – Adding Examples – Integrating Multimedia Elements – Adding Examples – Developing PracticeandAssessmentTests–AddingAdditionalResources–CoursewareDevelopment Authoring Tools – Types of Authoring Tools – Selecting an AuthoringTool.

**UNIT IV       LEARNINGPLATFORMS                                  9**
Types of Learning Platforms – Proprietary Vs. Open – Source LMS – LMS Vs LCMS – Internally Handled and Hosted LMS – LMS Solutions – Functional Areas of LMS.

**UNIT V       COURSE DELIVERYAND EVALUATION                       9**
Components of an Instructor-Led or Facilitated Course – Planning and Documenting Activities – Facilitating Learners Activities – E-Learning Methods and Delivery Formats – Using Communication Tools for E-Learning – Course Evaluation.

**TOTAL: 45 PERIODS**

**OUTCOMES:On completion of course, the students will be able to:**
- Distinguish the phases of activities in models of E-learning.
- Identify appropriate instructional methods and delivery strategies.
- Choose appropriate E-learning Authoring tools.
- Create interactive E-learning courseware.
- Evaluate the E-learning courseware.

**REFERENCE BOOKS:**
1. Clark, R. C., Mayer, R. E., "E-Learning and the Science of Instruction". Third Edition, 2011.
2. Crews, T. B., Sheth, S. N., Horne, T. M., "Understanding the Learning Personalities of Successful Online Students", 1st Edition, Educause Review, 2014.
3. Johnny Schneider, "Understanding DesignThinking, Lean and Agile", 1st Edition, O'Reilly Media,2017.
4. MadhuriDubey, "Effective E–learning Design, Development and Delivery", 1st Edition, University Press, 2011.

| Mapping of COs with POs and PSOs | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COs/POs & PSOs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | 1 | 2 | 2 | 3 | | | | | | | | | | |
| CO2 | 1 | 3 | 3 | 2 | 1 | | | | | | | | 1 | |
| CO3 | 1 | 2 | 3 | 2 | | | | | | | | | 1 | |
| CO4 | 1 | 3 | 1 | 1 | | | | | | | | | 1 | |
| CO5 | 1 | 3 | 1 | | | | | | | | | | 1 | |

1 – Slight, 2 – Moderate,    3 – Substantial.

**MC5018**                    **SOFTWARE QUALITY AND TESTING**                    **L T P C**
                                                                                              **3 0 0 3**

**OBJECTIVES:**
- To know the behavior of the testing techniques and to design test cases to detect the errors in the software
- To get insight into software testing methodologies
- To understand standard emerging areas in testing
- To learn about the software quality models.
- To understand the models and metrics of software quality and reliability.

**UNIT I          INTRODUCTION                                                               9**
Basic concepts and Preliminaries – Theory of Program Testing– Unit Testing – Control Flow Testing –Data Flow Testing– System Integration Testing

**UNIT II          SOFTWARETESTINGMETHODOLOGY                                   9**
Software Test Plan–Components of Plan - Types of Technical Reviews - Static and Dynamic Testing- – Software Testing in Spiral Manner - Information Gathering - Test Planning - Test Coverage - Test Evaluation -Prepare for Next Spiral - Conduct System Test - Acceptance Test – Summarize Testing Results.

**UNIT III          EMERGING SPECIALIZED AREAS IN TESTING                    9**
Test Process Assessment – Test Automation Assessment - Test Automation Framework – Nonfunctional Testing – SOA Testing – Agile Testing – Testing Center of Excellence – Onsite/Offshore Model - Modern Software Testing Tools – Software Testing Trends – Methodology to Develop Software Testing Tools.

**UNIT IV   SOFTWARE QUALITY MODELS                                             9**
Software quality –Verification versus Validation– Components of Quality Assurance – SQA Plan – Quality Standards – CMM – PCMM – CMMI – Malcolm Baldrige National Quality Award.

**UNIT V          QUALITY THROUGH CONTINUOUS IMPROVEMENT PROCESS          9**
Role of Statistical Methods in Software Quality – Transforming Requirements intoTest Cases – Deming's Quality Principles – Continuous Improvement through Plan Do Check Act (PDCA)

                                                                            **TOTAL: 45 PERIODS**

**OUTCOMES:**
Up on completion of the course the students will be able to
- choose the software testing techniques to cater to the need of the project
- identify the components of software quality assurance systems
- apply various software testing strategies
- design and develop software quality models
- make use of statistical methods in software quality.

**REFERENCE BOOKS:**
1. William E.Lewis, "Software Testing and Continuous Quality Improvement", 3rdEdition, Auerbach Publications, 2011
2. KshirasagarNaik and PriyadarshiTripathy, "Software Testing and Quality Assurance Theory and Practice", 2nd Edition, John Wiley & Sons Publication, 2011
3. Ron Patton, "Software Testing", 2nd Edition, Pearson Education, 2007

4. Glenford J. Myers, Tom Badgett, Corey Sandler, "The Art of Software Testing", 3rd Edition, John Wiley & Sons Publication, 2012.
5. Paul C. Jorgensen, "Software Testing, A Craftman'sApproach", CRC Press Taylor & Francis Group, Fourth Edition, 2018

| COs/POs & PSOs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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| CO3 | | | | √ | √ | | | | | | | | | |
| CO4 | | | √ | | √ | | | | | | | | | |
| CO5 | √ | √ | √ | √ | √ | | | | | | | | 1 | |

**Mapping of COs with POs and PSOs**

**MC5019**  **ADVANCES IN OPERATING SYSTEMS**  **L T P C**
**3 0 0 3**

**OBJECTIVES**:
● To learn the fundamentals of Operating Systems
● To gain knowledge on Distributed operating system concepts that includes architecture, Mutual exclusion algorithms, Deadlock detection algorithms and agreement protocols
● To gain insight on to the distributed resource management components viz. the algorithms for implementation of distributed shared memory, recovery and commit protocols
● To know the components and management aspects of Real time, Mobile operating systems

**UNIT I**  **FUNDAMENTALS OF OPERATING SYSTEMS**  **9**
Overview – Synchronization Mechanisms – Processes and Threads - Process Scheduling – Deadlocks: Detection, Prevention and Recovery – Models of Resources – Memory Management Techniques.

**UNIT II**  **DISTRIBUTED OPERATING SYSTEMS**  **9**
Issues in Distributed Operating System – Architecture – Communication Primitives – Lamport's Logical clocks – Causal Ordering of Messages – Distributed Mutual Exclusion Algorithms – Centralized and Distributed Deadlock Detection Algorithms – Agreement Protocols

**UNIT III**  **DISTRIBUTED RESOURCE MANAGEMENT**  **9**
Distributed File Systems – Design Issues - Distributed Shared Memory – Algorithms for Implementing Distributed Shared memory–Issues in Load Distributing – Scheduling Algorithms – Synchronous and Asynchronous Check Pointing and Recovery – Fault

Tolerance – Two-Phase Commit Protocol – Nonblocking Commit Protocol – Security and Protection

**UNIT IV        REAL TIME AND MOBILE OPERATING SYSTEMS                9**

Basic Model of Real Time Systems  - Characteristics- Applications of Real Time Systems – Real Time Task Scheduling  - Handling Resource Sharing  - Mobile Operating Systems – Micro Kernel Design  - Client Server Resource Access – Processes and Threads  - Memory Management - File system.

**UNIT V        CASE STUDIES                                              9**

Linux System: Design Principles - Kernel Modules - Process Management Scheduling - Memory Management - Input-Output Management - File System – Interprocess Communication. iOS and Android: Architecture and SDK Framework - Media Layer - Services Layer - Core OS Layer - File System.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

Upon Completion of the course, the students should be able to:
- Discuss the various synchronization, scheduling and memory management issues
- Demonstrate the Mutual exclusion, Deadlock detection and agreement protocols of Distributed operating system
- Discuss the various resource management techniques for distributed systems
- Identify the different features of real time and mobile operating systems
- Install and use available open source kernel

**REFERENCES:**

1. Abraham Silberschatz; Peter Baer Galvin; Greg Gagne, "Operating System Concepts- Essentials", ninth Edition, John Wiley & Sons, 2013.
2. MukeshSinghal, NiranjanG. Shivaratri, "Advanced Concepts in Operating Systems – Distributed, Database, and Multiprocessor Operating Systems", Tata McGraw-Hill,First Edition, 1994.
3. Love Robert," Linux Kernel Development", Pearson Education India, Third Edition, 2018.
4. Neil Smyth, "iPhoneiOS 4 Development Essentials – Xcode", Fourth Edition, Payload media, 2011.
5. Rajib Mall, "Real-Time Systems: Theory and Practice", Pearson Education India, First Edition2006.
6. Daniel P Bovet and Marco Cesati, "Understanding the Linux kernel", 3rd edition, O'Reilly, 2005.

| Mapping of COs with POs and PSOs | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COs/POs & PSOs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | | √ | | √ | | √ | | | | | | √ | | |
| CO2 | | | √ | √ | | | | | | | | √ | | |
| CO3 | | | | √ | √ | | | | | | | √ | | |
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| CO5 | √ | √ | √ | √ | √ | | | | | √ | √ | √ | √ |

**MC5020**             **DIGITAL IMAGE PROCESSING**         **L   T   P   C**
                                                           **3   0   0   3**

**OBJECTIVES:**
- Learn digital image fundamentals.
- Be exposed to simple image processing techniques.
- Learn to represent image enhancement in the spatial and frequency domain..
- Be familiar with image restoration and segmentation techniques.

**UNIT  I        DIGITAL IMAGE FUNDAMENTALS                    9**
Elements of visual perception, Electromagnetic Spectrum-overview, Image Sensing and Image Acquisition Systems, Sampling and Quantization, Image Formation, Image Geometry, Relationship between pixels, Basic concepts of distance transform, Color Image fundamentals-RGB-HIS Models, Different color models-conversion

**UNIT  II       IMAGE TRANSFORMS                              9**
Unitary Image Transforms-1D Discrete Fourier Transform (DFT),Properties of DFT, 2D transforms – 2D DFT, Discrete Cosine Transform, Hadamard, Walsh and PCA.

**UNIT III      IMAGE ENHANCEMENT                             9**
Spatial Domain: Gray Level transformations, contrast stretching operation, Histogram Equalization and Specifications, Basics of Spatial Filtering-smoothing and sharpening spatial filters.  Frequency domain: smoothing and sharpening frequency domain filters,   Ideal, Butterworth and Gaussian filters.

**UNIT IV       IMAGE RESTORATION                             9**
Degradation Models-continuous and discrete form, Estimation of degradation models: Observation, Experimentation, Mathematical Modeling of Noise models, Restoration Techniques: Inverse Filtering, Minimum Mean Square (Wiener) filtering, Constrained Least Square Filter and Adaptive filters.

**UNIT V        MORPHOLOGICAL IMAGE PROCESSING AND SEGMENTATION      9**
Basic Morphological operators-erosion, dilation, opening and closing-Basic Morphological Reconstruction Algorithms. Segmentation: point, line, edge detection, Region based segmentation, Region Splitting and Merging Technique, Thresholding Techniques, Applications of image processing.

                                                           **TOTAL: 45 PERIODS**
**OUTCOMES:**
Up on completion of the course, the students will be able to
- Learn  how images are formed, sampled, quantized and represented digitally
- Understand and analyze  the different image transform techniques
- Understand how the images are enhanced to improve subjective perception to spatial domain and frequency domain.
- Apply image restoration techniques

- Analyze the fundamental concepts of Morphological Image Processing and Segmentation techniques.

**REFERENCES:**

1. Rafael C.Gonzalez and Richard E.Woods, "Digital Image Processing", 4<sup>th</sup> Edition, Pearson Education, New Delhi, 2018
2. Jain Anil K.,"Fundamentals of Digital Image Processing", 1<sup>st</sup> Edition, Prentice Hall of India, New Delhi, 2002.
3. Kenneth R.Castleman, "Digital Image Processing", 1<sup>st</sup> Edition, Prentice Hall of India, New Delhi, 2006.
4. John C.Russ, "The Image Processing Handbook", 5thEdition, Prentice Hall, New Jersey, 2002.
5. Willliam K Pratt, "Digital Image Processing", 3<sup>rd</sup> Edition, John Willey,2002.
6. Malay K. Pakhira, "Digital Image Processing and Pattern Recognition", First Edition, PHI Learning Pvt. Ltd., 2011.

| **Mapping of COs with POs and PSOs** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COs/POs & PSOs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | 2 | 1 | | | | | | | | | | | | |
| CO2 | 1 | 3 | | | | | | | | | | | | |
| CO3 | 1 | 1 | | | | | | | | | | | | |
| CO4 | | | 2 | 1 | | | | | | | | | | |
| CO5 | 1 | 3 | | | | | | | | | | | | |

**MC5021**                    **COMPILER OPTIMIZATION TECHNIQUES**            **L T P C**
                                                                             **3 0 0 3**

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

**UNIT I        INTRODUCTION                                                        9**

Language Processors - The Structure of a Compiler – The Evolution of Programming Languages - The Science of Building a Compiler – Applications of Compiler Technology Programming Language Basics - The Lexical Analyzer Generator -Parser Generator - Overview of Basic Blocks and Flow Graphs - Optimization of Basic Blocks - Principle Sources of Optimization.

**UNIT II          INSTRUCTION-LEVEL PARALLELISM                    9**
Processor Architectures – Code-Scheduling Constraints – Basic-Block Scheduling –Global Code Scheduling – Software Pipelining.

**UNIT III        OPTIMIZING FOR PARALLELISM AND LOCALITY-THEORY       9**
Basic Concepts – Matrix-Multiply: An Example - Iteration Spaces - Affine Array Indexes – Data Reuse Array data dependence Analysis.

**UNIT IV         OPTIMIZING FOR PARALLELISM AND LOCALITY APPLICATION    9**
Finding Synchronization - Free Parallelism – Synchronization between Parallel Loops – Pipelining – Locality Optimizations – Other Uses of Affine Transforms.

**UNIT V          INTERPROCEDURAL ANALYSIS                           9**
Basic Concepts – Need for Interprocedural Analysis – A Logical Representation of Data Flow – A Simple Pointer-Analysis Algorithm – Context Insensitive Interprocedural Analysis - Context - Sensitive Pointer-Analysis - Datalog Implementation by Binary Decision Diagrams.
                                                              **TOTAL: 45 PERIODS**
**OUTCOMES:**
On completion of the course the students should be able to:
- Identify the various sources of optimization
- identify the constraints and architectures of parallel execution of instructions
- identify the sources of optimization of parallel execution of instructions
- apply the process of optimization using various techniques
- Implement optimization techniques

**REFERENCES:**
1. Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, "Compilers: Principles, Techniques and Tools", Second Edition, Pearson Education, 2008.
2. Randy Allen, Ken Kennedy, "Optimizing Compilers for Modern Architectures: A Dependence-based Approach", Morgan Kaufmann Publishers, First Edition, 2002.
3. Steven S. Muchnick, "Advanced Compiler Design and Implementation", Morgan Kaufmann Publishers - Elsevier Science, India, Indian Reprint2003.

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO2 |
|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------|-------|-------|-------|------|
| CO 1 |     | √   | √   | √   |     |     |     |     |     |       |       | √     | √     |      |
| CO 2 |     | √   | √   |     |     |     |     |     |     | √     | √     | √     |       |      |
| CO 3 | √   | √   | √   |     |     |     |     |     |     |       | √     | √     |       | √    |
| CO 4 | √   | √   | √   |     |     |     |     |     |     |       | √     | √     |       |      |
| CO 5 | √   | √   | √   | √   | √   |     |     |     |     |       | √     | √     | √     |      |

**MC5022**                    **C# AND .NET PROGRAMMING**                    **L T P C**
                                                                             **3 0 0 3**

**OBJECTIVES:**
- To learn the technologies of the .NET framework.
- To cover all segments of programming in C# starting from the language basis, followed by the object oriented programming concepts.
- To update and enhance skills in writing Windows applications, ADO.NET and ASP .NET.
- To introduce advanced topics namely data connectivity, WPF, WCF and WPF with C# and .NET 4.5.
- To implement mobile applications using .Net Compact Framework.

**UNIT I        C# LANGUAGE BASICS                                        9**
.Net Architecture – Core C# – Variables – Data Types – Flow control – Objects and Types- Classes and Structs – Inheritance- Generics – Arrays and Tuples – Operators and Casts – Indexers- Assemblies – Shared Assemblies – CLR Hosting – Appdomains.

**UNIT II        C# ADVANCED FEATURES                                     9**
Delegates – Lambdas – Lambda Expressions – Events – Event Publisher – Event Listener – Strings and Regular Expressions – Generics – Collections – Memory Management and Pointers – Errors and Exceptions – Reflection.

**UNIT III        BASE CLASS LIBRARIES AND DATA MANIPULATION            9**
Diagnostics Tasks – Threads and Synchronization – Manipulating XML – SAX and DOM – Manipulating files and the Registry – Transactions – Data access with ADO.NET: Introduction, LINQ to Entities and the ADO.NET Entity Framework, Querying a Database with LINQ – Creating the ADO.NET Entity Data Model Class Library, Creating a Windows Forms Project – Data Bindings between Controls and the Entity Data Model – Dynamically Binding Query Results.

**UNIT IV        WINDOW AND WEB BASED APPLICATIONS                       9**
Window Based Applications – Core ASP.NET – ASP.NET Web Forms – Server Controls, Data Binding – ASP.NET State Management, Tracing, Caching, Error Handling, Security, Deployment, User and Custom Controls – Windows Communication Foundation (WCF) – Introduction to Web Services.

**UNIT V        .NET COMPACT FRAMEWORK                                   9**
Reflection – .Net Remoting-.Net Security – Localization – Peer-to-Peer Networking – Building P2P Applications – .Net Compact Framework – Compact Edition DataStores – Testing and Debugging – Optimizing performance – Packaging and Deployment.

                                                          **TOTAL: 45 PERIODS**
**OUTCOMES:**
Up on completion of the course, the student will be able to:
- Understand the difference between .NET and Java framework.
- Work with the basic and advanced features of C# language.
- Create applications using various data providers.
- Create web application using ASP.NET.
- Create mobile application using .NET compact framework.

**REFERENCES:**

1. Christian Nagel, Bill Evjen, Jay Glynn, Karli Watson, Morgan Skinner, "Professional C# and .NET 4.5", Wiley, First Edition2012
2. Andrew Troelsen, "Pro C# 5.0 and the .NET 4.5 Framework", Apress publication, First Edition2012
3. Ian Gariffiths, Mathew Adams, Jesse Liberty, "Programming C# 4.0", O'Reilly, Sixth Edition, 2010
4. Andy Wigley, Daniel Moth, "Peter Foot, —Mobile Development Handbook", Microsoft Press,2nd Edition, 2011
5. Herbert Schildt, "C# - The Complete Reference", Tata McGraw Hill, FirstEdition2010.

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO1 | PSO2 |
|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO 1 | √ | √ | √ | √ | √ | √ | √ | √ | √ | | | √ | √ | √ |
| CO 2 | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ |
| CO 3 | √ | √ | √ | √ | √ | | | | √ | | | √ | √ | √ |
| CO 4 | √ | √ | √ | √ | √ | | | | √ | | | √ | √ | √ |
| CO 5 | √ | √ | √ | √ | √ | | √ | | √ | √ | √ | √ | √ | √ |

| MC5023 | WIRELESS NETWORKING | L T P C |
|---|---|---|
| | | 3 0 0 3 |

**OBJECTIVES:**

The student should be made:

● To understand the concept about Wireless networks, protocol stack and standards
● To understand and analyse the network layer solutions for Wireless networks
● To study about fundamentals of 3G Services, its protocols and applications
● To learn about evolution of 4G Networks, its architecture and applications
● To explore the architecture of 5G, 5G Modulation Schemes and to analyse the concept of MIMO and other research areas in 5G

**UNIT I      WIRELESS LAN                                              9**

Introduction-WLAN technologies: Infrared, UHF narrowband, spread spectrum, IEEE802.11: System architecture, protocol architecture, 802.11b, 802.11a – Hiper LAN: WATM, BRAN, HiperLAN2 – Bluetooth: Architecture, WPAN – IEEE 802.15.4, Wireless USB, Zigbee, 6LoWPAN, WirelessHART- IEEE802.16-WIMAX: Physical layer, MAC, Spectrum allocation for WIMAX

**UNIT II      MOBILE NETWORK LAYER                                     9**

Introduction - Mobile IP: IP packet delivery, Agent discovery, tunneling and encapsulation, IPV6-Network layer in the internet- Mobile IP session initiation protocol - mobile ad-hoc network: Routing: Destination Sequence distance vector, Dynamic source routing, IoT: CoAP. TCP enhancements for wireless protocols

**UNIT III    3G OVERVIEW    9**

Overview of UTMS Terrestrial Radio access network-UMTS Core network Architecture: 3G-MSC, 3G-SGSN, 3G-GGSN, 3GPP Architecture, SMS-GMSC/SMS-IWMSC, Firewall, DNS/DHCP-High speed Downlink packet access (HSDPA)- LTE network architecture and protocol, User equipment, CDMA2000 overview- Radio and Network components, Network structure, Radio Network, TD-CDMA, TD – SCDMA

**UNIT IV    4G NETWORKS    9**

Introduction – 4G vision – 4G features and challenges - Applications of 4G – 4G Technologies: Cognitive Radio,  IMS Architecture, LTE, Advanced Broadband Wireless Access and Services, MVNO.

**UNIT V    5G NETWORKS    9**

Introduction to 5G, vision and challenges, 5G NR – New Radio – air interface of 5G, radio access, Ultra-Dense Network Architecture and Technologies for 5G- Generalized frequency division multicarrier (GFDM)- Principles, Transceiver Block diagram-MIMO in LTE, Theoretical background, Single user MIMO, Multi-user MIMO, Capacity of massive MIMO: a summary, Basic forms of massive MIMO implementation.

**TOTAL: 45 PERIODS**

**OUTCOMES: outcomes to be changed with respect to contents**
**At the end of the course, the student should be able to:**
● Conversant with the latest 3G/4G networks and its architecture
● Design and implement wireless network environment for any application using latest wireless protocols and standards
● Ability to select the suitable network depending on the availability and requirement
● Implement different type of applications for smart phones and mobile devices with latest network strategies

**REFERENCES:**
1. Jochen Schiller, Mobile Communications, Second Edition, Pearson Education 2012.
2. Vijay Garg, —Wireless Communications and networkingǁ, First Edition, Elsevier 2007.
3. AfifOsseiran, Jose.F.Monserrat and Patrick Marsch, "5G Mobile and Wireless Communications Technology", Cambridge University Press, First Edition2016.
4. Clint Smith, Daniel Collins, "Wireless Networks", 3rd Edition, McGraw-Hill Education, 2014.
5. Anurag Kumar, D.Manjunath, Joy kuri, —Wireless Networking, First Edition, Elsevier 2011.
6. Xiang, W; Zheng, K; Shen, X.S; "5G Mobile Communications", Springer, First Edition2016
7. Saad Z Asif, "5G Mobile Communication,Concepts and Challenges", First EditionCRC Press
8. Thomas L. Marzetta, Erik G. Larsson, Hong Yang,HienQuoc Ngo, "Fundamentals of Massive MIMO", Cambridge University Press, First Edition2018.

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO 1 | √ | √ | | √ | √ | | | | √ | | | √ | √ | |
| CO 2 | | √ | √ | | √ | | | | | | √ | √ | √ | |
| CO 3 | √ | √ | √ | | | | | | | | | | √ | √ |
| CO 4 | √ | √ | √ | | | √ | | | | | | | √ | |
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**MC5024**                        **WEB DESIGN**                  **L T  P C**
                                                                   **3 0 0 3**

**OBJECTIVES:**

- To understand the concepts and architecture of the World Wide Web.
- To understand and practice markup languages
- To understand and practice embedded dynamic scripting on client-side Internet
- Programming
- To understand and practice web development techniques on client-side.
- The objective is to enable the students to understand the Organizational Behaviour, and Organizational Change and dynamic of groups.

**UNIT I        INTRODUCTION TO WWW                                      9**
Understanding the working of Internet-Web Application Architecture-Brief history of Internet-Web Standards – W3C-Technologies involved in Web development – Protocols-Basic Principles involved in developing a website-Five Golden Rules of Web Designing.

**UNIT II       UI DESIGN                                                9**
HTML Documents-Understanding markup languages-Structure of HTML Documents-Markup Tags-Basic markup tags-Working with Text-Working with Images-Hyperlinks -Images-Tables-List-SVG-Advanced HTML- Iframes-HTML5 Video and Audio tags
Cascading Style Sheet: Need for CSS - Importance of separating document structuring and styling-Basic CSS selectors and properties-CSS properties for text (Color, font, weight, align, etc.) and working with colors-Selecting with classes, IDs, tags-CSS Specificity-Ways of linking CSS to HTML-CSS Pseudo selectors-Understanding the box model - Margins, padding and border – Inline and block elements -Structuring pages using Semantic Tags

**UNIT III      WEB PAGE LAYOUTS WITH CSS3                               9**
Positioning with CSS – Positions, Floats, z-index-Layouts with Flexbox –Responsive web design with media queries-Advanced CSS Effects – Gradients, opacity, box-shadow-CSS3 Animations – Transforms and Transitions-CSS Frameworks – Bootstrap

**UNIT IV       JAVA SCRIPT                                              9**
Basic JavaScript syntax-JavaScript Objects and JSON-Understanding the DOM-JavaScript Events and Input validation-Modifying CSS of elements using JavaScript-JavaScript Local Storage and Session Storage-Cross domain data transfer with AJAX-Using JQuery to add interactivity-JQuery Selectors-JQuery Events-Modifying CSS with JQuery -Adding and removing elements with JQuery-AJAX with JQuery-Animations with JQuery (hide, show, animate, fade methods, Slide Method)

**UNIT V    SERVER-SIDE PROGRAMMING WITH PHP    9**

PHP basic syntax-PHP Variables and basic data structures-Using PHP to manage form submissions-File Handling -Cookies and Sessions with PHP-Working with WAMP and PHPMYADMIN-Establishing connectivity with MySQL using PHP

.**TOTAL:  45 PERIODS**

**OUTCOMES:**

- Create a basic website using HTML and Cascading Style Sheets.
- Create websites with complex layouts
- Add interactivity to websites using simple scripts
- Design rich client presentation using AJAX.
- Add business logic to websites using PHP and databases

**REFERENCES:**

1. David Flanagan, "JavaScript: The Definitive Guide", 7th Edition, O'Reilly Publications,2020
2. Danny Goodman, "Dynamic HTML: The Definitive Reference: A Comprehensive Resource for XHTML, CSS, DOM, JavaScript" , O'Reilly Publications, 3rd Edition,2007
3. Robin Nixon; "Learning PHP, MySQL, JavaScript & CSS: A Step-by-Step Guide to Creating Dynamic Websites", O'Reilly Publications, 2nd Edition,2018
4. Keith J Grant; "CSS in Depth", Manning Publications. 1st edition,2018
5. Elizabeth Castrol, "HTML5 & CSS3 Visual Quick start Guide", Peachpit Press, 7th Edition, 2012.
6. Harvey & Paul Deitel& Associates, Harvey Deitel and Abbey Deitel, "Internet and World Wide Web -  How to Program", Fifth Edition, Pearson Education, 2012
7. https://developer.mozilla.org/en-US/
8. https://learn.shayhowe.com/

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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| CO 1 | √ | | | | √ | | | | | | | | | √ |
| CO 2 | | √ | √ | √ | | | | | | | | | √ | |
| CO 3 | | | | | | √ | √ | | | | | | | √ |
| CO 4 | | | | √ | √ | | | | | | | | √ | |
| CO 5 | | | | | | | √ | | | | √ | | | |

**MC5025          NETWORK PROGRAMMING AND SECURITY        L T  P C**
**3 0 0 3**

**OBJECTIVES:**

- To understand the  basics of Network Programming
- To be familiar with building network applications
- To design and implement client server Applications using TCP and UDP Sockets
- To expose with various socket options
- To get aware of Network security  for Network Programming

**UNIT I          INTRODUCTION          9**

TCP/IP Layer Model – Multicast, broadcast and Any cast - Socket address Structures – Byte ordering functions – address conversion functions – Elementary TCP Sockets – socket, connect, bind, listen, accept, read, write , close functions – Iterative Server – Concurrent Server

**UNIT II          ELEMENTARY TCP SOCKETS          9**

TCP Echo Server – TCP Echo Client – Posix Signal handling – Server with multiple clients – boundary conditions: Server process Crashes, Server host Crashes, Server Crashes and reboots, Server Shutdown

**UNIT III          SOCKET OPTIONS AND MULTIPLEXING          9**

Socket options – getsocket and setsocket functions – generic socket options – IP socket options – ICMP socket options – TCP socket options I/O multiplexing – I/O Models – select function – shutdown function – TCP echo Server (with multiplexing) – poll function – TCP echo Client (with Multiplexing)

**UNIT IV          ELEMENTARY UDP SOCKETS          9**

UDP echo Server – UDP echo Client – Multiplexing TCP and  UDP sockets – Domain name system – gethostbyname function – Ipv6 support in DNS – gethostbyadr function – getservbyname and getservbyport functions.

**UNIT V          NETWORK SECURITY          9**

SSL - SSL Architecture, SSL Protocols, SSL Message , Secure Electronic Transaction (SET). TLS –TLS Protocols,DTLS Protocols, PKI – Fundamentals, Standards and Applications

**TOTAL: 45 PERIODS**

**REFERENCE BOOKS:**
1. W. Richard Stevens, Bill Fenner, Andrew M. Rudoff ,"Unix Network Programming, Volume 1: The Sockets Networking API", Third Edition, ISBN:0-13-141155-1, Addison Wesley Pearson Education,2004
2. Behrouz A Forouzan,DebdeepMukhopadhyay "Cryptography and Network Security" ,Second Edition, ISBN -13:978-0-07—070208-0 Tata McGraw Hill Education Private Limited 2010
3. William Stallings, "Cryptographic and network security Principles and Practices",Fourth Edition, Publisher Prentice Hall, November 2005
4. Andre Perez, "Network Security", First Edition, Publisher John Wiley & Sons, 2014
5. Gary R. Wright , W. Richard Stevens, "TCP/IP Illustrated: The Implementation" , ISBN 0-201-63354-X , Vol. 2, 1st Edition , Addison Wesley Professional, January 2008
6. Michael J. Donahoo, Kenneth L. Calvert "TCP/IP Sockets in C: Practical Guide for Programmers ", Morgan Kaufmann Publishers 2ndEdition. 2009
7. Lewis Van Winkle ,"Hands-On Network Programming with C: Learn socket programming in C and write secure and optimized network code" ,ISBN -978-1-78934-986-3, Packt Publishing  2019 First Edition.

**OUTCOMES:**
Upon completion of the course, the student will be able to
- Design and implement  the client/server programs using variety of protocols
- Understand the key protocols which support Internet
- Demonstrate advanced knowledge of programming interfaces  for network communication

- Use the basic tools for design and testing of network programs in Unix environment.
- Identify some of the factors driving the need for network security
- 

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO 1 | √ | √ | √ | √ | | | | √ | √ | | | √ | √ | √ |
| CO 2 | √ | √ | | | | | √ | | | | | √ | √ | |
| CO 3 | √ | √ | √ | √ | | √ | | | | √ | √ | √ | √ | √ |
| CO 4 | √ | √ | √ | | √ | | | | | | √ | √ | √ | √ |
| CO 5 | √ | | √ | | √ | √ | √ | √ | √ | √ | | | √ | √ |

**MC5026**　　　　　　**MICROSERVICES AND DEVOPS**　　　　**L T P C**
　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　**3 0 0 3**

**OBJECTIVES:**
- To introduce Microservices and Containers. .
- To understand the key concepts and principles of DevOps
- To be familiar with most common DevOps tools
- To explain the business benefits of DevOps and continuous delivery.
- To recall specific DevOps methodologies and frameworks

**UNIT I　　INTRODUCTION TO MICROSERVICES　　9**
Definition of Microservices – Characteristics - Microservices and Containers – Interacting with Other Services – Monitoring and Securing the Services – Containerized Services – Deploying on Cloud

**UNIT II　　MICROSERVICES ARCHITECTURE　　9**
Monolithic architecture- Microservice architectural style- Benefits - Drawbacks of Microservice architectural style - decomposing monolithic applications into Microservices.

**UNIT III　　BASICS OF DEVOPS　　9**
History of DevOps- DevOps and software development life cycle- water fall model – agile model –DevOps life cycle – DevOps tools: distributed version control tool –**Git**- automation testing tools – **Selenium -** reports generation – T**estNG -** User Acceptance Testing – **Jenkins**.

**UNIT IV　　MICROSERVICES IN DEVOPS ENVIRONMENT　　9**
Evolution of Microservices and DevOps – Benefits of combining DevOps and Microservices- working of DevOps and Microservices in Cloud environment - DevOps Pipeline representation for a NodeJS based Microservices

**UNIT V　　VELOCITYAND CONTINUOUS DELIVERY　　9**
Velocity - Delivery Pipeline- test stack - Small/Unit Test – medium /integration testing – system testing- Job of Development and DevOps - Job of Test and DevOps – Job of Op and Devops- Infrastructure and the job of Ops.

　　　　　　　　　　　　　　　　　　　　　　　　　　**TOTAL: 45 PERIODS**

**OUTCOMES:**
　At the end of this course, the students will be able to:
- Understand the Microservices and containers.

- apply Microservices in DevOps
- Understand about DevOps and the common tools used in DevOps.
- Develop and integrate projects using DevOps
- Deploy and monitor projects using DevOps.

**REFERENCES:**

1. NamitTanasseri, RahulRai, Microservices with Azure, 1st Edition, Packt Publishing, UK, 2017
2. Eberhard Wolff, Microservices: Flexible Software Architecture, 1st Edition, Pearson Education, 2017
3. James A Scott, A Practical Guide to Microservices and Containers, MapR Data Technologies e – book. https://mapr.com/ebook/microservices-and-containers/assets/microservices-and-containers.pdf
4. Joyner Joseph, Devops for Beginners, First Edition, MihailsKonoplovs publisher, 2015.
5. Gene Kim, Kevin Behr, George Spafford, The Phoenix Project, A Novel about IT, DevOps, 5th Edition, IT Revolution Press, 2018 .
6. Michael Hüttermann, DevOps for Developers, 1st Edition, APress, e-book, 2012.

| Mapping of COs with POs and PSOs | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COs/POs & PSOs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | √ | √ | | | | | | | | | | | | |
| CO2 | √ | √ | | | | | | | | | | | | |
| CO3 | √ | √ | | | | | | | | | | | | |
| CO4 | | | √ | √ | | | | | | | | | | |
| CO5 | √ | √ | | | | | | | | | | | | |

**MC5027**  **SOCIAL NETWORK ANALYTICS**  **L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To gain knowledge about social networks, its structure and their data sources.
- To study about the knowledge representation technologies for social network analysis.
- To analyse the data left behind in social networks.
- To gain knowledge about the community maintained social media resources.
- To learn about the visualization of social networks.

**UNIT I       INTRODUCTION TO SEMANTIC WEB       9**
The development of Semantic Web – Emergence of the Social Web – The Development of Social Network Analysis – Basic Graph Theoretical Concepts of Social Network Analysis – Electronic Sources for Network Analysis – Electronic Discussion Networks, Blogs and Online Communities, Web-based Networks.

**UNIT II          KNOWLEDGE REPRESENTATION ON THE SEMANTIC WEB          9**

Ontology-based knowledge Representation – Ontology languages for the Semantic Web: RDF and OWL–Modeling Social Network Data – Network Data Representation, Ontological Representation of Social Individuals and Relationships –Aggregating and Reasoning with Social Network Data.

**UNIT III          SOCIAL NETWORK MINING          9**

Detecting Communities in Social Network – Evaluating Communities –Methods for Community Detection – Applications of Community Mining Algorithms – Tools for detecting communities – Application: Mining Facebook - Exploring Facebook's social Graph API – Analyzing social graph connections

**UNIT IV          COMMUNITY MAINTAINED SOCIAL MEDIA RESOURCES          9**

Community Maintained Resources – Supporting technologies for community maintained resources– User motivations-Location based social interaction –  location technology– mobile location sharing –  Social Information Sharing and social filtering – Automated recommender system.

**UNIT V          VISUALIZATION OF SOCIAL NETWORKS          9**

Visualization of Social Networks - Node-Edge Diagrams – Random Layout – Force-Directed Layout – Tree Layout – Matrix Representations –Matrix and Node-Link Diagrams – Hybrid Representations – Visualizing Online Social Networks.

                                                                    **TOTAL: 45 PERIODS**

**OUTCOMES:**

Up on completion of the course, the students will be able to:
- Explain the basic principles behind network analysis algorithms.
- Model and represent knowledge for social semantic Web.
- Use extraction and mining tools for analyzing Social networks.
- Discuss about community maintained social media resources.
- Develop personalized visualization for Social networks.

**REFERENCES:**

1. Matthew A. Russell,"Mining the Social Web: Data Mining Facebook, Twitter, LinkedIn, Google+, Githuband more", O'REILLY, Third Edition, 2018.
2. CharuAggarwal, "Social Network Data Analytics," Springer, First Edition, 2014
3. Jennifer Golbeck, "Analyzing the social web", Waltham, MA: Morgan Kaufmann (Elsevier), First Edition, 2013.
4. BorkoFurht, "Handbook of Social Network Technologies and Applications", Springer, First Edition, 2010
5. Peter Mika, "Social Networks and the Semantic Web", Springer, First Edition, 2007
6. Stanley Wasserman and Katherine Faust, "Social network analysis: methods and applications", Cambridge University Press, First Edition, 1999.

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
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| CO 5 | √ | √ | | √ | √ | √ | √ | | | √ | | √ | √ |

**MC5028**             **BIO INSPIRED COMPUTING**                 **L  T  P  C**
                                                                  **3  0  0  3**

**OBJECTIVES:**
- To Learn bio-inspired theorem and algorithms
- To Understand random walk and simulated annealing
- To Learn genetic algorithm and differential evolution
- To Learn swarm optimization and ant colony for feature selection
- To understand bio-inspired application in various fields

**UNIT I         INTRODUCTION                                              9**
Introduction to algorithm - Newton ' s method - optimization algorithm - No-Free-Lunch Theorems - Nature-Inspired Metaheuristics -Analysis of Algorithms -Nature Inspires Algorithms -Parameter tuning and parameter control.

**UNIT II         RANDOM WALK AND ANEALING                                 9**
Random variables - Isotropic random walks - Levy distribution and flights - Markov chains - step sizes and search efficiency - Modality and intermittent search strategy - importance of randomization- Eagle strategy-Annealing and Boltzmann Distribution - parameters -SA algorithm - Stochastic Tunneling.

**UNIT III        GENETIC ALOGRITHMS AND DIFFERENTIAL EVOLUTION            9**
Introduction to genetic algorithms and - role of genetic operators - choice of parameters - GA varients - schema theorem - convergence analysis - introduction to differential evolution - varients - choice of parameters - convergence analysis - implementation.

**UNIT IV        SWARM OPTIMIZATION AND FIREFLY ALGORITHM                  9**
Swarm intelligence - PSO algorithm - accelerated PSO - implementation - convergence analysis - binary PSO - The Firefly algorithm - algorithm analysis - implementation - variants- Ant colony optimization toward feature selection.

**UNIT V         APPLICATIONS OF BIO INSPIRED COMPUTING                    9**
Improved Weighted Thresholded Histogram Equalization Algorithm for Digital Image Contrast Enhancement Using Bat Algorithm - Ground Glass Opacity Nodules Detection and Segmentation using Snake Model - Mobile Object Tracking Using Cuckoo Search- Bio inspired algorithms in cloud computing- Wireless Sensor Networks using Bio inspired Algorithms

**TOTAL: 45 PERIODS**

**OUTCOMES:**
Upon completion of the course, the students should be able to
- Implement and apply bio-inspired algorithms
- Explain random walk and simulated annealing
- Implement and apply genetic algorithms

- Explain swarm intelligence and ant colony for feature selection
- Apply bio-inspired techniques in various fields.

**REFERENCES:**
1. Eiben,A.E.Smith,James E, "Introduction to Evolutionary Computing", Springer 2$^{nd}$Edition2015.
2. Helio J.C. Barbosa, "Ant Colony Optimization - Techniques and Applications", IntechFirst Edition,2013
3. Xin-She Yang , Jaao Paulo papa, "Bio-Inspired Computing and Applications in Image Processing",Elsevier First Edition, 2016
4. Xin-She Yang, "Nature Inspired Optimization Algorithm",Elsevier First Edition 2014
5. Yang ,Cui,XIao,Gandomi,Karamanoglu,"Swarm Intelligence and Bio-Inspired Computing", Elsevier First Edition 2013

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO1 | PSO2 |
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| CO 3 | √ | √ | √ | √ | √ | | | | √ | | | √ | | √ |
| CO 4 | √ | √ | √ | √ | √ | | √ | | √ | √ | √ | √ | √ | √ |
| CO 5 | √ | √ | √ | √ | √ | √ | √ | | √ | √ | | √ | | √ |

**MC5029**        **INFORMATION RETRIEVAL TECHNIQUES**        **L T P C**
                                                              **3 0 0 3**

**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 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    CLASSIFICATION AND CLUSTERING    9**

Text Classification and Naïve Bayes – Vector Space Classification – Support vector machines and Machine learning on documents. Flat Clustering – Hierarchical Clustering – Matrix decompositions and latent semantic indexing – Fusion and Meta learning

**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

**TOTAL: 45 PERIODS**

**OUTCOMES:**

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

- Build an Information Retrieval system using the available tools.
- Identify and design the various components of an Information Retrieval system.
- Model an information retrieval system
- Apply machine learning techniques to text classification and clustering which is used for efficient Information Retrieval.
- Design an efficient search engine and analyze the Web content structure.

**REFERENCES:**

1. Implementing and Evaluating Search Enginesǁ, The MIT Press, Cambridge, Massachusetts London, England, First Edition2010
2. Ricardo Baeza – Yates, BerthierRibeiro – Neto, —Modern Information Retrieval: The concepts and Technology behind Searchǁ (ACM Press Books), Second Edition, 2011.
3. Stefan Buttcher, Charles L. A. Clarke, Gordon V. Cormack, —Information RetrievalFirst Edition 2010
4. Manning Christopher D., Raghavan Prabhakar & SchutzeHinrich, " Introduction to Information Retrieval", Cambridge University Press, Online Edition,2009

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO1 | PSO2 |
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| CO 2 | √ | √ | √ | √ | √ | | | | √ | | | √ | √ | √ |
| CO 3 | √ | √ | √ | √ | √ | | | | √ | | | √ | √ | √ |
| CO 4 | √ | √ | √ | √ | √ | | √ | | √ | √ | √ | √ | √ | √ |
| CO 5 | √ | √ | √ | √ | √ | | | | √ | √ | | √ | √ | √ |

**MC5030**                    **SOFTWARE ARCHITECTURE**          **L  T   P  C**
                                                                  **3  0   0  3**

**OBJECTIVES:**

- Understand software architectural requirements and drivers
- Be exposed to architectural styles and views
- Be familiar with architectures for emerging technologies

**UNIT I         INTRODUCTION AND ARCHITECTURAL DRIVERS             9**
Introduction – Software architecture - Architectural structures – Influence of software architecture on organization - both business and technical – Architecture Business Cycle-Functional requirements – Technical constraints – Quality Attributes.

**UNIT II        QUALITY ATTRIBUTE WORKSHOP                         9**
Quality Attribute Workshop – Documenting Quality Attributes – Six part scenarios – Case studies.

**UNIT III       ARCHITECTURAL VIEWS                                9**
Introduction – Standard Definitions for views – Structures and views – Representing views-available notations – Standard views – 4+1 view of RUP, Siemens 4 views, SEI's perspectives and views – Case studies

**UNIT IV        ARCHITECTURAL STYLES                               9**
Introduction – Data flow styles – Call-return styles – Shared Information styles – Event styles – Case studies for each style.

**UNIT V         DOCUMENTING THE ARCHITECTURE                       9**
Good practices – Documenting the Views using UML – Merits and Demerits of using visual languages – Need for formal languages – Architectural Description Languages – ACME – Case studies. Special topics: SOA and Web services – Cloud Computing – Adaptive structures

**TOTAL: 45 PERIODS**

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

- Explain influence of software architecture on business and technical activities
- Summarize quality attribute workshop
- Identify key architectural structures
- Use styles and views to specify architecture
- Design document for a given architecture

**REFERENCES:**

1. Len Bass, Paul Clements, and Rick Kazman, "Software Architectures Principles and Practices", 2n Edition, Addison-Wesley, 2003.
2. Anthony J Lattanze, "Architecting Software Intensive System. A Practitioner's Guide", 1st Edition, Auerbach Publications, 2010.
3. Paul Clements, Felix Bachmann, Len Bass, David Garlan, James Ivers, Reed Little, Paulo Merson, Robert Nord, and Judith Stafford, "Documenting Software Architectures. Views and Beyond", 2nd Edition, Addison-Wesley, 2010
4. Paul Clements, Rick Kazman, and Mark Klein, "Evaluating software architectures: Methods and case studies.",1st Edition, Addison-Wesley, 2001.
5. Mark Hansen, "SOA Using Java Web Services", 1st Edition, Prentice Hall, 2007
6. David Garlan, Bradley Schmerl, and Shang-Wen Cheng, "Software Architecture-Based Self-Adaptation," 31-56. Mieso K Denko, Laurence Tianruo Yang, and Yan

Zang (eds.), "Autonomic Computing and Networking".1st Edition, Springer Verlag 2009.

| COs/POs & PSOs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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| **Mapping of COs with POs and PSOs** | | | | | | | | | | | | | | |
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| CO3 | √ | √ | | | | | | | | | | | | |
| CO4 | √ | √ | | | | | | | | | | | | |
| CO5 | √ | √ | √ | | | | | | | | | | | |

**MC5031**                         **DIGITAL FORENSICS**                    **L  T  P  C**
                                                                            **3  0  0  3**

**OBJECTIVES**:
- To learn the security issues network layer and transport layer.
- To be exposed to security issues of the application layer.
- To be familiar with forensics tools.
- To analyze and validate forensics data.
- To perform digital forensic analysis based on the investigator's position.

**UNIT I        INTRODUCTION                                              9**
Digital Forensics – Uses- Digital Forensics Process – Locard's Exchange Principle – Scientific Method – Role of Forensic examiner in Judicial System – Key technical concepts – Bits, bytes and numbering schemes- File extension and file signatures – Storage and memory- computing environment

**UNIT II       ANTI-FORENSICS & LEGAL                                    9**
Introduction – Hiding data – Password attacks – Additional resources – Stegnography – Data destruction. Legal: Fourth Amendment – Criminal law-searches without a warrant – searching with a warrant- Electronic discovery-Expert testimony.

**UNIT III      EVIDENCE COLLECTION                                       9**
Evidence Collection – Collection option – Obstacles – Types of Evidence – The rules of Evidence – General Procedure – Collection and archiving – Methods of collection – Artifacts – Collection steps – Controlling Contamination: The Chain of Custody Duplication and Preservation of Digital Evidence: Preserving the digital Crime Scene – Computer Evidence processing steps - Legal Aspects of Collecting and Preserving Computer Forensic Evidence - Computer Image Verification and Authentication.

**UNIT IV       COMPUTER FORENSICS                                        9**
Introduction to Traditional Computer Crime, Traditional problems associated with Computer Crime. Introduction to Identity Theft & Identity Fraud.Types of CF techniques – Incident and incident response methodology – Forensic duplication and investigation. Preparation for IR: Creating response tool kit and IR team. – Forensics Technology and Systems – Understanding Computer Investigation – Data Acquisition.

**UNIT V      NETWORK FORENSICS & MOBILE DEVICE FORENSICS      9**

Introduction – Network fundamentals – Network Security tools – Network evidence and investigations. Mobile device forensics: Cellular Network – Cell phone evidence – Cell phone forensic tools- Global Positioning systems.

**TOTAL:   45 PERIODS**

**OUTCOME:**

Upon Completion of the course, the students will be able to

- Explain digital forensic process and role of forensic examiner.
- Explore Legal amendments.
- Demonstrate evidence collection
- Explore computer forensics, network forensics and mobile device forensics.
- Make Use forensics tools.

**REFERENCES:**

1. John Sammons, The Basics of Digital Forensics The Primer for Getting Started in Digital Forensics, Second Edition, Syngress, 2015.
2. Cory Altheide and Harlan Carvey, ―Digital Forensics with Open Source Tools, 1st Edition, Elsevier publication, April 2011.
3. Nihad A. Hassan, Digital Forensics Basics: A Practical Guide Using Windows OS, 1st Edition, A Press, 2019
4. ThmasJ.Holt, Adam M.Bossler, K.C.Seigfried – Spellar, Cybercrime and Digital Forensics An Introduction, 1st Edition, Taylor and Francis,New York, 2015.
5. Darren R. Hayes, A Practical Guide to Digital Forensics Investigations, 2nd Edition , Pearson Education, 2020.

| COs/POs & PSOs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | √ | √ | | | | | | √ | | | | | | |
| CO2 | √ | √ | | | | | | √ | | | | | | |
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| CO5 | √ | √ | | | | | | √ | | | | | | |

Table title (spanning): **Mapping of COs with POs and PSOs**

**MC5032          DATA MINING AND DATA WAREHOUSING TECHNIQUES L T P C**

**3 0  0 3**

**OBJECTIVES:**

- To gain knowledge on data mining and the need for pre-processing.
- To characterize the kinds of patterns that can be discovered by association rule mining.
- To implement classification techniques on large datasets.
- To analyze various clustering techniques in real world applications.

- To get exposed to the concepts of data warehousing architecture and implementation.

**UNIT I          DATA MINING & DATA PREPROCESSING          9**

Data Mining–Concepts , DBMS versus Data mining , kinds of Data, Applications, Issues and Challenges–Need for Data Pre-processing – Data Cleaning – Data Integration and Transformation – Data Reduction – Data Discretization and Concept Hierarchy Generation.

**UNIT II          ASSOCIATION RULE MINING AND CLASSIFICATION BASICS          9**

Introduction to Association rules – Association Rule Mining – Mining Frequent Itemsets with and without Candidate Generation – Mining Various Kinds of Association Rules - Classification versus Prediction – Data Preparation for Classification and Prediction.

**UNIT III          CLASSIFICATION AND PREDICTION TECHNIQUES          9**

Classification by Decision Tree – Bayesian Classification – Rule Based Classification – Bayesian Belief Networks – Classification by Back Propagation – Support Vector Machines – K-Nearest Neighbor Algorithm –Linear Regression, Nonlinear Regression, Other Regression-Based Methods

**UNIT IV          CLUSTERING TECHNIQUES          9**

Cluster Analysis – Partitioning Methods: k-Means and k- Mediods – Hierarchical Methods: Agglomerative and Divisive – Density–Based Method: DBSCAN –Model Based Clustering Methods: Fuzzy clusters and Expectation-Maximization Algorithm – Clustering High-Dimensional Data: Biclustering – Outlier Analysis.

**UNIT V          DATA WAREHOUSE          9**

Need for Data Warehouse – Database versus Data Warehouse – Multidimensional Data Model – Schemas for Multidimensional Databases – OLAP operations – OLAP versus OLTP – Data Warehouse Architecture – Extraction, Transformation and Loading (ETL).

**TOTAL: 45 PERIODS**

**OUTCOMES:**

On completion of the course, the students will be able to:
1. Identify data mining techniques in building intelligent model.
2. Illustrate association mining techniques on transactional databases.
3. Apply classification and clustering techniques in real world applications.
4. Evaluate various mining techniques on complex data objects.
5. Design, create and maintain data warehouses.

**REFERENCES:**

1. Daniel T. Larose, Chantal D. Larose, "Data mining and Predictive analytics," Second Edition, Wiley Publication, 2015
2. G. K. Gupta, "Introduction to Data Mining with Case Studies", Eastern Economy Edition, Prentice Hall of India, Third Edition, 2014

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO 1 | √ | √ | | | | | | | | | | | √ | |
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| CO 4 | √ | √ | | √ | √ | | | | √ | | | | | √ |
| CO 5 | √ | √ | | | √ | √ | √ | | √ | √ | √ | √ | | √ |

| **MC5033** | **DATA VISUALIZATION TECHNIQUES** | **L** | **T** | **P** | **C** |
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**OBJECTIVES:**
- To understand the categories of data quality principles.
- To describe data through visual representation.
- To provide basic knowledge about how large datasets are represented into visual graphics and easily understand about the complex relationships within the data.
- To design effective visualization techniques for any different problems.

**UNIT I        INTRODUCTION                                                                        9**
Visualization – visualization process – role of cognition – Pseudocode conventions – Scatter plot - Data foundation : Types of data  - Structure within and between records - Data preprocessing – Human perceptions and  information processing.

**UNIT II        VISUALIZATION FOUNDATIONS                                            9**
Semiology of graphical Symbols – Eight Visual Variables – Historical Perspective- Visualization Techniques for spatial data – One-dimensional data- two dimensional data – Three dimensional data- dynamic data – combining techniques- Visualization of Geospatial data – Visualization of Point, line, area data.

**UNIT III        DESIGNING EFFECTIVE VISUALIZATION                              9**
Steps in Designing Visualization – problems in Designing Effective Visualization – Comparing and evaluating visualization techniques – Visualization Systems.

**UNIT IV        INFORMATION DASHBOARD DESIGN                                   9**
Characteristics of dashboards – Key goals in visual design process – Dashboard display media – Designing dashboards for usability – Meaningful organization – Maintaining consistency – Aesthetics of dashboards – Testing for usability – Case Studies: Sales dashboard, Marketing analysis dashboard.

**UNIT V        VISUALIZATION SYSTEMS                                                   9**
Systems based on Data type-systems based on Analysis type – Text analysis and visualization – Modern integrated visualization systems – toolkit-Research directions in visualization – issues of cognition, perception and reasoning –issues of evaluation - issues of Hardware.

**TOTAL:   45 PERIODS**

**OUTCOME:**
**On completion of the course the student should be able to:**
- Describe principles of visual perception
- Apply visualization techniques for various data analysis tasks – numerical data
- Apply visualization techniques for various data analysis tasks – Non numerical data
- Design effective  visualization techniques for different problems
- Design information dashboard.

**REFERENCES:**
1. Matthew O. Ward , Georges Grinstein , Daniel Keim "Interactive Data Visualization: Foundations, Techniques, and Applications", CRC Press; 2nd edition, 2015
2. 2Stephen Few, "Now you see it: Simple Visualization Techniques for Quantitative Analysis", 1st Edition, Analytics Press, 2009.
3. Stephen Few, "Information Dashboard Design: The Effective Visual Communication of Data",1st Edition,  O'Reilly,2006.
4. Ben Fry, "Visualizing data: Exploring and explaining data with the processing environment", 1st Edition, O'Reilly, 2008.

| Mapping of COs with POs and PSOs | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COs/POs & PSOs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | √ | √ | | | | | | | | | | | | |
| CO2 | √ | √ | √ | | | | | | | | | | | |
| CO3 | √ | √ | √ | | | | | | | | | | | |
| CO4 | √ | √ | √ | | | | | | | | | | | |
| CO5 | √ | √ | √ | | | | | | | | | | | |

**MC5034**                         **OPERATIONS RESEARCH**             **L T P C**
                                                                        **3 0 0 3**

**OBJECTIVES:**
- To provide the concept and an understanding of basic concepts in Operations Research techniques for Analysis and Modeling in ComputerApplications.
- To understand , develop and solve mathematical modelof      linear programming problems
- To understand , develop and solve mathematical model of Transport and assignment problems
- To Understand network modeling for planning and scheduling the projectactivities

**UNIT I          LINEAR PROGRAMMING MODELS                                    9**
Formulation of LPP, Graphical solution of LPP. Simplex Method, Artificial variables: big-M method, degeneracy and unbound solutions.

**UNIT II          TRANSPORTATION AND ASSIGNMENT MODELS                        9**
Formulation - Methods for finding basic Feasible Solution - Optimality Test - MODI method - Degeneracy in Transportation Problem -Unbalanced Transportation Problem. Assignment Method: Mathematical formulation of assignment models – Hungarian Algorithm – Variants of the Assignment problem

**UNITIII          SCHEDULING BY PERT AND CPM                                  9**
Introduction - Rules to frame a Network - Fulkerson's Rule to numbering of events - Activity, Times - Critical Path Computation - Slack and Float - PERT- Steps and computing variance, Merits and demerits of PERT, CPM- Time estimating & Limitations, Comparison between PERT & CPM.

**UNIT IV        QUEUEING MODELS                                        9**

Characteristics of Queueing Models–Poisson Queues-(M /M/1):(FIFO/∞/∞), (M / M / 1) : (FIFO / N / ∞), (M / M / C) : (FIFO / ∞ / ∞), (M / M / C) : (FIFO / N / ∞)models.

**UNIT V   GAME THEORY                                              9**

Competitive game, rectangular game, saddle point, minimax (maximin) method of optimal strategies- value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2 X 2 games.

                                                        **TOTAL: 45 PERIODS**

**OUTCOMES**:

Upon Completion of the course, the students will be able to

- Understand and apply linear programming to solve operational problem with constraints
- Apply transportation and assignment models to find optimal solution
- To prepare project scheduling using PERT andCPM
- Identify and analyze appropriate queuing model to reduce the waiting time in queue.
- To choose the best strategy using decision making methods under game theory.

**REFERENCES:**

1. Taha H.A., "Operations Research: An Introduction", 10th Edition, Prentice Hall of India, New Delhi, 2017
2. KantiSwarup, P.K. Gupta, Man Mohan, "Operations Research", 15th Revised Edition, S. Chand& Sons Education Publications, New Delhi, 2017
3. Ronald L Rardin, Optimization In Operations Research, 2nd Edition, Pearson Education, India, 2018
4. Jatinder Kumar, Optimization Techniques in Operations Research, LAP LAMBERT Academic Publishing, 2015
5. D.S.Hira and P.K.Gupta, Operations Research, 5th Edition, S.Chand& Sons, 2015.

| COs/POs & PSOs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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| **Mapping of COs with POs and PSOs** | | | | | | | | | | | | | | |
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| CO2 | √ | √ | √ | √ | √ | | | | | | | | | |
| CO3 | √ | √ | √ | √ | | | | | | | | | | |
| CO4 | √ | √ | √ | √ | | √ | | | | | | | | |
| CO5 | √ | √ | √ | √ | | | | | | | | | | |
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**MC5035**                **PROFESSIONAL ETHICS IN IT**          **L T P C**
                                                          **3 0 0 3**

**OBJECTIVES:**

- To understand the concepts of computer ethics in work environment.
- To understand the threats in computing environment
- To Understand the intricacies of accessibility issues

- To ensure safe exits when designing the software projects

**UNIT I          INTRODUCTION TO ETHICS                                    9**
Definition of Ethics- Right, Good, Just- The Rational Basis of Ethics -Theories of Right: Intuitionist vs. End-Based vs. Duty-Based -Rights, Duties, Obligations -Theory of Value - Conflicting Principles and Priorities -The Importance of Integrity -The Difference Between Morals, Ethics, and Laws -Ethics in the Business World - Corporate Social Responsibility - Creating an Ethical Work Environment -Including Ethical Considerations in Decision Making

**UNIT II          ETHICS IN INFORMATION TECHNOLOGY, INTERNET CRIME          9**
IT Professionals - Are IT Workers Professionals- Professional Relationships That Must Be Managed -Professional Codes of Ethics - Professional Organizations - Certification - IT Professional Ethics, Three Codes of Ethics, Management Conflicts. The RevetonRansomware Attacks -IT Security Incidents: A Major Concern - Why Computer Incidents Are So Prevalent -Types of Exploits -Types of Perpetrators-Federal Laws for Prosecuting Computer Attacks-Implementing Trustworthy Computing -Risk Assessment - Establishing a Security Policy -Educating Employees and Contract Workers

**UNIT III          FREEDOM OF EXPRESSION, PRIVACY                           9**
First Amendment Rights -Obscene Speech-Defamation -Freedom of Expression: Key Issues -Controlling Access to Information on the Internet -Strategic Lawsuit Against Public Participation (SLAPP)-Anonymity on the Internet-Hate Speech- Privacy Protection and the Law- Information Privacy- Privacy Laws, Applications, and Court Rulings-Key Privacy and Anonymity Issues- Data Breaches -Electronic Discovery-Consumer Profiling- Workplace Monitoring -Advanced Surveillance Technology

**UNIT IV          FREEDOM OF EXPRESSION, INTELLECTUAL PROPERTY RIGHTS     9**
Intellectual Property Rights-Copyrights-Copyright Term - Eligible Works -Fair Use Doctrine - Software Copyright Protection –Copyright Laws and the internet-Copyright and Piracy– Patents- -Software Patents -Cross-Licensing Agreements -Trade Secrets-Trade Secret Laws -Employees and Trade Secrets-Key Intellectual Property Issues-Plagiarism -Reverse Engineering-Open Source Code- Competitive Intelligence -Trademark Infringement -Cyber squatting

**UNIT V          SOCIAL NETWORKING ETHICS AND ETIQUETTES                   9**
Social Networking Web Site- Business Applications of Online Social Networking-Social Network Advertising-The Use of Social Networks in the Hiring Process-Social Networking Ethical Issues –Cyber bullying- Online Virtual Worlds-Crime in Virtual Worlds-Educational and Business Uses of Virtual Worlds

**TOTAL: 45 PERIODS**

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

- Helps to examine situations and to internalize the need for applying ethical principles, values to tackle with various situations.
- Develop a responsible attitude towards the use of computer as well as the technology.

- Able to envision the societal impact on the products/ projects they develop in their career
- Understanding the code of ethics and standards of computer professionals.
- Analyze the professional responsibility and empowering access to information in the work place.

**REFERENCES:**
1. Caroline Whitback," Ethics in Engineering Practice and Research ", Cambridge University Press, 2nd Edition2011.
2. George Reynolds, "Ethics in Information Technology", Cengage Learning, 6th Edition2018.
3. Barger, Robert. (2008). Computer ethics: A case-based approach.Cambridge University Press 1st Edition.
4. John Weckert and Douglas Adeney, Computer and Information Ethics, Greenwood Press,FirstEdition1997.
5. Penny Duquenoy, Simon Jones and Barry G Blundell, "Ethical, legal and professional issues in computing", Middlesex University Press, First Edition2008.
6. Sara Baase, "A Gift of Fire: Social, Legal, and Ethical Issues for Computing and the Internet", 3rd Edition, Prentice Hall, 2008.
7. http://www.infosectoday.com/Articles/Intro_Computer_Ethics.html

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**MC5036**                          **MARKETING MANAGEMENT**          **L T P C**
                                                                      **3 0 0 3**

**OBJECTIVE:**
- To provide basic knowledge of concepts, principles, tools and techniques of Marketing.
- To provide an exposure to the students pertaining to marketing strategies, which they are expected to possess when they enter the industry as practitioners.
- To give them an understanding of the various marketing Strategies used in consumer and industrial marketing.

**UNIT I        INTRODUCTION TO MARKETING MANAGEMENT                    9**
Introduction - Market and Marketing - the Exchange Process- Core Concepts of Marketing - Functions of Marketing - Importance of Marketing - Marketing Orientations -Marketing Mix- The Traditional 4Ps - The Modern Components of the Mix - The Additional 3Ps - Developing an Effective Marketing Mix.

**UNIT II        MARKETING ENVIRONMENT                                          9**

Introduction - Environmental Scanning - Analysing the Organization's Micro Environment - Company's Macro Environment, Differences between Micro and Macro Environment - Techniques of Environment Scanning - Marketing organization - Marketing Research and the Marketing Information System, Types and Components.

**UNIT III       CONSUMER AND BUSINESS BUYER BEHAVIOUR                9**

Introduction - Characteristics - Types of Buying Decision Behaviour - Consumer Buying Decision Process - - Buying Motives - Buyer Behaviour Models - Characteristics of Business Markets - Differences between Consumer and Business Buyer Behaviour - Buying Situations in Industrial/Business Market - Buying Roles in Industrial Marketing - Factors that Influence Business Buyers - Steps in Business Buying Process

**UNIT IV        SEGMENTATION, TARGETING AND POSITIONING              9**

Introduction - Concept of Market Segmentation - Benefits of Market Segmentation - Requisites of Effective Market Segmentation - The Process of Market Segmentation - Bases for Segmenting Consumer Markets - Targeting (T) - Market Positioning (P)

**UNIT V         INTERNATIONAL MARKETING MANAGEMENT & RECENT TRENDS    9**

Introduction - Nature of International Marketing - International Marketing Concept – International Market Entry Strategies - Approaches to International Marketing - Cause related marketing - Ethics in marketing –Online marketing trends.

**TOTAL:  45 PERIODS**

**OUTCOMES:**
- Knowledge of basic understanding in solving marketing related problems.
- Awareness of marketing management process, strategies and the marketing mix elements.
- Clear understanding of functional area of marketing
- Demonstrating conceptual knowledge and analytical skills in analyzing the marketing environment.
- Develop skills in recent trends in global marketing.

**REFERENCES:**
1. Sherlekar, "Marketing Management ", S.A, Himalaya Publishing House, Thirteenth Edition2016.
2. Philip Kortler and Kevin Lane Keller, ". Marketing Management ", PHI 15th Edition, 2015
3. S.H.H. Kazmi, ". Marketing Management,", Excel Books India, 2ndEdition, 2013
4. C. B Gupta & N Rajan Nair, "Marketing Management text and Case " 17th Edition 2016
5. KS Chandrasekar, "Marketing management-Text and Cases", Tata McGraw Hill, First edition, 2010.
6. V S Ramaswamy& S Namkumari, "Marketing management Global Perspective, Indian Context" , Macmillan Publishers India, 5th Edition, 2015

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**MC5037**                    **ORGANIZATIONAL BEHAVIOR**            **L T P C**
                                                                     **3  0 0 3**

**OBJECTIVE:**

- The objective is to enable the students to understand the Organizational Behavior, and Organizational Change and dynamic of groups.

**UNIT I          ORGANISATIONAL BEHAVIOUR                              9**
Organization Behaviour – Definition – Scope and Application in Management – Contributions of Other Disciplines to OB. Emerging Issues in Organizational Behaviour- Organizational behaviour models

**UNIT II          INDIVIDUAL PROCESSES                                 9**
Personality – types – Factors influencing personality– Theories. Emotions - Theories – Emotional Intelligence- Learning – Types of learners – The learning process – Learning theories.
Perceptions – Importance – Factors influencing perception- Attitudes – Nature of Attitudes Components of Attitudes Formation of Attitude Benefits of Positive Attitude Functions of Attitudes– Measurement-Motivation – Importance – Types – Theories.

**UNIT III          LEADERSHIP AND POWER                                9**
Meaning – Importance – Leadership styles – Theories – Leaders Vs Managers – Sources of power – Power centers – Power and Politics.

**UNIT IV          GROUP DYNAMICS                                       9**
Meaning – Types of Groups – Functions of Small Groups – Group Size Status – Managerial Implications – Group Behaviour – Group Norms – Cohesiveness – Group Thinking

**UNIT V          ORGANISATIONAL CHANGE AND DEVELOPMENT                 9**
Organizational Change: Meaning – Nature of Work Change – Need for Change – Change Process – Types of Change – Factors Influencing Change – Resistance to Change – Overcoming Resistance – Organizational Development: Meaning and Different Types of OD Interventions.

                                                                **TOTAL:  45 PERIODS**

**OUTCOMES:**
On completion of the course should be able to:

- Students will have a better understanding of human behavior in organization.
- They will know the framework for managing individual and group performance.
- Characteristics of attitudes and components of attitudes — A brief discussion

- List the determinants of personality
- List the characteristics of various leadership styles.

**REFERENCES:**

1. K. Aswathappa, "Organizational behaviour", Himalaya Publishing House Pvt. Ltd. 11thEdition.
2. Stephen P. Robins, "Organizational Behavior", PHI Learning / Pearson Education, Edition 17, 2016 (Global edition)
3. Fred Luthans, "Organizational Behavior", McGraw Hill, 12th Edition
4. Nelson, Quick, Khandelwal. "ORGB – An innovative approach to learning and teaching". Cengage, 2nd edition 2012
5. Ivancevich, Konopaske&Maheson, "Organizational Behaviour& Management", Tata McGraw Hill, 7th edition, 2008
6. Robert Kreitner and Angelo Kinicki, "Organizational Behaviour", Tata McGraw Hill, 10th Edition, 2016

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| **MC5038** | **BUSINESS DATA ANALYTICS** | **L T P C** |
| | | **3 0 0 3** |

**OBJECTIVES:**

- To understand the basics of business analytics and its life cycle.
- To gain knowledge about fundamental business analytics.
- To learn modeling for uncertainty and statistical inference.
- To understand analytics using Hadoop and Map Reduce frameworks.
- To acquire insight on other analytical frameworks.

**UNIT I        OVERVIEW OF BUSINESS ANALYTICS                    9**
Introduction – Drivers for Business Analytics – Applications of Business Analytics: Marketing and Sales, Human Resource, Healthcare, Product Design, Service Design, Customer Service and Support – Skills Required for a Business Analyst – Framework for Business Analytics Life Cycle for Business Analytics Process.

**UNIT II        ESSENTIALS OF BUSINESS ANALYTICS                    9**
Descriptive Statistics – Using Data – Types of Data – Data Distribution Metrics: Frequency, Mean, Median, Mode, Range, Variance, Standard Deviation, Percentile, Quartile, z-Score, Covariance, Correlation – Data Visualization: Tables, Charts, Line Charts, Bar and Column Chart, Bubble Chart, Heat Map – Data Dashboards.

**UNIT III        MODELING UNCERTAINTY AND STATISTICAL INFERENCE        9**

Modeling Uncertainty: Events and Probabilities – Conditional Probability – Random Variables – Discrete Probability Distributions – Continuous Probability Distribution – Statistical Inference: Data Sampling – Selecting a Sample – Point Estimation – Sampling Distributions – Interval Estimation – Hypothesis Testing.

**UNIT IV        ANALYTICS USING HADOOP AND MAPREDUCE FRAMEWORK        9**

Introducing Hadoop – RDBMS versus Hadoop – Hadoop Overview – HDFS (Hadoop Distributed File System) – Processing Data with Hadoop – Introduction to MapReduce – Features of MapReduce – Algorithms Using Map-Reduce: Matrix-Vector Multiplication, Relational Algebra Operations, Grouping and Aggregation – Extensions to MapReduce

**UNIT V        OTHER DATA ANALYTICAL FRAMEWORKS        9**

Overview of Application development Languages for Hadoop – PigLatin – Hive – Hive Query Language (HQL) – Introduction to Pentaho, JAQL – Introduction to Apache: Sqoop, Drill and Spark, Cloudera Impala – Introduction to NoSQL Databases – Hbase and MongoDB.

**TOTAL: 45 PERIODS**

**OUTCOMES**:

On completion of the course, the student will be able to:

- Identify the real world business problems and model with analytical solutions.
- Solve analytical problem with relevant mathematics background knowledge.
- Convert any real world decision making problem to hypothesis and apply suitable statistical testing.
- Write and Demonstrate simple applications involving analytics using Hadoop and MapReduce
- Use open source frameworks for modeling and storing data.

**REFERENCES:**

1. U. Dinesh Kumar, "Business Analytics: The Science of Data-Driven Decision Making", Wiley, First Edition, 2017.
2. Umesh R Hodeghatta, UmeshaNayak, "Business Analytics Using R – A Practical Approach", Apress, First Edition2017.
3. Jeffrey D. Camm, James J. Cochran, Michael J. Fry, Jeffrey W. Ohlmann, David R. Anderson, "Essentials of Business Analytics", Cengage Learning, second Edition, 2016.
4. Rui Miguel Forte, "Mastering Predictive Analytics with R", Packt Publication, First Edition2015.
5. VigneshPrajapati, "Big Data Analytics with R and Hadoop", Packt Publishing, First Edition2013.
6. AnandRajaraman, Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press,First Edition 2012.
7. A. Ohri, "R for Business Analytics", Springer, FirstEdition, 2012

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**MC5039      CRYPTOCURRENCY AND BLOCK CHAIN TECHNOLOGIES      L T P C**
**3 0 0 3**

**Objectives:**

- To understand the basics of Blockchain
- To understand the basicsofCryptocurrency
- To understand the working of digital tokens and wallets
- To understand the working of contracts
- To understand the working of block chain platforms

**UNIT I      OVERVIEW OF BLOCKCHAIN**:                                                        **9**
Why Blockchain - The Structure of Blockchain - Data Structure of Blockchain - Data Distribution in Blockchain - Block Validation. **Block Validators:** Proof of Work – Proof of Stake - Proof of Activity - Proof of Elapsed Time - Proof of Burn.

**UNIT II      CRYPTOCURRENCY**                                                                  **9**
Overview. **Bitcoin:** Bitcoin Working - Bitcoin Transactions - Bitcoin Mining - Value of Bitcoin - Community, Politics and Regulations – Advantages – Disadvantages. **Ethereum:** Overview – Decentralized Application. **Components of Ethereum:** Smart contracts – Ether - Ethereum Clients - Ethereum Virtual Machine – Etherscripter.

**UNIT III      HYPERLEDGER**                                                                    **9**
Introduction**. Digital Tokens:** Overview **-** Initial Coin Offering – OmiseGO – EOS – Tether. **MetaMask:** Wallet Seed - MetaMask Transactions. **Mist:** Overview **-** Mist wallet. **Truffle**: Features of Truffle – Development Truffle boxes - Community truffle box.

**UNIT IV      SOLIDITY**                                                                          **9**
Smart Contracts - Contract and Interfaces - **Hyperledger Fabric:** Introduction - Fabric v/s Ethereum - HyperledgerIroha - Features of Iroha.**HyperledgerSawtooth:** Components of sawtooth - Proof of Elapsed time.

**UNIT V      BLOCKCHAIN PLATFORMS**                                                        **9**
Multichain - HydraChain**. Future Blockchain:** IOTA **–** Corda - Chain Core.**Blockchain Framework:** CoCo Framework – Tierion – BigchainDB.

**TOTAL:45 PERIODS**

**OUTCOME:**

Upon Completion of the course, the students will be able to

- describe the Basics of Block chain Technology concepts and its applications
- know about the implementation of Crypto currency
- identify the different ways to achieve Block chain Technology
- Illustrate how to design and build smart contracts using various platforms
- understand about the future of Block chain technology

**REFERENCES:**

1. Josh Thompson, 'Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming', Create Space Independent Publishing Platform, 1st Edition, 2017.
2. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. Bitcoin and cryptocurrency technologies: a comprehensive introduction. 1st Edition, Princeton University Press, 2016.
3. Joseph Bonneau et al, SoK: Research perspectives and challenges for Bitcoin and cryptocurrency, IEEE Symposium on security and Privacy, 1st Edition, 2015.
4 https://www.blockchainexpert.uk/book/blockchain-book.pdf

MOOC Website references (Example website references are only given; it's not an exhaustive list)

1. www.coursera.org
    a. Blockchain
    b. Blockchain and cryptocurrency explained
    c. Blockchain revolution
    d. Bitcoin and Cryptocurrency technologies
    e. Blockchain basics
    f. Introduction to Blockchain
    g. Introduction to Blockchain technologies
    h. Blockchain foundations and use cases
2. www.udemy.com
    a. Build a blockchain and cryptocurrency from scratch
    b. The Basics of Blockchain
    c. Blockchain advanced level
    d. Learn Blockchain technology and cryptocurrency in Java
    e. Full Cryptocurrency courses: Ethereum, bitcoin and blockchain

| Mapping of COs with POs and PSOs | | | | | | | | | | | | | |
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**MC5040**                    **ADVANCES IN NETWORKING**              **L T P C**
                                                                      **3 0 0 3**

**OBJECTIVES:**
The student should be made:
- To understand the theme underlying IPv6 Structure and addressing methods
- To understand and analyse the protocols for IPv6 Implementation
- To identify and provide solutions for QoS and Security Issues with IPv6
- To learn about Software Defined concepts, architectures, protocols and applications
- To explore the significance of Network Function Virtualization

**UNIT I      IPv6 STRUCTURE AND ADDRESSING                                    9**
IPv4 Address Depletion- IPv6 Transition Issues-IPv6 Structure: IPv6 Header, Extension Headers: Hop-by-Hop Options Header, Destination Options Header, Routing Header, Fragment Header, AH, ESP- IPv6 Addresses: Unicast, Anycast, Multicast – Address Autoconfiguration

**UNIT II   IPv6 NETWORKING                                                    9**
IPv6 Internet Control Message Protocol (ICMPv6): ICMPv6 Messages, Fragmentation and Path MTU- IPv6 Neighbor Discovery- IPv6 Routing: RIPng, EIGRP for IPv6,OSPFv3 - Mobile IPv6

**UNIT III   QoS, PROVISIONING AND SECURITY WITH IPv6                          9**
QoS in IPv6 Protocols: Differentiated Services and IPv6, IPv6 Flows, Explicit Congestion Notification in IPv6 –Provisioning: Stateless DHCPv6,Stateful DHCPv6, DNS Extensions for IPv6- Security with IPv6: IP Security Protocol (IPsec)Basics, IPv6 Security Elements, Interaction of IPsec with IPv6 Elements

**UNIT IV   SOFTWARE DEFINED NETWORKING                                        9**
Genesis of SDN – Separation of Control Plane and Data Plane – Distributed Control Plane – IP and MPLS – Characteristics of SDN – Operation – Devices – Controller – OpenFlow Specification

**UNIT V   NETWORK FUNCTION VIRTUALIZATION                                     9**
Building SDN Framework – Network Functions Virtualization – Introduction –Virtualization and Data Plane I/O – Service Locations and Chaining – Applications – Use Cases of SDNs: Data Centers, Overlays, Big Data and Network Function Virtualization

                                                                 **TOTAL: 45 PERIODS**
**OUTCOMES:**
**At the end of the course, the student should be able to:**
- Understand the fundamentals of IPv6 and IPv6 Protocols
- Analyze the need for separation of data and control plane
- Understand the functionality of NFV
- Be Conversant with the latest networks and its architecture
- Gain an in-depth coverage of various networking technologies

**REFERENCES:**

1. Rick Graziani,"IPv6 Fundamentals: A Straightforward Approach to Understanding IPv6" Second Edition, Cisco Press, 2017
2. Peter Loshin, "IPv6:Theory,Protocoland Practice" Second Edition, Morgan Kaufmann Publishers, 2004
3. William Stallings, "Foundations of Modern Networking – SDN, NFC, QoE, IoT and Cloud" Third Edition, Pearson Publications, 2019.
4. Oswald Coker, SiamakAzodolmolky, "Software-Defined Networking with OpenFlow", Second Edition, Packt Publishing, 2017.
5. Paul Goransson, Chuck Black, "Software Defined Networks: A Comprehensive Approach", Morgan Kaufmann Publisher, First Edition 2014.
6. Thomas D. Nadeau, Ken Gray, "SDN: Software Defined Networks, an Authoritative Review of Network Programmability Technologies", O'Reilly Media, First Edition August 2013.

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**MC5041**          **SOFT COMPUTING TECHNIQUES**          **L T P C**
                                                           **3 0 0 3**

**OBJECTIVES:**

● To gain knowledge of soft computing theories and its fundamentals.
● To design a soft computing system required to address a computational task.
● To learn and apply artificial neural networks, fuzzy sets and fuzzy logic and genetic algorithms in problem solving and use of heuristics based on human experience.
● To introduce the ideas of fuzzy sets, fuzzy logic and to become familiar with neural networks that can learn from available examples and generalize to form appropriate rules for inferencing systems.
● To familiarize with genetic algorithms and other random search procedures while seeking global optimum in self – learning situations.

**UNIT I          FUZZY COMPUTING                                        9**

Basic Concepts of Fuzzy Logic, Fuzzy Sets and Crisp Sets, Fuzzy Set Theory and Operations, Properties of Fuzzy Sets, Fuzzy and Crisp Relations, Fuzzy to Crisp Conversion Membership Functions, Interference in Fuzzy Logic, Fuzzy If – Then Rules, Fuzzy Implications and Fuzzy Algorithms, Fuzzifications and Defuzzificataions, Fuzzy Controller, Industrial Applications.

**UNIT II          FUNDAMENTALS OF NEURAL NETWORKS                         9**

Neuron, Nerve Structure and Synapse, Artificial Neuron and its Model, Activation Functions, Neural Network Architecture: Single Layer and Multilayer Feed Forward Networks, Recurrent Networks. Various Learning Techniques; Perception and Convergence Rule, Auto-Associative and Hetero-Associative Memory.

**UNIT III          BACKPROPAGATION NETWORKS                              9**

Back Propagation Networks) Architecture: Perceptron Model, Solution, Single Layer Artificial Neural Network, Multilayer Perception Model; Back Propagation Learning Methods, Effect of Learning Rule Co – Efficient ;Back Propagation Algorithm, Factors Affecting Back Propagation Training, Applications.

**UNIT IV          COMPETETIVE NEURAL NETWORKS                            9**

Kohenen's Self Organizing Map – SOM Architecture, learning procedure – Application; Learning Vector Quantization – learning by LVQ; Adaptive Resonance Theory – Learning procedure – Applications.

**UNIT V          GENETIC ALGORITHM                                        9**

Basic Concepts, Working Principle, Procedures of GA, Flow Chart of GA, Genetic Representations, (Encoding) Initialization and Selection, Genetic Operators, Mutation, Generational Cycle, Applications.

**TOTAL: 45 PERIODS**

**OUTCOMES**:

On completion of the course, the students will be able to:
- Identify and describe soft computing techniques and their roles in building intelligent machines.
- Recognize the feasibility of applying a soft computing methodology for a particular problem.
- Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems.
- Apply genetic algorithms to optimization problems.
- Design neural networks to pattern classification and regression problems using soft computing approach.

**REFERENCES:**
1. S. Rajasekaran and G.A. VijayalakshmiPai, "Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications", Prentice Hall of India,  2003.
2. J.S.R. Jang, C.T. Sun and E. Mizutani, "Neuro – Fuzzy and Soft Computing", Pearson Education, ,2004
3. S. N. Sivanandam, S. N. Deepa, "Principles of Soft Computing", Second Edition, Wiley, 2007.
4. SimonHaykin, "Neural Networks", Prentice Hall, 2ndEdition,1999.
5. Timothy Ross, "Fuzzy Logic with Engineering Applications", Wiley Publications,4thEdition 2016.
6. David E. Goldberg, "Genetic Algorithms in Search, Optimization and Machine Learning", Pearson Education, First Edition,2008.

| Mapping of COs with POs and PSOs | | | | | | | | | | | | | | |
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| COs/POs & PSOs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
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**MC5042**　　　　　　　　　**DEEP LEARNING**　　　　　　　**L T P C**
　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　**3 0 0 3**

**OBJECTIVES:**
- To understand how to represent the high-dimensional data, such as images, text and data.
- To explain convolution neural network
- To introduce major deep learning algorithms and their applications to solve real world problems.
- To explore about optimization and generalization in Deep learning
- To understand about deep reinforcement learning

**UNIT I　　　NEURAL NETWORK　　　　　　　　　　　　　　　　　9**
Building Intelligence Machine-Expressing Linear Perceptron as Neurons-Feed Forward Neural Netwoks - Activation function. Supervised and Unsupervised Learning:Single Layer Perceptron – Perceptron Learning Algorithm – Least Mean Square Learning Algorithm - Multilayer Perceptron – Back Propagation Algorithm – XOR problem – Limitations of Back Propagation Algorithm- Implementing Neural Networks in TensorFlow.

**UNIT II　　　CONVOLUTION NEURAL NETWORK　　　　　　　　9**
Introduction-Filter and Feature Maps-Full Description of CNN-Max Pooling- Full Architectural Description of CNN-Image Preprocessing Pipeline Enable More Roburst Models-Accelerating Training with Batch Normalization-Visualizing Learning with Convolution Network-Leveraging and Learning Convolution Filters - Predefined Convolutional Filters Network (PCFNet)- Transfer Learning with Convolutional Neural Networks.

**UNIT III　　　DEEP NETWORKS　　　　　　　　　　　　　　　　9**
History of Deep Learning- A Probabilistic Theory of Deep Learning- Backpropagation and regularization, batch normalization- VC Dimension and Neural Nets-Deep Vs Shallow Networks - Convolutional Networks- Generative Adversarial Networks (GAN), Semi-supervised Learning

**UNIT IV　　　OPTIMIZATION AND GENERALIZATION　　　　　　9**
Optimization in deep learning– Non-convex optimization for deep networks- Stochastic Optimization Generalization in neural networks- Spatial Transformer Networks- Recurrent networks, LSTM - Recurrent Neural Network Language Models- Word-Level RNNs & Deep Reinforcement Learning.

## UNIT V     DEEP REINFORCEMENT LEARNING                                        9
Markov Decision Processes-Explore versus Exploit-Policy versus Value Learning-Pole-Cart with Policy Gradients-Q Learning and Deep Q Networks-Improving and Moving Beyond DQN

**TOTAL: 45 PERIODS**

**OUTCOME:**
On completion of the course, the students will be able to
- Describe the fundamental concepts of Neural Networks
- Apply Convolution Neural Network techniques to solve problems in image processing
- Summarize the characteristics of  deep Learning
- Comprehend the Optimization and Generalization in Deep Learning
- Interpret the concepts of Deep Reinforcement Learning to solve real world problems.

**REFERENCES**
1. Nikhil Buduma, Nicholas Locascio, "Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms", First Edition, O'ReillyMedia, 2017.
2. SudharsanRavichandiran, Hands on Deep Learning Algorithms with Python, FirstEdition, Packt Publishing Limited, 2019.
3. François Chollet, Deep Learning with Python, First Edition,Manning Publications Company, 2017.
4. Ian Goodfellow, YoshuaBengio and Aaron Courville, Deep Learning, First editionMIT Press, London, 2016

| Mapping of COs with POs and PSOs | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COs/POs & PSOs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| PSOCO1 | 2 | 1 | | | | | | | | | | | 1 | |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 2 | |
| CO3 | 3 | 2 | | | | | | | | | | | 2 | |
| CO4 | 3 | 2 | | | | | | | | | | | 2 | |
| CO5 | 3 | 2 | | | | | | | | | | | 2 | |

| **MC5043** | **BIG DATA PROCESSING** | **L T P C** |
|---|---|---|
| | | **3 0 0 3** |

**OBJECTIVES:**
- To know the fundamental concepts of big data and analytics.
- To explore tools and practices for working with big data
- To learn about stream computing.
- To know about the research that requires the integration of large amounts of data.

## UNIT I     INTRODUCTION TO BIG DATA                                          9
Evolution of Big data – Best Practices for Big data Analytics – Big data characteristics – Validating – The Promotion of the Value of Big Data – Big Data Use Cases- Characteristics of Big Data Applications – Perception and Quantification of Value -Understanding Big Data

Storage – A General Overview of High-Performance Architecture – HDFS – MapReduce and YARN – Map Reduce Programming Model

**UNIT II          CLUSTERING AND CLASSIFICATION                              9**

Advanced Analytical Theory and Methods: Overview of Clustering – K-means – Use Cases – Overview of the Method – Determining the Number of Clusters – Diagnostics – Reasons to Choose and Cautions .- Classification: Decision Trees – Overview of a Decision Tree – The General Algorithm – Decision Tree Algorithms – Evaluating a Decision Tree – Decision Trees in R – Naïve Bayes – Bayes' Theorem – Naïve Bayes Classifier.

**UNIT III          ASSOCIATION AND RECOMMENDATION SYSTEM                  9**

Advanced Analytical Theory and Methods: Association Rules – Overview – Apriori Algorithm – Evaluation of Candidate Rules – Applications of Association Rules – Finding Association& finding similarity – Recommendation System: Collaborative Recommendation- Content Based Recommendation – Knowledge Based Recommendation- Hybrid Recommendation Approaches.

**UNIT IV          STREAM MEMORY                                                      9**

Introduction to Streams Concepts – Stream Data Model and Architecture – Stream Computing,
Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating
moments – Counting oneness in a Window – Decaying Window – Real time Analytics Platform(RTAP) applications – Case Studies – Real Time Sentiment Analysis, Stock Market Predictions. Using Graph Analytics for Big Data: Graph Analytics

**UNIT V          NOSQL DATA MANAGEMENT FOR BIG DATA AND VISUALIZATION  9**

NoSQL Databases : Schema-less Models‖: Increasing Flexibility for Data Manipulation-Key Value Stores- Document Stores – Tabular Stores – Object Data Stores – Graph Databases Hive – Sharding –-Hbase – Analyzing big data with twitter – Big data for E-Commerce Big data for blogs – Review of Basic Data Analytic Methods using R.

**TOTAL: 45 PERIODS**

**OUTCOMES**:

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

- Work with big data tools and its analysis techniques
- Analyze data by utilizing clustering and classification algorithms
- Learn and apply different mining algorithms and recommendation systems for large volumes of data
- Perform analytics on data streams
- Learn NoSQL databases and management.

**REFERENCES:**

1. Jure LeskovecAnandRajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, 2ndEdition2016.
2. David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", Morgan Kaufmann/El sevier Publishers, First Edition2013.

3. EMC Education Services, "Data Science and Big Data Analytics: Discovering, Analyzing,Visualizing and Presenting Data", Wiley publishers, First Edition, 2015.
4. Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications", Wiley Publishers,First Edition 2014.
5. DietmarJannach and Markus Zanker, "Recommender Systems: An Introduction", Cambridge University Press, First Edition2010.
6. Kim H. Pries and Robert Dunnigan, "Big Data Analytics: A Practical Guide for Managers "CRC Press,First Edition2015.

**MOOC REFERENCES:**

1. **www.swayam.gov.in:** Big Data Computing
2. **www.coursera.org:**Big Data Essentials: HDFS, MapReduce and Spark RDD
3. **www.udemy.com:** Big Data and Hadop: Interactive Intense Course
4. **www.edx.org:** Big Data Fundamentals, Processing Big Data with Hadoop in Azure HDInsight

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO 1 | √ | √ | √ | √ | √ | | | | √ | √ | | √ | √ | √ |
| CO 2 | √ | √ | √ | √ | √ | | | | √ | √ | | √ | √ | √ |
| CO 3 | √ | √ | √ | √ | √ | | | | √ | √ | | √ | √ | √ |
| CO 4 | √ | √ | √ | √ | √ | | | | √ | √ | | √ | √ | √ |
| CO 5 | √ | √ | √ | √ | √ | | | | √ | √ | √ | √ | √ | √ |

| MC5044 | NATURAL LANGUAGE PROCESSING | L T P C |
|--------|------------------------------|---------|
| | | 3 0 0 3 |

**OBJECTIVES:**
- To learn the fundamentals of natural language processing
- To understand word level and syntactic analysis.
- To understand the role of semantics of sentences and pragmatics
- To get knowledge about the machine translation.

**UNIT I       INTRODUCTION OF BASIC TEXT PROCESSING                              9**
Overview: NLP-Language - Basics of Text Processing – Spelling Correction – Weight Edit Distance- other Variations – Noisy Channel Model for spelling correction –N-Gram Language Models – Evaluation of Language models- Basic Smoothing.

**UNIT II       LANGUAGE MODELLING AND SMOOTHING                              9**
Language modeling – smoothing models – Computational Morphology – Finite state Methods for morphology – Introduction to POS tagging – Hidden Markov model for POS tagging – Models for sequential parsing – MaxEnt- CRF.

**UNIT III       SYTAX, PARSING, SEMANTICS                              9**
Syntax – Parsing – CKY-PCFGs – Inside and outside probabilities - Dependency grammar and parsing – Transition based Parsing – Formulation – Learning. MST Based Parsing -

Distributional model for semantics – Word Embeddings - Lexical Semantics-wordNet – Word Sense Disambiguation – Novel word sense detection.

**UNIT IV        TOPIC MODELS AND INFORMATION EXTRACTION                 9**

Topic Model- Latent Dirichlet Allocation – Gibbs sampling for LDA – Formulation and Application – LDA Variants- Entity Linking  - Information extraction – Relation extraction-Distant Supervision

**UNIT V        TEXT SUMMARIZATION & TEXT CLASSIFICATION                 9**

Optimization Based models for summarization – Evaluation- Text classification – sentiment analysis - Affective lexicon **-**Learning affective lexicons -   computing with affective lexicons

**TOTAL: 45 PERIODS**

**OUTCOMES:**

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

- To tag a given text with basic Language features
- To design an innovative application using NLP components
- To implement a rule based system to tackle morphology/syntax of a language
- To design a tag set to be used for statistical processing for real-time applications
- To apply NLG and machine translation

**REFERENCES:**

1. Daniel Jurafsky, James H. Martin—Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, 3rd Edition,Pearson Publication, 2014.
2. Steven Bird, Ewan Klein and Edward Loper, —Natural Language Processing with Python, First Edition, OReilly Media, 2009.
3. Breck Baldwin, Language Processing with Java and LingPipe Cookbook, 1st Edition, Atlantic Publisher, 2015.
4. Richard M Reese, Natural Language Processing with Java, 2rd Edition, OReilly Media, 2015.
5. NitinIndurkhya and Fred J. Damerau, —Handbook of Natural Language Processing, 2rd  Edition, Chapman and Hall/CRC Press, 2010.

| Mapping of COs with POs and PSOs | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COs/POs & PSOs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| PSOCO1 | 2 | 1 | | | | | | | | | | | 2 | |
| CO2 | 2 | 1 | | | | | | | | | | | 2 | |
| CO3 | 2 | 1 | | | | | | | | | | | 2 | |
| CO4 | 2 | 1 | | | | | | | | | | | 2 | |
| CO5 | 2 | 1 | | | | | | | | | | | 2 | |

**MA5102      MATHEMATICAL FOUNDATIONS OF COMPUTER SCIENCE    L T P C**
**3 0 0 3**

**OBJECTIVES:**
- To introduce Mathematical Logic and their rules for validating arguments and programmes.
- To introduce counting principles for solving combinatorial problems.
- To give exposure to Graph models and their utility in connectivity problems.
- To introduce abstract notion of Algebraic structures for studying cryptographic and its related areas.
- To introduce Boolean algebra as a special algebraic structure for understanding logical circuit problems.

**UNIT I      LOGIC AND PROOFS                                         9**
Propositional Logic – Propositional Equivalences – Predicates and Quantifiers – Nested Quantifiers – Rules of Inference – Introduction to Proofs – Proof Methods and Strategy.

**UNIT II      COMBINATORICS                                           9**
Mathematical Induction – Strong Induction and Well Ordering – The Basics of Counting - The Pigeonhole Principle – Permutations and Combinations – Recurrence Relations Solving Linear Recurrence Relations Using Generating Functions – Inclusion – Exclusion – Principle and Its Applications.

**UNIT III      GRAPHS                                                 9**
Graphs and Graph Models – Graph Terminology and Special Types of Graphs – Matrix Representation of Graphs and Graph Isomorphism – Connectivity – Euler and Hamilton Paths.

**UNIT IV      ALGEBRAIC STRUCTURES                                    9**
Groups – Subgroups – Homomorphisms – Normal Subgroup and Coset – Lagrange's Theorem – Definitions and Examples of Rings and Fields.

**UNIT V      LATTICES AND BOOLEAN ALGEBRA                             9**
Partial Ordering – Posets – Lattices as Posets – Properties of Lattices – Lattices as Algebraic Systems – Sub Lattices – Direct Product And Homomorphism – Some Special Lattices – Boolean Algebra.

**TOTAL: 45 PERIODS**

**REFERENCE BOOKS:**
1. Kenneth H.Rosen, "Discrete Mathematics and its Applications", Tata Mc Graw Hill Pub. Co.Ltd., Seventh Edition, Special Indian Edition, New Delhi, 2011.
2. Tremblay J.P. and Manohar R, "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hill Pub. Co. Ltd, 30th Reprint, New Delhi, 2011.
3. Ralph. P. Grimaldi, "Discrete and Combinatorial Mathematics: An Applied Introduction", Pearson Education, 3rd Edition, New Delhi, 2014.
4. ThomasKoshy, "Discrete Mathematics with  Applications", 2nd Edition, Elsevier Publications, Boston, 2006.
5. SeymourLipschutz and Mark Lipson,"Discrete Mathematics", Schaum's Outlines, Tata McGraw Hill Pub. Co. Ltd., Third Edition, New Delhi, 2013.

**OUTCOMES:**
Upon completion of the module the student should able to:
- Apply Mathematical Logic to validate logical arguments and programmes.

- Apply combinatorial counting principles to solve application problems.
- Apply graph model and graph techniques for solving network other connectivity related problems.
- Apply algebraic ideas in developing cryptograph techniques for solving network security problems.
- Apply Boolean laws in developing and simplifying logical circuits.

**BX5001**            **PROBLEM SOLVING AND PROGRAMMING IN C**        **L  T  P  C**
                                                                    **3  0  2  4**

**OBJECTIVES:**
- To understand the basic concepts of problem solving approaches and to develop the algorithms
- Apply the techniques of structured (functional) decomposition to break a program into smaller pieces and describe the mechanics of parameter passing.
- To design, implements, test, and apply the basic C programming concepts.

**UNIT I        INTRODUCTION TO COMPUTER PROBLEM SOLVING              15**
Introduction – The Problem Solving aspect – Top down design – Implementation of algorithm – Program Verification – The efficiency of algorithms – The analysis of algorithms – Fundamental Algorithms

**UNIT II         PROGRAMMING AND ALGORITHMS                          15**
Programs and Programming – building blocks for simple programs -pseudo code representation – flow charts - Programming Languages - compiler –Interpreter, Loader and Linker - Program execution – Classification of Programming Language - Structured Programming Concept – Illustrated Problems: Algorithm to check whether a given number is Armstrong numberor not- Find factorial of a number.

**UNIT III        BASICS OF 'C', INPUT / OUTPUT & CONTROL STATEMENTS        15**
Introduction- Identifier – Keywords - Variables – Constants – I/O Statements - Operators - Initialization –Expressions – Expression Evaluation – Lvalues and Rvalues – Type Conversion in C –Formatted input and output functions - Specifying Test Condition for Selection and Iteration- Conditional Execution - and Selection – Iteration and Repetitive Execution- go to Statement – Nested Loops- Continue and break statements. Programs to be implemented:
  1. Write a program to find whether the given year is leap year or Not? (Hint: not every centurion year is a leap. For example 1700, 1800 and 1900 is not a leap year)
  2. Write a program to perform the Calculator operations, namely, addition, subtraction, multiplication, division and square of a number.

**UNIT IV        ARRAYS, STRINGS, FUNCTIONS AND POINTERS                15**
Array – One dimensional Character Arrays- Multidimensional Arrays- Arrays of Strings – Two dimensional character array – functions - parameter passing mechanism scope – storage classes – recursion - comparing iteration and recursion- pointers – pointer operators - uses of pointers- arrays and pointers – pointers and strings - pointer indirection pointers to functions - Dynamic memory allocation.
  1. Write a program in C to get the largest element of an array using the function.
  2. Display all prime numbers between two intervals using functions.
  3. Reverse a sentence using recursion.

4. Write a C program to concatenate two strings.
5. Find the frequency of a character in a string.

**UNIT V        USER-DEFINED DATATYPES & FILES                              15**

Structures – initialization - nested structures – structures and arrays – structures and pointers - union– type def and enumeration types - bit fields - File Management in C – Files and Streams – File handling functions – Sequential access file- Random access file – Command line arguments.

1. Write a C program to Store Student Information in Structure and Display it.
2.  The annual examination is conducted for 10 students for five subjects.
3. Write a program to read the data and determine the following:
    (a) Total marks obtained by each student.
    (b) The highest marks in each subject and the marks of the student who secured it.
    (c) The student who obtained the highest total marks.

**TOTAL: 75PERIODS**

**OUTCOMES:**
   ● Able to design a computational solution for a given problem.
   ● Able to break a problem into logical modules that can be solved (programmed).
   ● Able to transform a problem solution into programs involving programming constructs.
   ● To write programs using structures, strings, arrays, pointer and files for solving complex computational problem.
   ● Able to introduce modularity using functions and pointers which permit ad hoc runtime polymorphism.

**REFERENCES:**
1. Deitel and Deitel, "C How to Program", Pearson Education. 2013, 7$^{th}$ Edition
2. Byron S Gottfried, ―Programming with C, Schaums Outlines, Second Edition, Tata McGraw-Hill, 2006.
3. Brian W. Kernighan and Dennis M. Ritchie, "The C programming Language", Edition? 2$^{nd}$ edition 2015, Pearson Education India
4. How to solve it by Computer, R. G. Dromey, Pearson education, Fifth Edition, 2007.
5. Kamthane, A.N., "Programming with ANSI and Turbo C", Pearson Education, Delhi, 3$^{rd}$Edition, 2015.
6. Mastering C- by K R Venugopal, Sudeep R Prasad McGraw Hill Education (India) Private Limited; Second edition 2015.
7. PradipDey, ManasGhosh, ―Computer Fundamentals and Programming in C, Second Edition, Oxford University Press, 2013.

**BX5002        DIGITAL LOGIC AND COMPUTER ORGANISATION         L T P C**
                                                                **3 0 0 3**

**OBJECTIVES:**
   • To become familiar with Boolean algebra
   • To study the different types of combinational and sequential circuits
   • To comprehend the basis operations that happen in a CPU
   • To learn the data path and control path implementation
   • To become familiar with the memory hierarchy design and I/O design

**UNIT I        DIGITAL FUNDAMENTALS                                          8**

Number Systems and Conversions – Boolean Algebra an Simplifications – Minimization of Boolean Functions – Karnaugh Map, QuineMcClusky Method. Logic Gates – NAND NOR implementation.

**UNIT II          COMBINATIONAL AND SEQUENTIAL CIRCUITS                    10**

Design of Circuits –Adder /Subtracter – Encoder – Decoder – MUX /DEMUX – Comparators, Flip flops – Triggering – Master – Slave Flip Flop – State Diagram and Minimization – Counters - Registers

**UNIT III          BASIC STRUCTURE OF COMPUTER                    9**

Functional Units - Basic Operational Concepts – Bus structures – Performance and Metrics – instruction and instruction sequencing – Hardware Software Interface – Addressing modes – Instruction Sets – RISC and CISC – ALU Design – Fixed point and Floating point operations

**UNIT IV          PROCESSOR DESIGN                    9**

Processor basics –CPU Organization – Data Path Design – Control Design – Basic concepts – Hardwired control – Micro Programmed control – Pipe control – Hazards super scale operations

**UNIT V          MEMORY AND I/O SYSTEMS                    9**

Memory technology – Memory Systems- Virtual Memory – Caches – Design Methods – Associative memories – Input /output system – Programmed I/O – DMA and interrupts – I/O devices and Interfaces

**TOTAL: 45 PERIODS**

**OUTCOMES:**

Upon Completion of the course, the students will be able to
- Simplify using laws of Boolean algebra and Karnaugh map method
- Design various combinational and sequential circuits
- Differentiate between various addressing modes
- Differentiate between the various mapping policies used in cache memories
- Discuss the various types of I/O transfers

**REFERENCES:**

1. Carl Hamacher, ZvonkoVranesic, SafwatZaky and NaraigManjikian, "Computer Organization and Embedded Systems", 6thEdition, Tata McGraw Hill, 2012.
2. Carl Hamacher, Zvonkovranesic and SafwatZaky, fifth edition, "Computer Organisation" 5th Edition, Tata Mc Graw Hill, 2002.
3. Charles H. Roth, Jr., "Fundamentals of Logic Design", Jaico Publishing House, Mumbai, 4thEdition 1992.
4. David A. Patterson and John L. Hennessy, "Computer Organization and Design: The Hardware/Software Interface",2ndEdition, Morgan Kaufmann , 2002.Morris Mano "Digital Design", Printice Hall of India 1997
5. John P. Hayes, "Computer Architecture and Organization", 3rdEdition, Tata McGraw Hill, 1998 6. William Stallings,"Computer Organization & Architecture – Designing for Performance" 6th Edition, Pearson Education, 2003.

**BX5003**                    **OPERATING SYSTEMS**              **L  T  P C**
                                                                 **3  0  0  3**

**OBJECTIVES**
- To be familiar with the basic concepts and functions of Operating Systems
- To understand Processes and Threads
- To analyze Scheduling algorithms
- To gain expertise in various Memory Management schemes
- To expose with various I/O Management and File systems

**UNIT I          OS OVERVIEW                                              9**
Instruction Execution-Memory Hierarchy-Direct Memory Access- Types of Operating Systems- Operating Systems Services-Operation on Processes-Co-operating processes-System Calls-System Programs-Evolution of OS-OS Structure.

**UNIT II          PROCESS SYNCHRONIZATION                                  9**
Processes-Process Concept-Process Synchronization-Critical Regions - Critical Section Problem – InterProcess Communication-Synchronization Hardware-Mutex Locks – Semaphores-Classical problems of Synchronization – Monitors – Threads – Overview-Multithreading Models-Threading Issues.

**UNIT III          PROCESS SCHEDULING                                      9**
Process Scheduling-Scheduling mechanisms-Strategy selection-Pre emptive and Non pre emptive strategies-Scheduling criteria-Scheduling Algorithms-Multiprocessor Scheduling.

**UNIT IV          STORAGE MANAGEMENT                                       9**
Main Memory – Background-Mapping Address space to Memory space – Swapping-Contiguous Memory allocation-Memory Allocation Strategies – Paging – Segmentation-Virtual Memory-Page Replacement – Thrashing.

**UNIT V          FILE SYSTEMS AND I/O SYSTEMS                              9**
Disk structures-Disk Scheduling and Management-File System Interface-File Concepts-Access Methods-Directory Structures-Directory Organization–Filesystem Mounting–Filesharing and Protection–Filesystem Implementation-Allocation Methods-Free space Management-Efficiency and Performance – Recovery.

                                                        **TOTAL:45 PERIODS**
**OUTCOMES:**
Upon completion of the course, the student will be able to
- Deliver the main concepts, structure and functions of Operating Systems
- Implement the algorithms in Process management and solving the issues of IPC
- Analyze various Scheduling Algorithms
- Demonstrate the mapping between Physical memory and Virtual memory
- Understand the functionality of File systems in OS perspective

**REFERENCE BOOKS:**
1. Abraham Silberschatz Peter B Galvin&G.Gagne, "Operating Systems Concepts", NinthEdition,AddisionWesley Publishing Co.,2012.
2. Andrew S.Tanenbaum, "Modern operating Systems", Fourth Edition, Pearson Education, 2016.
3. William Stallings, "Operating Systems: Internals and Design Principles",Seventh Edition, PrenticeHall, 2011.

4.  H M Deitel, P J Deitel& D R Choffnes, "Operating Systems" ,ThirdEdition, Pearson Education,2011.

5.  D M Dhamdhere, "Operating Systems: A Concept-based Approach", Second Edition, TataMcGraw-Hill Education, 2007.

| BX5004 | DATA STRUCTURES AND ALGORITHMS | L T P C |
|---|---|---|
| | | 3 0 0 3 |

**OBJECTIVES:**

- Be familiar with basic techniques of algorithm analysis.
    - Be exposed to the concept of ADTs.
    - Learn linear data structures-List, Stack and Queue.
    - Learn nonlinear data structures-Tree and Graphs.
    - Be exposed to sorting, searching and hashing algorithms

**UNIT I      INTRODUCTION                                    9**

Introduction - Abstract Data Types (ADT) – Arrays and its representation –Structures – Fundamentals of algorithmic problem solving – Important problem types – Fundamentals of the analysis of algorithm – analysis frame work – Asymptotic notations, Properties, Recurrence Relation.

**UNIT II      LINEAR DATA STRUCTURES – LIST                   9**

List ADT - Array-based Implementation - Linked list implementation - Singly Linked Lists – Circularly linked lists – Doubly Linked Lists - Applications of linked list – Polynomial Addition.

**UNIT III      LINEAR DATA STRUCTURES - STACK, QUEUE           9**

Stack ADT – Operations on Stack - Applications of stack – Infix to postfix conversion – evaluation of expression - Queue ADT – Operations on Queue - Circular Queue - Applications of Queue.

**UNIT IV      NON LINEAR DATA STRUCTURES - TREES AND GRAPHS    9**

Trees and its representation – left child right sibling data structures for general trees- Binary Tree – Binary tree traversals –- Binary Search Tree - Graphs and its representation - Graph Traversals - Depth-first traversal – breadth-first traversal-Application of graphs.

**UNIT V      SORTING, SEARCHING AND HASH TECHNIQUES           9**

Sorting algorithms: Insertion sort - Bubble sort - Quick sort - Merge sort - Searching: Linear search –Binary Search - Hashing: Hash Functions – Separate Chaining – Open Addressing – Rehashing.

**TOTAL: 45 PERIODS**

**OUTCOMES**:

Upon Completion of the course, the students will be able to

- analyze algorithms and determines their time complexity.
- understand the concepts of data types, data structures and linear structures
- apply data structures to solve various problems
- understand non-linear data structures
- apply different Sorting, Searching and Hashing algorithms.

**REFERENCES:**
1. A.K. Sharma, "Data Structures using C", 2nd Edition, Pearson Education Asia, 2013
2. AnanyLevitin "Introduction to the Design and Analysis of Algorithms" 3rd Edition, Pearson Education 2012
3. E. Horowitz, Anderson-Freed and S.Sahni, "Fundamentals of Data structures in C", 2nd Edition,University Press, 2007
4. E.Balagursamy," Data Structures using C", Tata McGraw Hill 2015 Reprint
5. M. A. Weiss, "Data Structures and Algorithm Analysis in C", 3rd Edition, Pearson Education Asia, 2013.

**BX5005     PROGRAMMING AND DATA STRUCTURES USING C LABORATORY**
                                                              **L T P C**
                                                              **0 0 4 2**

**OBJECTIVES:**

To develop skills in design and implementation of data structures and their applications
* To learn and implement linear, non linear and tree data structures
* To study, implement and analyze the sorting technique.

**LIST OF EXPERIMENTS**
1. Array- Insertion and Deletion
2. Application using array of structures
3. Array Implementation of Stack
4. Array Implementation of Queue
5. Infix to postfix conversion
6. Singly Linked List operations
7. Polynomial manipulation- addition, subtraction
8. Binary Tree Traversal
9. Quick Sort
10. Binary Search

**TOTAL: 60 PERIODS**

**OUTCOMES:**

Upon Completion of the course, the students will be able to:
* Work with basic data structures that are suitable for the problems to be solved efficiently.
* Implement stack & queue techniques for related problems
* Implement prefix and post fix conversion
* Design and implement linear, and tree and its applications
* Design sorting technique, its algorithm design and analysis.

**BX5006            DATABASE MANAGEMENT SYSTEMS            L T P C**
                                                              **3 0 0 3**

**OBJECTIVES:**
● To understand the fundamentals of data models and conceptualize and depict a database system using ER diagram.
● To make a study of SQL and relational database design.

● To know about data storage techniques and query processing.
● To impart knowledge in transaction processing, concurrency control techniques and recovery procedures.

**UNIT I            INTRODUCTION                                              9**
File systems versus Database systems – Data Models – DBMS Architecture – Data Independence – Data Modeling using Entity – Relationship Model – Enhanced E-R Modeling.

**UNIT II          RELATIONAL MODEL AND QUERY EVALUATION              9**
Relational Model Concepts – Relational Algebra – SQL – Basic Queries – Complex SQL Queries – Views – Constraints – Relational Calculus – Tuple Relational Calculus – Domain Relational Calculus

**UNIT III         DATABASE DESIGN & APPLICATION DEVELOPMENT           9**
Functional Dependencies – Non-loss Decomposition – First, Second, Third Normal Forms, Dependency Preservation – Boyce/Codd Normal Form – Multi-valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form.

**UNIT IV         TRANSACTION PROCESSING                               9**
Transaction Processing – Properties of Transactions - Serializability – Transaction support in SQL - Locking Techniques – Time Stamp ordering – Validation Techniques – Granularity of Data Items – Recovery concepts – Shadow paging – Log Based Recovery.

**UNIT V          FILES AND INDEXING                                   9**
File operations – Hashing Techniques – Indexing – Single level and Multi-level Indexes – B+ tree – Static Hashing - Indexes on Multiple Keys.

**TOTAL: 45 PERIODS**

**OUTCOMES:**
● Understand the basic concepts of the database and data models.
● Design a database using ER diagrams and map ER into Relations and normalize the relations
● Acquire the knowledge of query evaluation to monitor the performance of the DBMS.
● Develop a simple database applications using normalization.
● Acquire the knowledge about different special purpose databases and to critique how they differ from traditional database systems.

**REFERENCES:**
1. Abraham Silberschatz, Henry F.Korth and S.Sundarshan "Database System Concepts", Seventh Edition, McGraw Hill, 2017.
2. RamezElamassri and ShankantBNavathe, "Fundamentals of Database Systems", Seventh Edition, Pearson Education Delhi, 2017.
3. RaghuRamakrishnan, ―Database Management Systemsǁ, Fourth Edition, McGrawHill College Publications, 2015.
4. Lee Chao, "Database Development and Management", Auerbach Publications, 1st edition, 2010
5. Carlos Coronel, Peter Rob, and Stephen Morris, "Database Principles Fundamentals of Design, Implementation, and Management –10th Edition", Course Technology, Cengage Learning, 2013.
6. C.J. Date, "An Introduction to Database Systems", Eighth Edition, Pearson Education Delhi, 2003.

**BX5007           JAVA PROGRAMMING                    L T P C**

**3  00 3**

**OBJECTIVES:**

- To provide an overview of working principles of internet, web related functionalities
- To understand and apply the fundamentals core java, packages, database connectivity for computing
- To enhance the knowledge to server side programming.
- To Understand the OOPS concept & how to apply in programming.

**UNIT I          JAVA FUNDAMENTALS                                    9**

Java features – Java Platform – Java Fundamentals – Expressions, Operators, and Control Structures – Classes, Methods – Inheritance - Packages and Interfaces – Boxing, Unboxing – Variable-Length Arguments (Varargs), Exception Handling.

**UNIT II          COLLECTIONS AND ADVANCE FEATURES                    9**

Utility Packages- Introduction to collection –Hierarchy of Collection framework – Generics, Array list, LL, HashSet, Treeset, HashMap – Comparators – Java annotations – Premain method.

**UNIT III          ADVANCED JAVAPROGRAMMING                           9**

Input Output Packages – Inner Classes – Java Database Connectivity - Introduction JDBC Drivers - JDBC connectivity with MySQL/Oracle -Prepared Statement & Result Set – JDBC Stored procedures invocation - Servlets - RMI – Swing Fundamentals - Swing Classes.

**UNIT IV OVERVIEW OF DATA RETRIEVAL & ENTERPRISE APPLICATION DEVELOPMENT                                                          9**

Tiered Application development - Java Servers, containers –Web Container – Creating Web Application using JSP/Servlets – Web Frameworks Introduction to Spring/ Play Framework – ORM Layer – Introduction to Hibernate.

**UNIT V JAVA INTERNALS AND NETWORKING                              9**

Java jar Files-Introspection – Garbage collection – Architecture and design – GC Cleanup process, Invoking GC, Generation in GC - Networking Basics Java and the Net – Inet Address – TCP/IP Client Sockets – URL –URL Connection – TCP/IP Server Sockets – A Caching Proxy HTTP Server – Datagrams.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

1. Implement Java programs.
2. Make use of hierarchy of Java classes to provide a solution to a given set of requirements found in the Java API

3. Use the frameworks JSP, Hibernate, Spring

4. Design and implement server side programs using Servlets and JSP

**5.** Make use of networking concepts in Java

**REFERENCES:**

1. R. Nageswara Rao, "Core Java: An Inte**grated Approa**ch", DreamTech Press, Edition 2016

2. Amritendu De, "Spring 4 and Hibernate 4: Agile Java Design and Development", McGraw-Hill Education, Illustrated Edition,2015

3. Herbert Schildt, The Complete Reference – Java 2, Ninth Edition, Tata McGrawHill, 2014

4. Joyce Farrell, "Java Programming", Cengage Learning, Seventh Edition, 2014

5. John Dean, Raymond Dean, "Introduction to Programming with JAVA – A Problem Solving Approach", Tata Mc Graw Hill, Second Edition, 2014.

6. Mahesh P. Matha, "Core Java A Comprehensive Study", Prentice Hall of India, First Edition, 2011

| BX5008 | SOFTWARE ENGINEERING | L T P C |
|---|---|---|
| | | 3 0 0 3 |

**OBJECTIVES:**

- To provide an insight into software life cycle and various software process models
- To estimate the resources for developing the application and to prepare the schedule
- .To know the various designing concepts and notations for modeling the software.
- To prepare the test cases for the project, apply various testing techniques, strategies and metrics to evaluate the software.
- To construct software with high quality and reliability.

**UNIT I          INTRODUCTION                                                    9**
Software Engineering Paradigms – Waterfall Life Cycle Model – Spiral Model – Prototype Model – Agile Process Model – Unified Process Model - Planning – Software Project Scheduling – SRS - Case Study:  Project Plan and SRS

**UNIT II          SOFTWARE DESIGN                                              9**
Designing Concepts - Abstraction – Modularity – Software Architecture – Cohesion – Coupling – Dataflow Oriented Design - Jackson System Development - Real time and Distributed System Design – Designing for Reuse — Case Study :  Design for any Application Oriented Project.

**UNIT III          SOFTWARE TESTING AND MAINTENANCE                9**
Software Testing Fundamentals – Software Testing Strategies – Black Box Testing – White Box Testing – System Testing – Object Orientation Testing – State Based Testing - Testing Tools – Test Case Management – Types of Maintenance – Case Study:   Testing Techniques.

## UNIT IV          SOFTWARE METRICS          9

Scope – Classification of metrics – Measuring Process and Product attributes – Direct and Indirect measures – Cost Estimation - Reliability – Software Quality Assurance – Standards – Case Study for COCOMO model.

## UNIT V          SCM & WEB ENGINEERING          9

Need for SCM – Version Control – SCM process – Software Configuration Items – Taxonomy – Re Engineering – Reverse Engineering - Web Engineering - CASE Repository – Features.

**TOTAL:    45 PERIODS**

**OUTCOMES:**

- Able to understand the problem domain to choose process models and to develop SRS
- Able to model software projects using appropriate design notations
- Able to measure the product and process performance using various metrics
- Able to evaluate the system with various testing techniques and strategies
- Able to analyze, design, verify, validate, implement, and maintain software systems.

**REFERENCES**

1. Roger S. Pressman, "Software Engineering: A Practitioner Approach", Seventh Edition, Tata McGraw – Hill International Edition, 2010
2. Richard Fairley, "Software Engineering Concepts", Tata McGraw Hill Edition, 2008
3. Ali Behforroz, Frederick J.Hudson, "Software Engineering Fundamentals", Oxford Indian Reprint, First Edition, 2012.
4. Sommerville, "Software Engineering", Tenth Edition, Pearson, 2016.
5. PankajJalote, "An Integrated approach to Software Engineering", Third Edition, NarosaPublications, 2011.

**BX5009          BASICS OF COMPUTER NETWORKS          L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To understand networking concepts and basic communication model
- To understand network architectures and components required for data communication.
- To analyze the function and design strategy of physical, data link, network layer and   transport layer
- To acquire basic    knowledge of various application protocol for internet security issues and  services.

## UNIT I          NETWORK FUNDAMENTALS          9

Uses of Networks – Categories of Networks -Communication model –Data transmission concepts and terminology – Protocol architecture – Protocols – OSI – TCP/IP – LAN Topology - Transmission media .

## UNIT II          DATA LINK LAYER          9

Data link control - Flow Control – Error Detection and Error Correction - MAC – Ethernet, Token ring, Wireless LAN MAC – Blue Tooth – Bridges.

**UNIT III        NETWORK LAYER                                                9**

Network layer – Switching concepts – Circuit switching – Packet switching –IP –– Datagrams ––IP addresses- IPV6– ICMP – Routing Protocols – Distance Vector – Link State- BGP.

**UNIT IV        TRANSPORT LAYER                                              9**

Transport layer –service –Connection establishment – Flow control – Transmission control protocol – Congestion control and avoidance – User datagram protocol. -Transport for Real Time Applications (RTP).

**UNIT V         APPLICATIONS AND SECURITY                                    9**

Applications - DNS- SMTP – WWW –SNMP- Security –threats and services - DES- RSA.

**TOTAL : 45 PERIODS**

**OUTCOMES:**
- Able to trace the flow of information from one node to another node in the network
- Able to Identify the components required to build different types of networks
- Able to understand the functionalities needed for data communication into layers
- Able to choose the required functionality at each layer for given application
- Able to understand the working principles of various application protocols and fundamentals of security issues and services available.

**REFERENCES:**
1. Larry L. Peterson & Bruce S. Davie, "Computer Networks – A systems Approach", Fifth Edition, Morgan Kaufmann, 2012.
2. James F. Kurose, Keith W. Ross, "Computer Networking: A Top-down Approach, Pearson    Education, Limited, sixth edition, 2012.
3. AndrewS.Tannenbaum, David J. Wetherall, "Computer Networks" Fifth Edition, Pearson Education 2011.
4. Forouzan, "Data Communication and Networking", Fifth Edition , TMH 2012.
5. William Stallings, ―Data and Computer Communications‖, Tenth Edition, Pearson Education,  2013.

**BX5010        JAVA PROGRAMMING LABORATORY              L T P C**

**0 0 4 2**

**OBJECTIVES:**

To develop skills in design and implementation of object oriented concepts and networking applications

- To learn and implement class, interface and package
- To study, implement and analyze the client server and remote programming.

**LIST OF EXPERIMENTS**

1. Write Java programs by making use of class, interface, package, etc for the following Different types of inheritance study

   # Uses of 'this' keyword

   # Polymorphism

   # Creation of user specific packages

   # Creation of jar files and using them

   # User specific exception handling

2. Writing window based GUI applications using frames and applets such as Calculator application, Fahrenheit to Centigrade conversion etc.

3. Application of threads examples

4. Create an Application to search Phone Number using contact Name Using Hash Map.

5. Create an Application which finds the Duplicates in E-mail using Set Interface.

6. Writing an RMI application to access a remote method

7. Writing a Servlet program with database connectivity for a web based application such as students result status checking, PNR number enquiry etc.

**TOTAL: 60 PERIODS**

 **OUTCOMES:**

Upon Completion of the course, the students will be able to:

- Work with basic Object Oriented programming concepts that are suitable for the problems to be solved efficiently.

- Implement frames and applets for related problems

- Implement prefix and post fix conversion

- Design and implement Threads in Java

- Design Remote method invocation

**BX5011          DATABASE PROGRAMMING LABORATORY          L T P C**
**0 0 4 2**

**OBJECTIVES:**
- To understand the concepts of DBMS.
- To familiarize with SQL queries.
- To write stored procedures in DBMS.
- To learn front end tools to integrate with databases.

**LIST OF EXPERIMENTS:**

1. Creation of base tables and views

2. Data Manipulation INSERT, DELETE and UPDATE in Tables. SELECT, Sub Queries

3. Data Control Commands

4. High level language extensions – PL/SQLOr Transact SQL – Packages

5. Use of Cursors, Procedures and Functions

6. Embedded SQL or Database Connectivity

7. Oracle or SQL Server Triggers – Block Level – Form Level Triggers

8. Working with Forms, Menus and ReportWriters for a application project in any domain

9. Develop a database application using Java/ Django/PHP/.NET as Front end

**TOTAL: 60 PERIODS**

Upon Completion of the course, the students will be able to:

- Design and Implement databases
- Formulate complex queries using SQL
- Implement procedures, Cursors and Function
- Implement Triggers
- Design and Implement applications that have GUI and access databases for backend connectivity