**KIT-Kalaignarkarunanidhi Institute of Technology**
(An Autonomous Institution)
**Coimbatore – 641 402.**
**Department of Computer Science and Engineering**
**PG – Computer Science and Engineering Conceptual Frame work**
(For Students admitted from the Academic Year 2023-24 and onwards)

| Semester | Level of Course | Hours / Week | No of Courses | Range of Credits/ Courses | Total Credits |
|---|---|---|---|---|---|
| **PART I** | | | | | |
| **A - Foundation Courses** | | | | | |
| I | Basic Science (BS) | 4 | 1 | 4 | 4 |
| **B - Professional Core Courses** | | | | | |
| I to III | Professional Core (PC) | 3 | 12 | 3-4 | 37 |
| **C - Elective Courses** | | | | | |
| I to III | Professional Elective (PE) | 3 | 4 | 3 | 12 |
| **D – Project Work** | | | | | |
| III & IV | Project Work (PW) | 12 -24 | 2 | 6 -12 | 18 |
| **Total Credit** | | | | | **71** |
| **PART II - Career Enhancement Courses (CEC)** | | | | | |
| II | Term paper and Seminar | 2 | 1 | 1 | 1 |
| **Total Credit** | | | | | **01** |
| Total Credits to be Earned | | | | | **72** |

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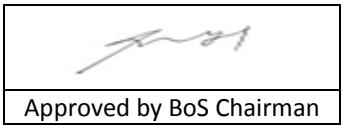
## Scheme of Instructions and Examinations

(For Students admitted from the Academic Year 2023-2024 and onwards)

| Semester I | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | CT | Instructional Hours | | | | | Assessment | | |
| | | | CP | L | T | P | C | CIA | ESE | Total |
| **Theory / Theory with Practical** | | | | | | | | | | |
| M23MAT102 | Applied Probability and Statistics for Computer Science Engineers | BS | 4 | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| M23CST101 | Research Methodology and IPR | PC | 3 | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| M23CST102 | Advanced Data Structures and Algorithms | PC | 3 | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| M23CST105 | Database Practices | PC | 3 | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| M23CST103 | Network Technologies | PC | 3 | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| M23CST104 | Principles of Programming Languages | PC | 3 | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| **Practical** | | | | | | | | | | |
| M23CSP101 | Advanced Data Structures and Algorithms Laboratory | PC | 4 | 0 | 4 | 0 | 2 | 40 | 60 | 100 |
| **Total credits to be earned** | | | | | | | 22 | | | |

| Semester II | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | CT | Instructional Hours | | | | | Assessment | | |
| | | | CP | L | T | P | C | CIA | ESE | Total |
| M23CST204 | Internet of Things | PC | 4 | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| M23CST202 | Multi-core Architecture and Programming | PC | 4 | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| M23CST203 | Machine Learning | PC | 4 | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| M23CST201 | Advanced Software Engineering | PC | 3 | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| | Professional Elective I | PE | 3 | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| | Professional Elective II | PE | 3 | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| **Practical** | | | | | | | | | | |
| M23CSP201 | Software Engineering Laboratory | PC | 0 | 0 | 0 | 2 | 2 | 40 | 60 | 100 |
| M23CSP202 | Term paper and Seminar | CEC | 2 | 0 | 2 | 0 | 1 | 40 | 60 | 100 |
| **Total credits to be earned** | | | | | | | 24 | | | |



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| Semester III | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Course Code** | **Course Name** | **CT** | **Instructional Hours** | | | | | **Assessment** | | |
| | | | **CP** | **L** | **T** | **P** | **C** | **CIA** | **ESE** | **Total** |
| M23CST301 | Security Practices | PC | 3 | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| | Professional Elective III | PE | 3 | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| | Professional Elective IV | PE | 4 | 3 | 1 | 0 | 4 | 50 | 50 | 100 |
| | Open Elective I | PC | 3 | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| **Practical** | | | | | | | | | | |
| M23CSP301 | Project Phase I | PW | 12 | 0 | 12 | 0 | 6 | 40 | 60 | 100 |
| **Total credits to be earned** | | | | | | | 19 | | | |

| Semester IV | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Course Code** | **Course Name** | **CT** | **Instructional Hours** | | | | | **Assessment** | | |
| | | | **CP** | **L** | **T** | **P** | **C** | **CIA** | **ESE** | **Total** |
| M23CSP401 | Project Phase II | PW | 24 | 0 | 0 | 24 | 12 | 40 | 60 | 100 |
| **Total credits to be earned** | | | | | | | 12 | | | |

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## BASIC SCIENCES (BS)

| Course Code | Course Name | CT | Instructional Hours | | | | | Assessment | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | CP | L | T | P | C | CIA | ESE | Total |
| M23MAT102 | Applied Probability and Statistics for Computer Science Engineers | BS | 4 | 3 | 0 | 1 | 4 | 40 | 60 | 100 |

## PROFESSIONAL CORE (PC)

| Course Code | Course Name | CT | Instructional Hours | | | | | Assessment | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | CP | L | T | P | C | CIA | ESE | Total |
| M23CST101 | Research Methodology and IPR | PC | 3 | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| M23CST102 | Advanced Data Structures and Algorithms | PC | 3 | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| M23CST105 | Database Practices | PC | 4 | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| M23CST103 | Network Technologies | PC | 3 | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| M23CST104 | Principles of Programming Languages | PC | 3 | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| M23CST204 | Internet of Things | PC | 4 | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| M23CST202 | Multi-core Architecture and Programming | PC | 4 | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| M23CST203 | Machine Learning | PC | 4 | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| M23CST201 | Advanced Software Engineering | PC | 3 | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| M23CST301 | Security Practices | PC | 3 | 3 | 0 | 0 | 3 | 40 | 60 | 100 |

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## PROFESSIONAL ELECTIVES (PE)

**Semester – II**
**Elective – I**

| Course Code | Course Name | CT | Instructional Hours | | | | | Assessment | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | CP | L | T | P | C | CIA | ESE | Total |
| M23CSE201 | Human Computer Interaction | PE | 3 | 0 | 0 | 0 | 3 | 40 | 60 | 100 |
| M23CSE202 | Cloud Computing Technologies | PE | 3 | 0 | 0 | 0 | 3 | 40 | 60 | 100 |
| M23CSE203 | Foundations of Data Sciences | PE | 3 | 0 | 0 | 0 | 3 | 40 | 60 | 100 |
| M23CSE204 | Wireless Communications | PE | 3 | 0 | 0 | 0 | 3 | 40 | 60 | 100 |
| M23CSE205 | Agile Methodologies | PE | 3 | 0 | 0 | 0 | 3 | 40 | 60 | 100 |
| M23CSE206 | Performance Analysis of Computer Systems | PE | 3 | 0 | 0 | 0 | 3 | 40 | 60 | 100 |
| M23CSE207 | Advanced Operating System | PE | 3 | 0 | 0 | 0 | 3 | 40 | 60 | 100 |
| M23CSE208 | Digital Image Processing | PE | 3 | 0 | 0 | 0 | 3 | 40 | 60 | 100 |

**Semester – II**
**Elective – II**

| Course Code | Course Name | CT | Instructional Hours | | | | | Assessment | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | CP | L | T | P | C | CIA | ESE | Total |
| M23CSE209 | High Performance Computing for Big Data | PE | 3 | 0 | 0 | 0 | 3 | 40 | 60 | 100 |
| M23CSE210 | Informational Retrieval Techniques | PE | 3 | 0 | 0 | 0 | 3 | 40 | 60 | 100 |
| M23CSE211 | Software Quality Assurance | PE | 3 | 0 | 0 | 0 | 3 | 40 | 60 | 100 |
| M23CSE212 | Autonomous Systems | PE | 3 | 0 | 0 | 0 | 3 | 40 | 60 | 100 |
| M23CSE213 | Web Analytics | PE | 3 | 0 | 0 | 0 | 3 | 40 | 60 | 100 |
| M23CSE214 | Cognitive Computing | PE | 3 | 0 | 0 | 0 | 3 | 40 | 60 | 100 |
| M23CSE215 | Quantum Computing | PE | 3 | 0 | 0 | 0 | 3 | 40 | 60 | 100 |
| M23CSE216 | Big Data Mining and Analytics | PE | 3 | 0 | 0 | 0 | 3 | 40 | 60 | 100 |

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**Semester – III**
**Elective – III**

| Course Code | Course Name | CT | Instructional Hours | | | | | Assessment | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | CP | L | T | P | C | CIA | ESE | Total |
| M23CSE301 | Mobile and Pervasive Computing | PE | 3 | 0 | 0 | 0 | 3 | 40 | 60 | 100 |
| M23CSE302 | Web Services and API Design | PE | 3 | 0 | 0 | 0 | 3 | 40 | 60 | 100 |
| M23CSE303 | Data Visualization Techniques | PE | 3 | 0 | 0 | 0 | 3 | 40 | 60 | 100 |
| M23CSE304 | Compiler Optimization Techniques | PE | 3 | 0 | 0 | 0 | 3 | 40 | 60 | 100 |
| M23CSE305 | Formal Models of Software Systems | PE | 3 | 0 | 0 | 0 | 3 | 40 | 60 | 100 |
| M23CSE306 | Robotics | PE | 3 | 0 | 0 | 0 | 3 | 40 | 60 | 100 |
| M23CSE307 | Natural Language Processing | PE | 3 | 0 | 0 | 0 | 3 | 40 | 60 | 100 |
| M23CSE308 | GPU Computing | PE | 3 | 0 | 0 | 0 | 3 | 40 | 60 | 100 |

**Semester – III**
**Electives – IV**

| Course Code | Course Name | CT | Instructional Hours | | | | | Assessment | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | CP | L | T | P | C | CIA | ESE | Total |
| M23CSE309 | Devops and Microservices | PE | 3 | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| M23CSE310 | Mobile Application Development | PE | 3 | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| M23CSE311 | Deep Learning | PE | 3 | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| M23CSE312 | Blockchain Technologies | PE | 3 | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| M23CSE313 | Embedded Software Development | PE | 3 | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| M23CSE314 | Full Stack Web Application Development | PE | 3 | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| M23CSE315 | Bioinformatics | PE | 3 | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| M23CSE316 | Cyber Physcial Systems | PE | 3 | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| M23CSE317 | Mixed Reality | PE | 3 | 3 | 1 | 0 | 4 | 40 | 60 | 100 |

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## PROJECT WORK (PW)

| Course Code | Course Name | CT | Instructional Hours | | | | | Assessment | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | CP | L | T | P | C | CIA | ESE | Total |
| M23CSP301 | Project Work - Phase I | PW | 12 | 0 | 12 | 0 | 6 | 40 | 60 | 100 |
| M23CSP401 | Project Work - Phase II | PW | 24 | 0 | 24 | 0 | 12 | 40 | 60 | 100 |

## CAREER ENHANCEMENT COURSE (CEC)

| Course Code | Course Name | CT | Instructional Hours | | | | | Assessment | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | CP | L | T | P | C | CIA | ESE | Total |
| M23CSP202 | Term Paper and Seminar | CEC | 2 | 0 | 2 | 0 | 1 | 100 | - | 100 |



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**Semester - I**

| M.E | M23CST101- RESEARCH METHODOLOGY AND IPR | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**Course Objectives**

1. To understand the basics of research formulation and design
2. To learn the concept of data collection and sources.
3. To study about data analytics and report writing.
4. To learn the concept of IPR.
5. To understand about the benefits and registration of patent.

**UNIT – I** RESEARCH DESIGN **9**

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

**UNIT – II** DATA COLLECTION AND SOURCES **9**

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

**UNIT – III** DATA ANALYSIS AND REPORTING **9**

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

**UNIT – IV** INTELLECTUAL PROPERTY RIGHTS **9**

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

**UNIT – V** PATENTS **9**

Patents – objectives and benefits of patent, Concept, features of patent, Inventive step, Specification, Types of patent application, process E-filing, Examination of patent, Grant of

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patent, Revocation, Equitable Assignments, Licenses, Licensing of related patents, patent agents, Registration of patent agents.

**Total Instructional hours: 45**

**Course Outcomes**

Students will be able to:

**CO1:** Outline the concept of research formulation and design.

**CO2:** Demonstrate the process of data collection and sources.

**CO3:** Make use of the data analysis methods and report writing.

**CO4:** Apply the basics of IPR and its functions.

**CO5:** Make use of the benefits and registration of patent.

**CO Mapping with PO & PSO**

| CO/PO & PSO | | PO1 (K3) | PO2 (K4) | PO3 (K5) | PO4 (K5) | PO5 (K6) | PO6 (K3) (A3) | PO7 (K2) (A3) | PO8 (K3) (A3) | PO9 (A3) | PO10 (A3) | PO11 (K3) (A3) | PO12 (A3) | PSO1 (K4) (A3) | PSO2 (K3) (A3) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | K2 | 2 | 2 | 1 | - | - | 1 | - | - | - | - | - | 1 | 1 | 2 |
| CO2 | K2 | 3 | 2 | 2 | - | - | 1 | - | - | - | - | - | 1 | 2 | 3 |
| CO3 | K3 | 3 | 2 | 2 | - | - | 1 | - | - | - | - | - | 1 | 2 | 3 |
| CO4 | K3 | 2 | 2 | 2 | - | - | 1 | - | - | - | - | - | 1 | 1 | 2 |
| CO5 | K3 | 2 | 2 | 1 | - | - | 1 | - | - | - | - | - | 1 | 2 | 2 |
| Weighted Average | | 3 | 2 | 2 | - | - | 1 | - | - | - | - | - | 1 | 2 | 2 |

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**3 – Strong** **2- Moderate** **1- Weak**

**Reference Books**


1. The Institute of Company Secretaries of India, Statutory body under an Act of parliament, “Professional Programme Intellectual Property Rights, Law and practice”, September 2013
2. Cooper Donald R, Schindler Pamela S and Sharma JK, “Business Research Methods”, Tata McGraw Hill Education, 11e (2012).
3. Catherine J. Holland, “Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets”, Entrepreneur Press, 2007.
4. David Hunt, Long Nguyen, Matthew Rodgers, “Patent searching: tools & techniques”, Wiley, 2007.




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| M.E | M23CST102 - ADVANCED DATA STRUCTURES AND ALGORITHMS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**Course Objectives**

1. To understand the usage of algorithms in computing
2. To learn and use hierarchical data structures and its operations
3. To learn the usage of graphs and its applications
4. To select and design data structures and algorithms that is appropriate for problems
5. To study about NP Completeness of problems.

**UNIT – I ROLE OF ALGORITHMS IN COMPUTING & COMPLEXITY ANALYSIS 9**

Review of Basic Concepts, Asymptotic Analysis of Recurrences Asymptotic notation- Importance of efficient algorithms- Program performance measurement. Randomized Algorithms. Randomized Quicksort, Analysis of Hashing algorithms. The Recursion- Implementing Recursion using Stacks, Queues – ADT.

**UNIT– II HIERARCHICAL DATA STRUCTURES 9**

Binary Search Trees: Basics – Querying a Binary search tree – Insertion and Deletion- Application to Splay Trees. External Memory ADT - B-Trees. Applications to Shortest Path Algorithms .Basic operations on B-Trees. Red Black trees: Properties of Red-Black Trees – Rotations – Insertion – Deletion-Priority Queues and Their Extensions: Heap- Binomial heaps, Fibonacci heaps. String Matching algorithms.

**UNIT– III GRAPHS 9**

Elementary Graph Algorithms: Breadth-First Search – Depth-First Search – Topological Sort – Strongly Connected Components- Minimum Spanning Trees: Growing a Minimum Spanning Tree – Kruskal's and Prims– Single-Source Shortest paths in Directed Acyclic

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Graphs – Dijkstra's Algorithm; Dynamic Programming - All-Pairs Shortest Paths: Shortest Paths and Matrix Multiplication – The Floyd-Warshall's Algorithm-Connectivity.

**UNIT– IV ALGORITHM DESIGN TECHNIQUES 9**

Dynamic Programming: Matrix-Chain Multiplication – Elements of Dynamic Programming – Longest Common Subsequence- Greedy Algorithms: – Elements of the Greedy Strategy- An Activity-Selection Problem - Huffman Coding**.** Backtracking, branch and bound,Brute force search.

**UNIT– V NP COMPLETE AND NP HARD 9**

NP-Completeness: Polynomial Time – Polynomial-Time Verification – NP- Completeness and Reducibility – NP-Completeness Proofs – NP-Complete Problems.

**Total Instructional hours: 45**

**Course Outcomes**

Students will be able to

**CO1**: Apply the computational complexity of different algorithms.

**CO2**: Identify computational solution to well-known problems using hierarchical data structure.

**CO3**: Solve minimum cost problems using graphs.

**CO4**: Apply algorithms using appropriate design techniques.

**CO5**: Infer all the possible solutions for a given problem using Backtracking, Branch and Bound.

**CO Mapping with PO & PSO**

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| CO/PO & PSO | | PO1 (K3) | PO2 (K4) | PO 3 (K5 ) | PO 4 (K5 ) | PO 5 (K6 ) | PO6 (K3) (A3) | PO 7 (K2 ) (A3 ) | PO8 (K3) (A3) | PO9 (A3) | PO10 (A3) | PO11 (K3) (A3) | PO12 (A3) | PSO1 (K4) (A3) | PSO2 (K3) (A3) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | K3 | 3 | 2 | 3 | 2 | 2 | - | - | - | - | - | - | 3 | 2 | 1 |
| CO2 | K3 | 3 | 2 | 2 | 2 | 2 | - | - | - | - | - | - | 2 | 3 | 1 |
| CO3 | K3 | 2 | 2 | 2 | 2 | 2 | - | - | - | - | - | - | 2 | 2 | 2 |
| CO4 | K3 | 3 | 2 | 3 | 2 | 2 | - | - | - | - | - | - | 2 | 2 | 1 |
| CO5 | K2 | 2 | 2 | 2 | 1 | 2 | - | - | - | - | - | - | 3 | 3 | 1 |
| Weighted Average | | 3 | 2 | 2 | 2 | 2 | - | - | - | | - | - | 2 | 2 | 1 |

**3 – Strong** **2- Moderate** **1- Weak**

**Text Books**

1. Jean-Paul Tremblay and Paul G Sorenson, An Introduction to Data structures with Applications, Second Edition, McGraw Hill, 1994 (chapters 0,2-5).

2."Introduction to Algorithms" by Thomas H. Cormen, Charles E Leiserson, Ronald L. Rivest, and Clifford Stein.

**REFERENCES**

1. S.Sridhar," Design and Analysis of Algorithms", Oxford University Press, 1st Edition, 2014.

2. Adam Drozdex, "Data Structures and algorithms in C++", Cengage Learning, 4th Edition, 2013.

Approved by BoS Chairman

3. T.H. Cormen, C.E.Leiserson, R.L. Rivest and C.Stein, "Introduction to Algorithms", Prentice Hall of India, 3rd Edition, 2012.

4. Mark Allen Weiss, “Data Structures and Algorithms in C++”, Pearson Education, 3rd Edition, 2009.

5. E. Horowitz, S. Sahni and S. Rajasekaran, “Fundamentals of Computer Algorithms”, University Press, 2nd Edition, 2008.

6. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, “Data Structures and Algorithms”, Pearson Education, Reprint 2006.



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| M.E | M23CST105- DATABASE PRACTICES | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 4 |

**Course Objectives**

1. Describe the fundamental elements of relational database management systems
2. Explain the basic concepts of relational data model, entity-relationship model, relational database design, relational algebra and SQL.
3. Understand query processing in a distributed database system.
4. Understand the basics of XML and create well-formed and valid XML documents.
5. Distinguish the different types of NoSQL databases

**UNIT – I** RELATIONAL DATA MODEL **12**

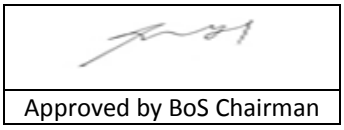
Entity Relationship Model – Relational Data Model – Mapping Entity Relationship Model to Relational Model – Relational Algebra – Structured Query Language – Database Normalization. Data Definition Language: Create, Alter and Drop - Enforce Primary Key, Foreign Key, Check, Unique and Not Null Constraints - Creating Views. Data Manipulation Language: Insert, Delete, Update - Cartesian product -Equi Join, Left Outer Join, Right Outer Join and Full Outer Join - Aggregate Functions - Set Operations - Nested Queries. Transaction Control Language: Commit, Rollback and Save Points.

**UNIT – II** DISTRIBUTED DATABASESOPEN DATABASE CONNECTIVITY **12**

Distributed Database Architecture – Distributed Data Storage – Distributed Transactions – Distributed Query Processing – Distributed Transaction Management – Event Condition Action Model – Design and Implementation Issues for Active Databases – Open Database Connectivity.Suggested Activities: Distributed Database Design and Implementation - Row Level and Statement Level Triggers - Accessing a Relational Database using PHP, Python and R.

**UNIT – III** XML DATABASES **12**

Structured, Semi structured, and Unstructured Data – XML Hierarchical Data Model – XML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Documents – Document Type Definition – XML Schema – XML Documents and Databases – XML Querying – XPath – XQuery. Suggested Activities: Creating XML Documents, Document Type Definition and XML Schema - Using a Relational Database to store the XML documents as text - Using a Relational Database to store the XML documents as data elements - Creating or publishing customized XML documents from pre-existing relational databases - Extracting XML Documents from Relational Databases - XML Querying.

**UNIT – IV** NOSQL DATABASES AND BIG DATA STORAGE SYSTEMS **12**

NoSQL – Categories of NoSQL Systems – CAP Theorem – Document-Based NoSQL Systems and MongoDB – MongoDB Data Model – MongoDB Distributed Systems Characteristics – NoSQL Key-Value Stores – DynamoDB Overview – Voldemort Key-Value Distributed Data Store – Wide Column NoSQL Systems – Hbase Data Model – Hbase Crud Operations – Hbase Storage and Distributed System Concepts – NoSQL Graph Databases and Neo4j – Cypher Query Language of Neo4j – Big Data – MapReduce – Hadoop – YARN.Suggested Activities: Creating Databases using MongoDB, DynamoDB, Voldemort Key-Value Distributed Data Store Hbase and Neo4j- Writing simple queries to access databases created using MongoDB, DynamoDB, Voldemort Key-Value Distributed Data Store Hbase and Neo4j.

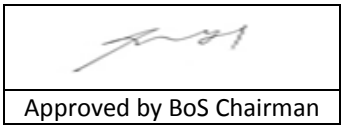
**UNIT – V DATABASE SECURITY** **12**

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

**Total Instructional hours: 60**

**Course Outcomes**

Students will be able to



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**CO1:** Translate the ER-model to relational tables, populate relational databases and formulate SQL queries on data.

**CO2:** Explain and write well-formed XML documents

**CO3:** Apply methods and techniques for distributed query processing.

**CO4:** Experiment with secure database systems.

**CO5:** Make use of the data control, definition, and manipulation languages of the NoSQL databases

**CO Mapping with PO & PSO**

| CO/PO & PSO | | PO1 (K3) | PO2 (K4) | PO3 (K5) | PO4 (K5) | PO5 (K6) | PO6 (K3) (A3) | PO7 (K2) (A3) | PO8 (K3) (A3) | PO9 (A3) | PO10 (A3) | PO11 (K3) (A3) | PO12 (A3) | PSO1 (K4) (A3) | PSO2 (K3) (A3) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | K2 | 3 | 2 | 2 | 2 | 2 | - | - | - | - | - | - | 1 | 2 | 1 |
| CO2 | K2 | 3 | 2 | 2 | 2 | 1 | - | - | - | - | - | - | 1 | 2 | 1 |
| CO3 | K3 | 3 | 2 | 3 | 2 | 1 | - | - | - | - | - | - | 1 | 2 | 2 |
| CO4 | K3 | 2 | 3 | 3 | 2 | 2 | - | - | - | - | - | - | 1 | 1 | 2 |
| CO5 | K3 | 2 | 3 | 3 | 1 | 1 | - | - | - | - | - | - | 1 | 1 | 2 |
| Weighted Average | | 3 | 2 | 3 | 2 | 1 | - | - | - | - | - | - | 1` | 2 | 2 |

**3 – Strong** **2- Moderate** **1- Weak**

**Reference Books**

Approved by BoS Chairman

1. Henry F. Korth, Abraham Silberschatz, S. Sudharshan, “Database System Concepts”, Seventh Edition, McGraw Hill, 2019

2. R. Elmasri, S.B. Navathe, “Fundamentals of Database Systems”, Seventh Edition, Pearson Education 2016.

3. Raghu Ramakrishnan , Johannes Gehrke “Database Management Systems”, Fourth Edition, McGraw Hill Education, 2015.

4. Harrison, Guy, “Next Generation Databases, NoSQL and Big Data” , First Edition, Apress publishers, 2015.

5. C.J.Date, A.Kannan, S.Swamynathan, “An Introduction to Database Systems, Eighth Edition, Pearson Education, 2006



Approved by BoS Chairman

| M.E | M23CST103 - NETWORK TECHNOLOGIES | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**Course Objectives:**

1. To understand the basic concepts of networks.
2. To explore various technologies in the wireless domain.
3. To study about 4G and 5G cellular networks.
4. To learn about Network Function Virtualization.
5. To understand the paradigm of Software defined networks

**UNIT – I** NETWORKING CONCEPTS **9**

Peer To Peer Vs Client-Server Networks. Network Devices. Network Terminology. Network Speeds. Network throughput, delay. OSI Model. Packets, Frames, And Headers. Collision AndBroadcast Domains. LAN Vs WAN. Network Adapter. Hub. Switch. Router. Firewall, IP addressing.

**UNIT – II** **WIRELESS NETWORKS** **9**

Wireless access techniques- IEEE 802.11a, 802.11g, 802.11e, 802.11n/ac/ax/ay/ba/be, QoS – Bluetooth – Protocol Stack – Security – Profiles – zigbee.

**UNIT – III** **MOBILE DATA NETWORKS** **9**

4G Networks and Composite Radio Environment – Protocol Boosters – Hybrid 4G Wireless Networks Protocols – Green Wireless Networks – Physical Layer and Multiple Access – Channel Modelling for 4G – Concepts of 5G – channel access –air interface -Cognitive Radiospectrum management – C-RAN architecture - Vehicular communications-protocol – Network slicing – MIMO, mmWave, Introduction to 6G.

**UNIT – IV** **SOFTWARE DEFINED NETWORKS** **9**

SDN Architecture. Characteristics of Software-Defined Networking. SDN- and NFV-Related Standards. SDN Data Plane. Data Plane Functions. Data Plane Protocols. OpenFlow

Approved by BoS Chairman

Logical Network Device. Flow Table Structure. Flow Table Pipeline. The Use of Multiple Tables. Group Table. OpenFlow Protocol. SDN Control Plane Architecture. Control Plane Functions. Southbound Interface. Northbound Interface. Routing. ITU-T Model. OpenDaylight. OpenDaylight Architecture. OpenDaylight Helium. SDN Application Plane Architecture. Northbound Interface. Network Services Abstraction Layer. Network Applications. User Interface.

**UNIT – V NETWORK FUNCTIONS VIRTUALIZATION 9**

Motivation-Virtual Machines –NFV benefits-requirements – architecture- NFV Infrastructure - Virtualized Network Functions - NFV Management and Orchestration- NFV Use Cases- NFV and SDN –Network virtualization – VLAN and VPN

**Total Instructional hours: 45**

**Course Outcomes**

Students will be able to

**CO1:** Explain basic networking concepts

**CO2:** Compare different wireless networking protocols

**CO3:**Identify the developments in each generation of mobile data networks.

**CO4** Plan and develop SDN based applications.

**CO5:**Interpret the concepts of network function virtualization

**CO Mapping with PO & PSO**

Approved by BoS Chairman

| CO/PO& PSO | | PO1 (K3) | PO2 (K4) | PO3 (K5) | PO4 (K5) | PO5 (K6) | PO6 (K3) (A3) | PO7 (K2) (A3) | PO8 (K3) (A3) | PO9 (A3) | PO10 (A3) | PO11 (K3) (A3) | PO12 (A3) | PSO1 (K4) (A3) | PSO2 (K3) (A3) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | K2 | 2 | 1 | 1 | - | - | - | - | - | - | - | - | 1 | 2 | 1 |
| CO2 | K2 | 2 | 2 | 2 | - | - | - | - | - | - | - | - | 1 | 2 | 1 |
| CO3 | K3 | 3 | 2 | 2 | - | - | - | - | - | - | - | - | 1 | 2 | 1 |
| CO4 | K3 | 3 | 2 | 2 | - | - | - | - | - | - | - | - | 1 | 1 | 1 |
| CO5 | K2 | 3 | 2 | 1 | - | - | - | - | - | - | - | - | 1 | 1 | 1 |
| Weighted Average | | 3 | 2 | 2 | - | - | - | - | - | - | - | - | 1 | 2 | 1 |

**3 – Strong** **2- Moderate** **1- Weak**

**Reference Books:**

1.James Bernstein, “Networking made Easy”, 2018. ( UNIT I )

2.HoudaLabiod, Costantino de Santis, HossamAfifi “Wi-Fi, Bluetooth, Zigbee and WiMax”, Springer 2007 ( UNIT 2 )

3.Erik Dahlman, Stefan Parkvall, Johan Skold, 4G: LTE/LTE-Advanced for Mobile Broadband, Academic Press, 2013 ( UNIT 3)

4.Saad Z. Asif “5G Mobile Communications Concepts and Technologies” CRC press – 2019 (UNIT 3)

5. William Stallings “Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud” 1st Edition, Pearson Education, 2016.( Unit 4 and 5 )

Approved by BoS Chairman

| M.E | M23CST104 - PRINICIPLES OF PROGRAMMING LANGUAGES | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**Course Objectives:**

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

**UNIT I SYNTAX AND SEMANTICS** 9

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

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

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

**UNIT III SUBPROGRAMS AND IMPLEMENTATIONS** **9**

Subprograms – design issues – local referencing – parameter passing – overloaded methods – Generic methods – design issues for functions – semantics of call and return – implementing Simple subprograms – stack and dynamic local variables – nested

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subprograms – blocks – Dynamic scoping- Introductions to Data Abstraction- Design Issues- Language Examples- Encapsulation Constructs- Naming Encapsulations.

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

Object-orientation – design issues for OOP languages – implementation of object-oriented constructs – concurrency in function languages – semaphores – monitors – message passing – threads – statement level concurrency – exception handling in Ada,c++,JAVA – event handling.

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

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

**Total Instructional hours: 45**

**Course Outcomes**

**CO1**: Analyze syntax and semantics of programming languages

**CO2**: Explain data, data types, and basic statements of programming languages

**CO3**: Develop and implement subprogram constructs

**CO4**: Apply object-oriented, concurrency, and event handling programming constructs

**CO5**: Develop programs in Scheme, ML, and Prolog and Understand and adopt new programming language.

**CO Mapping with PO & PSO**

| |
|---|
| Approved by BoS Chairman |

| CO/PO & PSO | | PO1 (K3) | PO2 (K4) | PO 3 (K5 ) | PO 4 (K5 ) | PO 5 (K6 ) | PO6 (K3) (A3) | PO 7 (K2 ) (A3 ) | PO8 (K3) (A3) | PO9 (A3) | PO10 (A3) | PO11 (K3) (A3) | PO12 (A3) | PSO1 (K4) (A3) | PSO2 (K3) (A3) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | K4 | 3 | 1 | 2 | 1 | 1 | - | - | - | - | - | - | 3 | 2 | 2 |
| CO2 | K2 | 3 | 2 | 2 | 2 | 1 | - | - | - | - | - | - | 2 | 3 | 2 |
| CO3 | K3 | 3 | 2 | 3 | 2 | 1 | - | - | - | - | - | - | 2 | 2 | 3 |
| CO4 | K3 | 3 | 2 | 2 | 2 | 2 | - | - | - | - | - | - | 1 | 2 | 2 |
| CO5 | K3 | 2 | 2 | 3 | 1 | 3 | - | - | - | - | - | - | 3 | 3 | 1 |
| Weighted Average | | 3 | 3 | 2 | 2 | 1 | - | - | - | | - | - | 2 | 2 | 2 |

**3 – Strong** **2- Moderate** **1- Weak**

**REFERENCES**


1. Concepts of Programming Languages Robert. W. Sebesta 10/E, Pearson Education.
2. Programming Language Design Concepts, D. A. Watt, Wiley Dreamtech, 2007.
3. Robert W. Sebesta, “Concepts of Programming Languages”, Eleventh Edition, Addison Wesley,2012
4. W. F. Clocksin and C. S. Mellish, “Programming in Prolog: Using the ISO Standard”, Fifth Edition, Springer, 2003
5. Michael L.Scott, “Programming Language Pragmatics”, Fourth Edition, Morgan Kaufmann, 2009.
6. R.KentDybvig,“TheSchemeprogramminglanguage”,FourthEdition,MITPress, 2009
7. Richard A. O'Keefe, “The craft of Prolog”, MIT Press, 2009
8. W.F.ClocksinandC.S.Mellish,“ProgramminginProlog:UsingtheISOStandard”,Fifth Edition, Springer,2003


Approved by BoS Chairman

| M.E | M23CSP101- ADVANCED DATA STRUCTURES AND ALGORITHMS LABORATORY | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 4 | 2 |

**Course Objectives:**

1. To acquire the knowledge of using advanced tree structures
2. To learn the usage of heap structures
3. To understand the usage of graph structures and spanning trees
4. To understand the problems such as matrix chain multiplication, activity selection and Huffman coding
5. To understand the necessary mathematical abstraction to solve problems.

**List of Experiments**

| Expt. No. | Description of the Experiments |
|---|---|
| 1. | Implementation of randomized quicksort algorithm |
| 2. | Implementation of hash functions and associated algorithms |
| 3. | Implementation of operations on splay trees |
| 4. | Implementation of operations on Fibonacci heaps |
| 5. | Implementation of operations on binary heaps |
| 6. | Implementation on operations on B-Trees |
| 7. | Implementation of operations on partition ADT and union-find data structures |
| 8. | Graph Traversals |
| 9. | Shortest Path Algorithms (Dijkstra's algorithm, Bellman Ford Algorithm) |
| 10. | Implementation of Matrix Chain Multiplication |

**Total Instructional hours: 45**

**Course Outcomes:**

Students will be able to

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**CO1:**Design data structures and algorithms to solve computing problems.

**CO2:**Choose and implement efficient data structures and apply them to solve problems.

**CO3:** Design algorithms using graph structure and various string-matching algorithms to solve real-life problems.

**CO4:** Design one's own algorithm for an unknown problem.

**CO5:** Apply suitable design strategy for problem solving.

**CO Mapping with PO & PSO**

| CO/PO & PSO | | PO1 (K3) | PO2 (K4) | PO3 (K5) | PO4 (K5) | PO5 (K6) | PO6 (K3) (A3) | PO7 (K2) (A3) | PO8 (K3) (A3) | PO9 (A3) | PO10 (A3) | PO11 (K3) (A3) | PO12 (A3) | PSO1 (K4) (A3) | PSO2 (K3) (A3) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | K3 | 2 | 1 | 3 | 2 | 2 | - | - | - | 2 | 2 | 2 | 3 | 2 | 2 |
| CO2 | K2 | 1 | 2 | 2 | 2 | 2 | - | - | - | 2 | 2 | 2 | 2 | 3 | 2 |
| CO3 | K3 | 2 | 2 | 2 | 2 | 2 | - | - | - | 1 | 1 | 3 | 2 | 2 | 3 |
| CO4 | K3 | 2 | 2 | 1 | 2 | 2 | - | - | - | 2 | 2 | 2 | 1 | 2 | 2 |
| CO5 | K3 | 2 | 2 | 2 | 1 | 2 | - | - | - | 3 | 2 | 2 | 3 | 3 | 1 |
| Weighted Average | | 2 | 3 | 2 | 2 | 2 | 2 | - | - | 2 | 2 | 2 | 2 | 2 | 2 |

**3 – Strong** **2- Moderate** **1- Weak**

**List of Equipment Required:**

**Requirements for a Batch of 25 Students**

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| Sl. No. | Description of the Equipment | Quantity required (Nos.) |
|---|---|---|
| 1. | 1. 64-bit Open source Linux or its derivative<br>2. Open Source C/C++ Programming tool like G++/GC | 25 |



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**Semester - II**

| M.E | M23CST204- INTERNET OF THINGS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 4 |

**Course Objectives:**

1. To Understand the Architectural Overview of IoT.
2. To Understand the IoT Reference Architecture and Real World Design Constraints
3. To Understand the various IoT levels.
4. To understand the basics of cloud architecture.
5. To gain experience in Raspberry PI and experiment simple IoT application on it.

**UNIT I INTRODUCTION 12**

Internet of Things- Domain Specific IoTs - IoT and M2M-Sensors for IoT Applications–Structure of IoT–IoT Map Device

**UNIT II IoT ARCHITECTURE, GENERATIONS 12**

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

**UNIT III IoT PROTOCOLS AND TECHNOLOGY 12**

SCADA and RFID Protocols - BACnet Protocol -Zigbee Architecture - 6LowPAN - CoAP–WirelessSensor Structure–Energy Storage Module–Power Management Module–RF Module–SensingModule

**UNIT IV CLOUD ARCHITECTURE BASICS 12**

The Cloud types; IaaS, PaaS, SaaS.- Development environments for service development; Amazon,Azure, Google Appcloud platform in industry

**UNIT V IOT WITH RASPBERRY PI 12**

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

**Total Instructional hours: 60**

**Course Outcomes:**

Students will be able to

**CO1:** Demonstrate the various concept of the IoT and their technologies

**CO2:** Develop the IoT application using different hardware platforms

**CO3:** Choose various IoT Protocols

**CO4:** Outline the basic principles of cloud computing

**CO5:** Develop and deploy the IoT application into cloud environment

**CO Mapping with PO & PSO**

| CO/PO & PSO | | PO1 (K3) | PO2 (K4) | PO3 (K5) | PO4 (K5) | PO5 (K6) | PO6 (K3) (A3) | PO7 (K2) (A3) | PO8 (K3) (A3) | PO9 (A3) | PO10 (A3) | PO11 (K3) (A3) | PO12 (A3) | PSO1 (K4) (A3) | PSO2 (K3) (A3) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **K2** | 3 | 2 | 2 | 2 | 2 | - | - | - | 2 | 2 | 2 | 2 | 2 | 2 |
| **CO2** | **K3** | 3 | 2 | 3 | 2 | 2 | - | - | - | 2 | 2 | 3 | 3 | 2 | 2 |
| **CO3** | **K3** | 3 | 2 | 2 | 2 | 2 | - | - | - | 2 | 2 | 2 | 2 | 3 | 2 |
| **CO4** | **K2** | 2 | 2 | 2 | 2 | 2 | - | - | - | 2 | 2 | 3 | 2 | 2 | 3 |
| **CO5** | **K3** | 3 | 2 | 3 | 2 | 2 | - | - | - | 2 | 2 | 2 | 2 | 2 | 2 |
| **Weighted Average** | | 3 | 2 | 2 | 2 | 2 | - | - | - | 2 | 2 | 2 | 2 | 2 | 2 |

Approved by BoS Chairman

**3 – Strong** **2- Moderate** **1- Weak**

**Reference Books:**


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


Approved by BoS Chairman

| M.E | M19CST202 MULTICORE ARCHITECTURE AND PROGRAMMING | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 4 |

**Course Objectives:**

1. To understand the need for multi-core processors, and their architecture.
2. To understand the challenges in parallel and multithreaded programming.
3. To learn about the various parallel programming paradigms,
4. To learn distributed memory and MPI concepts
5. To develop multicore programs and design parallel solutions.

**UNIT I MULTI-CORE PROCESSORS 12**

Single core to Multi-core architectures – SIMD and MIMD systems – Interconnection networks –Symmetric and Distributed Shared Memory Architectures – Cache coherence – PerformanceIssues – Parallel program design.

**UNIT II PARALLEL PROGRAM CHALLENGES 12**

Performance – Scalability – Synchronization and data sharing – Data races – Synchronization primitives (mutexes, locks, semaphores, barriers) – deadlocks and livelocks – communicationbetween threads .

**UNIT III SHARED MEMORY PROGRAMMING WITH OpenMP 12**

OpenMP Execution Model – Memory Model – OpenMP Directives – Work-sharing Constructs –Library functions – Handling Data and Functional Parallelism – Handling Loops – PerformanceConsiderations.

**UNIT IV DISTRIBUTED MEMORY PROGRAMMING WITH MPI 12**

MPI program execution – MPI constructs – libraries – MPI send and receive – Point-to-point andCollective communication – MPI derived datatypes – Performance evaluation

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**UNIT V PARALLEL PROGRAM DEVELOPMENT 12**

Case studies – n-Body solvers – Tree Search – OpenMP and MPI implementations and comparison.

**Total Instructional hours: 60**

**Course Outcomes:**

Students will be able to

**CO1:** Outline multicore architectures and identify their characteristics and challenges.

**CO2**: Identify the issues in programming Parallel Processors.

**CO3**: Develop programs using Open MP and MPI

**CO4**: Experiment with parallel programming solutions to common problems.

**CO5**: Compare and contrast programming for serial and for parallel processors.

**CO Mapping with PO & PSO**

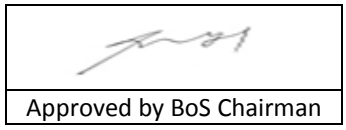
| CO/PO & PSO | | PO1 (K3) | PO2 (K4) | PO3 (K5) | PO4 (K5) | PO5 (K6) | PO6 (K3) (A3) | PO7 (K2) (A3) | PO8 (K3) (A3) | PO9 (A3) | PO10 (A3) | PO11 (K3) (A3) | PO12 (A3) | PSO1 (K4) (A3) | PSO2 (K3) (A3) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **K2** | 3 | 2 | 2 | 2 | 2 | - | - | - | 2 | 2 | 3 | 3 | 2 | 2 |
| **CO2** | **K3** | 3 | 2 | 2 | 2 | 2 | - | - | - | 2 | 2 | 2 | 2 | 3 | 2 |
| **CO3** | **K3** | 3 | 2 | 2 | 2 | 2 | - | - | - | 2 | 2 | 3 | 2 | 2 | 3 |
| **CO4** | **K3** | 3 | 1 | 2 | 2 | 2 | - | - | - | 2 | 2 | 2 | 2 | 2 | 2 |
| **CO5** | **K2** | 3 | 1 | 2 | 2 | 2 | - | - | - | 2 | 2 | 2 | 3 | 3 | 2 |
| **Weighted Average** | | 3 | 2 | 2 | 2 | 2 | - | - | - | 2 | 2 | 2 | 2 | 2 | 2 |

Approved by BoS Chairman

**3 – Strong** **2- Moderate** **1- Weak**

**Reference Books:**

1. Peter S. Pacheco, “An Introduction to Parallel Programming, Morgan-Kauffman/Elsevier,2021.
2. Darryl Gove, “Multicore Application Programming for Windows, Linux, and Oracle Solaris, Pearson, 2011 (unit 2)
3. Michael J Quinn, “Parallel programming in C with MPI and OpenMP, Tata McGraw Hill,2003.
4. Victor Alessandrini, Shared Memory Application Programming, 1st Edition, Concepts and Strategies in Multicore Application Programming, Morgan Kaufmann, 2015.
5. Yan Solihin, Fundamentals of Parallel Multicore Architecture, CRC Press, 2015.



Approved by BoS Chairman

| M.E | M23CST203 - MACHINE LEARNING | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 4 |

**Course Objectives:**

1. To understand the concepts and mathematical foundations of machine learning and types of problems tackled by machine learning
2. To explore the different supervised learning techniques including ensemble methods
3. To learn different aspects of unsupervised learning and reinforcement learning
4. To learn the role of probabilistic methods for machine learning
5. To understand the basic concepts of neural networks and deep learning

**UNIT I INTRODUCTION AND MATHEMATICAL FOUNDATIONS 12**

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

**UNIT II SUPERVISED LEARNING 12**

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

**UNIT III UNSUPERVISED LEARNING AND REINFORCEMENT LEARNING 12**

Introduction - Clustering Algorithms -K – Means – Hierarchical Clustering - Cluster Validity -

Dimensionality Reduction –Principal Component Analysis – Recommendation Systems – EM algorithm. Reinforcement Learning – Elements -Model based Learning – Temporal Difference Learning

Approved by BoS Chairman

**UNIT IV PROBABILISTIC METHODS FOR LEARNING** **12**

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

**UNIT V NEURAL NETWORKS AND DEEP LEARNING** **12**

Neural Networks – Biological Motivation- Perceptron – Multi-layer Perceptron – Feed Forward Network – Back Propagation-Activation and Loss Functions- Limitations of Machine Learning – Deep Learning– Convolution Neural Networks – Recurrent Neural Networks – Use cases

**Total Instructional hours: 60**

**Course Outcomes:**

Students will be able to

**CO1**: Outline problems for each type of machine learning

**CO2**: Illustrate Decision tree and Random forest for an application

**CO3**: Experiment Probabilistic Discriminative and Generative algorithms

**CO4**: Make Use of a tool to implement typical Clustering algorithms

**CO5**: Organize a HMM for a Sequence Model type of applications and suitable for different types of Machine Learning

**CO Mapping with PO & PSO**

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| CO/PO & PSO | | PO1 (K3) | PO2 (K4) | PO3 (K5) | PO4 (K5) | PO5 (K6) | PO6 (K3) (A3) | PO7 (K2) (A3) | PO8 (K3) (A3) | PO9 (A3) | PO10 (A3) | PO11 (K3) (A3) | PO12 (A3) | PSO1 (K4) (A3) | PSO2 (K3) (A3) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **K2** | 3 | 2 | 3 | 2 | 2 | - | - | - | 2 | 2 | 3 | 3 | 2 | 2 |
| **CO2** | **K2** | 3 | 2 | 2 | 2 | 2 | - | - | - | 2 | 2 | 2 | 2 | 3 | 2 |
| **CO3** | **K3** | 2 | 2 | 2 | 2 | 2 | - | - | - | 2 | 2 | 3 | 2 | 2 | 3 |
| **CO4** | **K3** | 3 | 2 | 3 | 2 | 2 | - | - | - | 2 | 2 | 2 | 2 | 2 | 2 |
| **CO5** | **K3** | 2 | 2 | 2 | 1 | 2 | - | - | - | 2 | 2 | 2 | 3 | 3 | 2 |
| **Weighted Average** | | 3 | 2 | 2 | 2 | 2 | - | - | - | 2 | 2 | 2 | 2 | 2 | 2 |

**3 – Strong** **2- Moderate** **1- Weak**

**Reference Books:**

1.Stephen Marsland, “Machine Learning: An Algorithmic Perspective”, Chapman /CRC, 2nd Edition, 2014.

2. Kevin Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012

3. Ethem Alpaydin, “Introduction to Machine Learning”, Third Edition, Adaptive Computation and Machine Learning Series, MIT Press, 2014

4. Tom M Mitchell, “Machine Learning”, McGraw Hill Education, 2013.

5. Peter Flach, “Machine Learning: The Art and Science of Algorithms that Make Sense of Data”, First Edition, Cambridge University Press, 2012.

Approved by BoS Chairman

| M.E | M23CST201-ADVANCED SOFTWARE ENGINEERING | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**Course Objectives:**

1. To understand the rationale for software development process models
2. To understand why the architectural design of software is important;
3. To understand the five important dimensions of dependability, namely, availability, reliability, safety, security, and resilience.
4. To understand the basic notions of a web service, web service standards, and service-oriented architecture.
5. To understand the different stages of testing from testing during development of a software system.

**UNIT I SOFTWARE PROCESS & MODELING 9**

Prescriptive Process Models – Agility and Process – Scrum – XP – Kanban – DevOps – Prototype Construction – Prototype Evaluation – Prototype Evolution – Modelling – Principles – Requirements Engineering – Scenario-based Modelling – Class-based Modelling – Functional Modelling – Behavioural Modelling.

**UNIT II SOFTWARE DESIGN 9**

Design Concepts – Design Model – Software Architecture – Architectural Styles – Architectural Design – Component-Level Design – User Experience Design – Design for Mobility – Pattern- Based Design.

**UNIT III SYSTEM DEPENDABILITY AND SECURITY 9**

Dependable Systems – Dependability Properties – Sociotechnical Systems – Redundancy and Diversity – Dependable Processes – Formal Methods and Dependability – Reliability Engineering – Availability and Reliability – Reliability Requirements – Fault-tolerant Architectures – Programming for Reliability – Reliability Measurement – Safety Engineering – Safety-critical Systems – Safety Requirements – Safety Engineering Processes – Safety

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Cases – Security Engineering – Security and Dependability – Safety and Organizations – Security Requirements – Secure System Design – Security Testing and Assurance .

**UNIT IV SERVICE-ORIENTED, SYSTEMS ENGINEERING AND REAL-TIME SOFTWARE ENGINEERING 9**

Service-oriented Architecture – RESTful Services – Service Engineering – Service Composition – Systems Engineering – Sociotechnical Systems – Conceptual Design – System Procurement – System Development – System Operation and Evolution – Real-time Software Engineering – Embedded System Design – Architectural Patterns for Real-time Software – Timing Analysis – Real-time Operating Systems.

**UNIT V SOFTWARE TESTING AND SOFTWARE CONFIGURATION MANAGEMENT 9**

Software Testing Strategy – Unit Testing – Integration Testing – Validation Testing – System Testing – Debugging – White-Box Testing – Basis Path Testing – Control Structure Testing – Black- Box Testing – Software Configuration Management (SCM) – SCM Repository – SCM Process – Configuration Management for Web and Mobile Apps.

**Total Instructional hours: 45**

**Course Outcomes:**

Students will be able to

**CO1:** Identify appropriate process models based on the Project requirements

**CO2**: Outline the importance of having a good Software Architecture.

**CO3**: Demonstrate the five important dimensions of dependability, Namely, availability, reliability, safety, security, and resilience.

**CO4**. Infer the basic notions of a web service, web service Standards, and service- oriented architecture;

**CO5**: Experiment with various levels of Software testing

**CO Mapping with PO & PSO**

Approved by BoS Chairman

| CO/PO & PSO | | PO1 (K3) | PO2 (K4) | PO3 (K5) | PO4 (K5) | PO5 (K6) | PO6 (K3) (A3) | PO7 (K2) (A3) | PO8 (K3) (A3) | PO9 (A3) | PO10 (A3) | PO11 (K3) (A3) | PO12 (A3) | PSO1 (K4) (A3) | PSO2 (K3) (A3) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **K2** | 3 | 2 | 3 | 2 | 2 | - | - | - | 2 | 2 | 2 | 2 | 2 | 2 |
| **CO2** | **K2** | 3 | 2 | 2 | 2 | 2 | - | - | - | 2 | 2 | 2 | 2 | 2 | 2 |
| **CO3** | **K2** | 2 | 2 | 2 | 2 | 2 | - | - | - | 2 | 2 | 2 | 2 | 2 | 2 |
| **CO4** | **K2** | 3 | 2 | 3 | 2 | 2 | - | - | - | 2 | 2 | 2 | 2 | 2 | 2 |
| **CO5** | **K3** | 3 | 2 | 2 | 2 | 2 | - | - | - | 2 | 2 | 2 | 2 | 2 | 2 |
| **Weighted Average** | | 3 | 2 | 2 | 2 | 2 | - | - | - | 2 | 2 | 2 | 2 | 2 | 2 |

**3 – Strong** **2- Moderate** **1- Weak**

**Reference Books:**


1. Software Engineering: A Practitioner's Approach, 9 th Edition. Roger Pressman and Bruce Maxim, McGraw-Hill 2019.
2. Software Engineering, 10 th Edition, Ian Somerville, Pearson Education Asia 2016.
3. Software Architecture In Practice, 3 rd Edition, Len Bass, Paul Clements and Rick Kazman, Pearson India 2018.
4. An integrated approach to Software Engineering, 3 rd Edition, Pankaj Jalote, Narosa Publishing House, 2018.
5. Fundamentals of Software Engineering, 5 th Edition, Rajib Mall, PHI Learning Private Ltd, 2018


Approved by BoS Chairman

| M.E | M23CSE201- HUMAN COMPUTER INTERACTION | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**Course Objectives:**

1. To learn the foundations of Human Computer Interaction
2. Understanding Interaction Styles and to become familiar with the design technologies for all.
3. To understand the process of Evaluation of Interaction Design.
4. To clarify the significance of task analysis for ubiquitous computing
5. To get insight on web and mobile interaction.

**UNIT I FOUNDATIONS OF HCI 9**

Context of Interaction –Human memory - Designing Interactive systems – Understanding Users-cognition and cognitive frameworks, User Centered approaches Usability, Universal Usability, Guidelines, Principles and Theories. Importance of User Interface: Definition-Importance of good design-Benefits of good design-Human-centered development and Evaluation-Human Performance models-Device for virtual reality and 3D interaction.

**UNIT II INTERACTION STYLES 9**

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

**UNIT III EVALUATION OF INTERACTION 9**

Evaluation Techniques- assessing user experience- usability testing –HCI in the software process, analytics predictive models. Cognitive models, Socio-organizational issues and stakeholder requirements, Communication and collaboration models

**UNIT IV MODELS AND THEORIES 9**

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

Approved by BoS Chairman

**UNIT V WEB AND MOBILE INTERACTION 9**

Hypertext, Multimedia and WWW, Designing for the web Direct Selection, control flow, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow. Use, shared application and artifacts, Mobile navigation, content and control idioms, Multi-touch gestures, Inter- app integration, Mobile web.

**Total Instructional hours: 45**

**Course Outcomes:**

Students will be able to

**CO1:** Show the basics of human computer interactions via usability engineering and cognitive modeling.

**CO2:** Identify the basic design paradigms, complex interaction styles.

**CO3.** Compare the models and theories for user interaction

**CO4:** Examine the evaluation of interaction designs and implementations.

**CO5**: Classify the above issues for web and mobile applications.

**CO Mapping with PO & PSO**

| CO/PO & PSO | | PO1 (K3) | PO2 (K4) | PO3 (K5) | PO4 (K5) | PO5 (K6) | PO6 (K3) (A3) | PO7 (K2) (A3) | PO8 (K3) (A3) | PO9 (A3) | PO10 (A3) | PO11 (K3) (A3) | PO12 (A3) | PSO1 (K4) (A3) | PSO 2 (K3) (A3) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | K2 | 3 | 2 | 2 | 3 | 2 | - | - | - | 1 | 1 | 1 | 2 | 1 | 1 |
| CO2 | K3 | 2 | 2 | 3 | 2 | 2 | - | - | - | 1 | 1 | 2 | 2 | 2 | 1 |
| CO3 | K2 | 2 | 2 | 3 | 2 | 2 | - | - | - | 1 | 1 | 1 | 2 | 1 | 1 |
| CO4 | K4 | 3 | 3 | 3 | 2 | 3 | - | - | - | 1 | 1 | 1 | 2 | 2 | 1 |
| CO5 | K2 | 3 | 3 | 3 | 2 | 3 | - | - | - | 1 | 1 | 2 | 2 | 2 | 1 |
| Weighted Average | | 3 | 2 | 3 | 2 | 2 | - | - | - | 1 | 1 | 1 | 2 | 2 | 1 |

**3- Strong** **2- Moderate** **1- Weak**

**Reference Books:**


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


Approved by BoS Chairman

| M.E | M23CSE202 CLOUD COMPUTING TECHNOLOGIES | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

1. To gain expertise in Virtualization, Virtual Machines and deploy practical virtualization solution
2. To understand the architecture, infrastructure and delivery models of cloud computing.
3. To explore the roster of AWS services and illustrate the way to make applications in AWS
4. To gain knowledge in the working of Windows Azure and Storage services offered by Windows Azure
5. To develop the cloud application using various programming model of Hadoop and Aneka

**UNIT I VIRTUALIZATION AND INFRASTRUCTURE 6**

Basics of Virtual Machines - Process Virtual Machines – System Virtual Machines –Emulation – Interpretation – Services and applications. Virtualization –Management Virtualization - Hardware Maximization – Architectures – Virtualization Management – Storage Virtualization – Network Virtualization- Implementation levels of virtualization – virtualization structure – virtualization of CPU, Memory and I/O devices –Resource Management – Virtualization for data center automation

**UNIT II CLOUD PLATFORM ARCHITECTURE 12**

Cloud Computing: Definition, Characteristics - Cloud deployment models: public, private, hybrid, community – Categories of cloud computing: Everything as a service: Infrastructure, platform, software- A Generic Cloud Architecture Design – Layered cloud Architectural Development – Architectural Design Challenges, Understanding Hypervisors.

**UNIT III AWS CLOUD PLATFORM - IAAS 9**

Amazon Web Services: AWS Infrastructure- AWS API- AWS Management Console - Setting up AWS Storage - Stretching out with Elastic Compute Cloud - Elastic Container Service for Kubernetes- AWS Developer Tools: AWS Code Commit, AWS Code Build, AWS Code Deploy, AWS Code Pipeline, AWS code Star - AWS Management Tools: Cloud Watch, AWS Auto Scaling, AWS control Tower, Cloud Formation, Cloud Trail, AWS License Manager

**UNIT IV PAAS CLOUD PLATFORM 9**

Windows Azure: Origin of Windows Azure, Features, The Fabric Controller – First Cloud APP in Windows Azure- Service Model and Managing Services: Definition and Configuration, Service runtime API- Windows Azure Developer Portal- Service Management API- Windows Azure Storage Characteristics-Storage Services- REST API- Blops

Approved by BoS Chairman

**UNIT V PROGRAMMING MODEL 9**

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

**Total Instructional hours: 45**

**Course Outcomes:**

Students will be able to

**CO1:** Explain the concepts of virtualization in the cloud computing

**CO2:** Identify the architecture, infrastructure and delivery models of cloud computing

**CO3:** Develop the Cloud Application in AWS platform

**CO4**: Apply the concepts of Windows Azure to design Cloud Application

**CO5:** Develop services using various Cloud computing programming models.

| CO/PO & PSO | | PO1 (K3) | PO2 (K4) | PO3 (K5) | PO4 (K5) | PO5 (K6) | PO6 (K3) (A3) | PO7 (K2) (A3) | PO8 (K3) (A3) | PO9 (A3) | PO10 (A3) | PO11 (K3) (A3) | PO12 (A3) | PSO1 (K4) (A3) | PSO2 (K3) (A3) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **K2** | 3 | 2 | 2 | 2 | 2 | - | 1 | - | 1 | - | - | 2 | 2 | 2 |
| **CO2** | **K3** | 3 | 2 | 2 | 2 | 2 | - | 1 | - | 1 | - | - | 2 | 3 | 2 |
| **CO3** | **K3** | 3 | 3 | 2 | 3 | 3 | - | 1 | - | 1 | - | - | 2 | 3 | 2 |
| **CO4** | **K3** | 3 | 3 | 2 | 3 | 3 | - | 1 | - | 1 | - | - | 2 | 3 | 2 |
| **CO5** | **K3** | 3 | 3 | 2 | 3 | 3 | - | 1 | - | 1 | - | - | 2 | 3 | 2 |
| **Weighted Average** | | 3 | 3 | 2 | 3 | 3 | - | 1 | - | 1 | - | - | 2 | 3 | 2 |

**CO Mapping with PO & PSO:**

**3 – Strong** **2- Moderate** **1- Weak**

**REFERENCES**


1. Bernard Golden, Amazon Web Service for Dummies, John Wiley & Sons, 2013.
2. Raoul Alongi, AWS: The Most Complete Guide to Amazon Web Service from Beginner to Advanced Level, Amazon Asia- Pacific Holdings Private Limited, 2019.
3. Sriram Krishnan, Programming: Windows Azure, O'Reilly,2010.
4. Rajkumar Buyya, Christian Vacchiola, S.Thamarai Selvi, Mastering Cloud Computing , MCGraw Hill Education (India) Pvt. Ltd., 2013.
5. John W.Rittinghouse and James F.Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010
6. Tom White, "Hadoop: The Definitive Guide", Yahoo Press, 2012.


Approved by BoS Chairman

| M.E | M23CSE203- FOUNDATIONS OF DATA SCIENCE | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

1. To apply fundamental algorithms to process data.
2. Learn to apply hypotheses and data into actionable predictions.
3. Document and transfer the results and display findings using visualization techniques.
4. To learn statistical methods and machine learning algorithms required for Data Science.
5. To develop the fundamental knowledge and understand concepts to become a data science

**UNIT I INTRODUCTION TO DATA SCIENCE 9**

Data Science: Benefits and uses – facets of data – Data Science Process: Overview – Defining research goals – Retrieving data – Data preparation – Exploratory Data analysis – build the model– presenting findings and building applications – cleaning and sampling for modeling and validation – introduction to No SQL.

**UNIT II MODELING METHODS 9**

Choosing and evaluating models – mapping problems to machine learning, evaluating clustering models, validating models – cluster analysis – K-means algorithm, Naïve Bayes – Memorization Methods – Linear and logistic regression – unsupervised methods.

**UNIT III INTRODUCTION TO R 9**

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

**UNIT IV MAP REDUCE 9**

Introduction – distributed file system – algorithms using map reduce, Matrix-Vector Multiplication by Map Reduce – Hadoop - Understanding the Map Reduce architecture - Writing Hadoop Map Reduce Programs - Loading data into HDFS - Executing the Map phase - Shuffling and sorting - Reducing phase execution.

**UNIT V DATA VISUALIZATION 9**

Documentation and deployment – producing effective presentations – Introduction to graphical analysis – plot() function – displaying multivariate data – matrix plots – multiple plots in one Window - exporting graph using graphics parameters - Importing Matplotlib – Line plots – Scatter plots – visualizing errors – density and contour plots.

**Total Instructional hours: 45**

**Course Outcomes:**

Students will be able to

Approved by BoS Chairman

**CO1:** Illustrate the process of collect, clean/process and transform data.

**CO2:** Interpret data using an ethically responsible approach after analysis.

**CO3:** Make use of appropriate models to analyze, assess input before deriving insight from results, and investigate potential issues.

**CO4:** Apply computing theory, languages and algorithms, as well as mathematical and Statistical models, and optimization for data analysis.

**CO5:** Construct and use appropriate models of data analysis to solve business-related challenges.

**CO Mapping with PO & PSO**

| CO/PO & PSO | | PO1 (K3) | PO2 (K4) | PO3 (K5) | PO4 (K5) | PO5 (K6) | PO6 (K3) (A3) | PO7 (K2) (A3) | PO8 (K3) (A3) | PO9 (A3) | PO10 (A3) | PO11 (K3) (A3) | PO12 (A3) | PSO1 (K4) (A3) | PSO2 (K3) (A3) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **K2** | 3 | 2 | 3 | 2 | 2 | - | - | - | 1 | - | - | 2 | 2 | 2 |
| **CO2** | **K2** | 3 | 3 | 3 | 2 | 3 | - | - | - | 2 | - | - | 2 | 3 | 3 |
| **CO3** | **K3** | 3 | 2 | 3 | 2 | 3 | - | - | - | 2 | - | - | 2 | 3 | 3 |
| **CO4** | **K3** | 2 | 2 | 2 | 1 | 3 | - | - | - | 2 | - | - | 2 | 3 | 2 |
| **CO5** | **K3** | 3 | 2 | 2 | 1 | 2 | - | - | - | 1 | - | - | 2 | 2 | 2 |
| **Weighted Average** | | 3 | 2 | 2 | 2 | 3 | - | - | - | 2 | - | - | 2 | 3 | 2 |

**3 – Strong** **2- Moderate** **1- Weak**

**Reference Books**


1. Nina Zumel, John Mount, “Practical Data Science with R”, Manning Publications, 2014.
2. Mark Gardener, “Beginning R - The Statistical Programming Language”, John Wiley & Sons, Inc., 2012.
3. W. N. Venables, D. M. Smith and the R Core Team, “An Introduction to R”, 2013.
4. Tony Ojeda, Sean Patrick Murphy, Benjamin Bengfort, Abhijit Dasgupta, “Practical Data Science Cookbook”, Packt Publishing Ltd., 2014.
5. Nathan Yau, “Visualize This: The FlowingData Guide to Design, Visualization, and Statistics”, Wiley, 2011.


Approved by BoS Chairman

| M.E | M23CSE204- WIRELESS COMMUNICATIONS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

## Course Objectives:

1. To understand the basic concepts in cellular communication.
2. To learn the characteristics of wireless channels.
3. To understand the impact of digital modulation techniques in fading.
4. To get exposed to diversity techniques in wireless communication.
5. To acquire knowledge in multicarrier systems

**UNIT I CELLULAR CONCEPTS 9**

Multiple Access techniques — FDMA, TDMA, CDMA — Capacity calculations–Cellular concept- Co-Channel Interference- Adjacent Channel Interference – Trucking and Grade of service – Improving coverage & capacity in cellular systems-Cell Splitting- Sectoring- truncking & grade of service — Coverage and capacity improvement.

**UNIT II THE WIRELESS CHANNEL 9**

Overview of wireless systems – Physical modeling for wireless channels Large scale path loss - Path loss models: Free Space and Two-Ray models -Link Budget design -Small scale fading- Parameters of mobile multipath channels - Time dispersion parameters-Coherence bandwidth - Doppler spread & Coherence time, fading due to Multipath time delay spread -flat fading - frequency selective fading -Fading due to Doppler spread - fast fading -slow fading.

**UNIT III DIGITAL MODULATION OVER WIRELESS CHANNELS 9**

Performance of flat fading and frequency selective fading – Structure of a wireless communication link, Principles of Offset-QPSK, p/4-DQPSK,–- Outage Probability– Average Probability of Error – Combined Outage and Average Error Probability – Doppler Spread – Inter symbol Interference.

**UNIT IV DIVERSITY TECHNIQUES 9**

Realization of Independent Fading Paths – Receiver Diversity – Selection Combining – Threshold Combing – Maximal-Ratio Combining – Equal - Gain Combining – Capacity with Receiver diversity – Transmitter Diversity – Channel known at Transmitter – Channel unknown at Transmitter – The Alamouti Scheme– Transmit & Receive Diversity-MIMO Systems.

**UNIT V MULTICARRIER MODULATION 9**

Data Transmission using Multiple Carriers – Multicarrier Modulation with Overlapping Sub channels – Mitigation of Subcarrier Fading – Discrete Implementation of Multicarrier Modulation – Peak to average Power Ratio- Frequency and Timing offset.

**SUGGESTED ACTIVITIES:**

Approved by BoS Chairman

1: Survey on various features of cellular networks

2: Study the nature of cellular networks

3: A comparative study on the performance of different digital modulation techniques

4: Perform a review of various diversity techniques in wireless communication

5: Presentation on design of multicarrier systems for 5G

**COURSE OUTCOMES:**

Students will be able to

**CO1:** Build solutions for cellular communication

**CO2:** Demonstrate the capacity of wireless channels

**CO3:** Experiment the performance of the digital modulation techniques in fading channels

**CO4:** Apply various diversity techniques in wireless communication

**CO5:** Make use of multicarrier systems in wireless communication

**Total Instructional hours: 45**

**CO Mapping with PO & PSO**

| CO/PO & PSO | | PO1 (K3) | PO2 (K4) | PO3 (K5) | PO4 (K5) | PO5 (K6) | PO6 (K3) (A3) | PO7 (K2) (A3) | PO8 (K3) (A3) | PO9 (A3) | PO10 (A3) | PO11 (K3) (A3) | PO12 (A3) | PSO1 (K4) (A3) | PSO2 (K3) (A3) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **K3** | 3 | 3 | 2 | 2 | 2 | - | - | - | - | - | - | 1 | 2 | 1 |
| **CO2** | **K2** | 3 | 3 | 2 | 2 | 2 | - | - | - | - | - | - | 1 | 2 | 1 |
| **CO3** | **K3** | 3 | 2 | 2 | 2 | 2 | - | - | - | - | - | - | 2 | 2 | 1 |
| **CO4** | **K3** | 3 | 2 | 3 | 2 | 3 | - | - | - | - | - | - | 2 | 2 | 2 |
| **CO5** | **K3** | 3 | 2 | 2 | 2 | 2 | - | - | - | - | - | - | 2 | 2 | 2 |
| **Weighted Average** | | 3 | 2 | 2 | 2 | 2 | - | - | - | - | - | - | 2 | 2 | 1 |

**3 – Strong** **2- Moderate** **1- Weak**

**Reference Books:**


1. Theodore.S. Rappaport, “Wireless Communications: Principles and Practice", 2nd Edition, Pearson Education, India, 2010.
2. Saad Z. Asif, “5G Mobile Communications Concepts and Technologies” CRC press – 2019.
3. Keith Q. T. Zhang, “Wireless Communications: Principles, Theory and Methodology” 1st edition, John Wiley & Sons, 2016.
4. Ramjee Prasad, "OFDM for Wireless Communication Systems", Artech House, 2004.


Approved by BoS Chairman

| M.E | M23CSE205- AGILE METHODOLOGIES | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**Course Objectives:**

1. To learn the fundamental principles and practices associated with agile development methods
2. To apply the principles and practices of agile software development on a relevant project.
3. To provide a good understanding of software design and a set of software technologies and APIs.
4. To do a detailed examination and demonstration of agile development and testing techniques.
5. To understand agile development and testing.

**UNIT I AGILE SOFTWARE DEVELOPMENT 9**

Basics and Fundamentals of Agile Process Methods, Values of Agile, Principles of Agile, stake holders, Challenges 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, differences between Agile plans at different lifecycle phases.

**UNIT II AGILE AND SCRUM PRINCIPLES 9**

Agile Manifesto, Crystal, Feature Driven Development- Adaptive Software Development - Extreme Programming: Method Overview – Lifecycle – Work Products, Roles and Practices. Twelve Practices of XP, Scrum Practices, Applying Scrum. Need of scrum, working of scrum, advanced Scrum Applications, Scrum and the Organization, scrum values

**UNIT III AGILE PRODUCT MANAGEMENT 9**

Communication, Planning, Estimation Managing the Agile approach Monitoring progress, Targeting and motivating the team, Managing business involvement, Escalating issue. Quality, Risk, Metrics and Measurements, Managing the Agile approach Monitoring progress, Targeting and motivating the team, Managing business involvement and Escalating issue

**UNIT IV AGILE REQUIREMENTS AND AGILE TESTING 9**

User Stories, Backlog Management. Agile Architecture: Feature Driven Development. Agile Risk Management: Risk and Quality Assurance, Agile Tools. Agile Testing Techniques, Test-Driven Development, User Acceptance Test

**UNIT V AGILE REVIEW AND SCALING AGILE FOR LARGE PROJECTS 9**

Approved by BoS Chairman

**Course Outcomes:**

Students will be able to

**CO1:** Model existing problems with the team, development process and wider organization

**CO2:** Apply a thorough understanding of Agile principles and specific practices

**CO3:** Select the most appropriate way to improve results for a specific circumstance or need

**CO4:** Construct appropriate adaptations to existing practices or processes depending upon analysis of typical problems

**CO5:**Identify likely successes and formulate plans to manage likely risks or problems

**Total Instructional hours: 45**

**CO Mapping with PO & PSO**

| CO/PO & PSO | | PO1 (K3) | PO2 (K4) | PO3 (K5) | PO4 (K5) | PO5 (K6) | PO6 (K3) (A3) | PO7 (K2) (A3) | PO8 (K3) (A3) | PO9 (A3) | PO10 (A3) | PO11 (K3) (A3) | PO12 (A3) | PSO1 (K4) (A3) | PSO2 (K3) (A3) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **K3** | 3 | 2 | 1 | 1 | 2 | - | - | - | 1 | 1 | 2 | 2 | 2 | 1 |
| **CO2** | **K3** | 2 | 2 | 1 | 2 | 1 | - | - | - | 1 | 2 | 2 | 2 | 3 | 1 |
| **CO3** | **K3** | 1 | 2 | 1 | 2 | 1 | - | - | - | 1 | 1 | 1 | 2 | 2 | 2 |
| **CO4** | **K3** | 3 | 2 | 1 | 1 | 1 | - | - | - | 1 | 1 | 2 | 2 | 2 | 1 |
| **CO5** | **K3** | 3 | 2 | 1 | 1 | 2 | - | - | - | 1 | 1 | 2 | 2 | 3 | 1 |
| **Weighted Average** | | 3 | 2 | 1 | 1 | 1 | - | - | - | 1 | 1 | 2 | 2 | 2 | 1 |

**3 – Strong** **2- Moderate** **1- Weak**

**Reference Books:**


1. Robert C. Martin ,Agile Software Development, Principles, Patterns, and Practices Alan Apt Series (2011)
2. Succeeding with Agile : Software Development Using Scrum, Pearson (2010)
3. David J. Anderson and Eli Schragenheim, “Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results, Prentice Hall, 2003.
4. Hazza and Dubinsky, “Agile Software Engineering, Series: Undergraduate Topics in Computer Science, Springer, 2009.
5. Craig Larman, “Agile and Iterative Development: A Managers Guide, Addison-Wesley, 2004.
6. Kevin C. Desouza, “Agile Information Systems: Conceptualization, Construction, and Management, Butterworth-Heinemann, 2007.


Approved by BoS Chairman

| M.E | M23CSE206- PERFORMANCE ANALYSIS OF COMPUTER SYSTEMS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

1. To understand the mathematical foundations of performance evaluation of computer systems
2. To understand the metrics used for performance evaluation
3. To understand the analytical modeling of computer systems
4. To enable the students to develop new queuing analysis for both simple and complex systems
5. To use smart scheduling to analytical techniques for evaluating scheduling policies.

**UNIT I OVERVIEW OF PERFORMANCE EVALUATION 9**

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

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

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

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

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

**UNIT IV REAL-WORLD WORKLOADS 9**

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

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

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

**Total Instructional hours: 45**

Approved by BoS Chairman

**Course Outcomes:**

Students will be able to

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

**CO2:** Distinguish between open and closed queuing networks

**CO3:** Apply Little'e law and other operational laws to open and closed systems

**CO4**: Make use of discrete-time and continuous-time Markov chains to model real world systems

**CO5:** Develop analytical techniques for evaluating scheduling policies

**CO Mapping with PO & PSO**

| CO/PO & PSO | | PO1 (K3) | PO2 (K4) | PO3 (K5) | PO4 (K5) | PO5 (K6) | PO6 (K3) (A3) | PO7 (K2) (A3) | PO8 (K3) (A3) | PO9 (A3) | PO10 (A3) | PO11 (K3) (A3) | PO12 (A3) | PSO1 (K4) (A3) | PSO2 (K3) (A3) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **K** | 2 | 1 | 3 | 2 | 2 | - | - | - | 2 | 2 | 2 | 3 | 2 | 2 |
| **CO2** | **K** | 1 | 2 | 2 | 2 | 2 | - | - | - | 2 | 2 | 2 | 2 | 3 | 2 |
| **CO3** | **K** | 2 | 2 | 2 | 2 | 2 | - | - | - | 1 | 1 | 3 | 2 | 2 | 3 |
| **CO4** | **K** | 2 | 2 | 1 | 2 | 2 | - | - | - | 2 | 2 | 2 | 1 | 2 | 2 |
| **CO5** | **K** | 2 | 2 | 2 | 1 | 2 | - | - | - | 3 | 2 | 2 | 3 | 3 | 1 |
| **Weighted Average** | | 2 | 2 | 3 | 2 | 2 | - | - | - | 2 | 2 | 2 | 2 | 2 | 2 |

**3 – Strong** **2- Moderate** **1- Weak**

## Reference Books:


1. K. S. Trivedi, "Probability and Statistics with Reliability, Queueing and Computer Science Applications‖, John Wiley and Sons, 2001.
2. Krishna Kant, "Introduction to Computer System Performance Evaluation‖, McGraw-Hill, 1992.
3. Lieven Eeckhout, "Computer Architecture Performance Evaluation Methods‖, Morgan and Claypool Publishers, 2010.
4. Mor Harchol - Balter, "Performance Modeling and Design of Computer Systems – Queueing Theory in Action, Cambridge University Press, 2013.
5. Paul J. Fortier and Howard E. Michel, "Computer Systems Performance Evaluation and Prediction, Elsevier, 2003.
6. Raj Jain, "The Art of Computer Systems Performance Analysis: Techniques for Experimental Design, Measurement, Simulation and Modeling‖, Wiley-Interscience, 1991.
7. Raj Jain, Art of Computer Systems Performance Analysis: Techniques For Experimental Design Measurements Simulation and Modeling,2nd edition, wiley, 2015


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| M.E | M23CSE207- ADVANCED OPERATING SYSTEM | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

## Course Objectives:

1 To get a comprehensive knowledge of the architecture of distributed systems.

2 To understand the deadlock and shared memory issues and their solutions in distributed environments.

3 To know the security issues and protection mechanisms for distributed environments.

4 To get a knowledge of multiprocessor operating systems and database operating systems.

**UNIT I INTRODUCTION 9**

Architectures of Distributed Systems - System Architecture types - issues in distributed operating systems - communication networks – communication primitives. Theoretical Foundations - inherent limitations of a distributed system – lamport's logical clocks – vector clocks – causal ordering of messages – global state – cuts of a distributed computation – termination detection. Distributed Mutual Exclusion – introduction – the classification of mutual exclusion and associated algorithms – a comparative performance analysis.

**UNIT II DISTRIBUTED DEADLOCK DETECTION AND RESOURCE MANAGEMENT 9**

Distributed Deadlock Detection -Introduction - deadlock handling strategies in distributed systems Issues in deadlock detection and resolution – control organizations for distributed deadlock detection Centralized and distributed deadlock detection algorithms –hierarchical deadlock detection algorithms. Agreement protocols – introduction-the system model, a classification of agreement problems, Solutions to the Byzantine agreement problem, applications of agreement algorithms. Distributed resource management: introduction-architecture – mechanism for building distributed File systems – design issues – log structured file systems.

**UNIT III DISTRIBUTED SHARED MEMORY AND SCHEDULING 9**

Distributed shared memory-Architecture– algorithms for implementing DSM – memory coherence and protocols – design issues. Distributed Scheduling – introduction – issues in load distributing – components of a load distributing algorithm – stability – load distributing algorithms – performance comparison – selecting a suitable load sharing algorithm – requirements for load distributing -task migration and associated issues. Failure Recovery and Fault tolerance: introduction– basic concepts – classification of failures – backward and forward error recovery, backward error recovery- recovery in concurrent systems – consistent set of checkpoints – synchronous and asynchronous check pointing and recovery – check pointing for distributed database systems- recovery in replicated distributed databases.

**UNIT IV DATA SECURITY 9**

Protection and security -preliminaries, the access matrix model and its implementations.-safety in matrix model- advanced models of protection. Data security – cryptography: Model of cryptography,

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conventional cryptography- modern cryptography, private key cryptography, data encryption standard- public key cryptography – multiple encryption – authentication in distributed systems.

**UNIT-V MULTIPROCESSOR AND DATABASE OPERATING SYSTEM 9**

Multiprocessor operating systems - basic multiprocessor system architectures – interconnection networks for multiprocessor systems – caching – hypercube architecture. Multiprocessor Operating System - structures of multiprocessor operating system, operating system design issues- threads- process synchronization and scheduling. Database Operating systems: Introduction- requirements of a database operating system Concurrency control : theoretical aspects – introduction, database systems – a concurrency control model of database systems- the problem of concurrency control – serializability theory- distributed database systems, concurrency control algorithms – introduction, basic synchronization primitives, lock based algorithms-timestamp based algorithms, optimistic algorithms – concurrency control algorithms: data replication.

**Total Instructional hours: 45**

**Course Outcomes:**

Students will be able to

**CO1:** Explain the working of Theoretical Foundations of OS.

**CO2:** Illustrate the working principles of Distributed Deadlock Detection and resource management

**CO3:** Outline the concepts of distributed shared memory and scheduling mechanisms

**CO4:** Construct and analyze the working of Data security

**CO5:** Apply the learning into multiprocessor system architectures.

**CO Mapping with PO & PSO**

| CO/PO & PSO | | PO1 (K3) | PO2 (K4) | PO3 (K5) | PO4 (K5) | PO5 (K6) | PO6 (K3) (A3) | PO7 (K2) (A3) | PO8 (K3) (A3) | PO9 (A3) | PO10 (A3) | PO11 (K3) (A3) | PO12 (A3) | PSO1 (K4) (A3) | PSO2 (K3) (A3) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **K2** | 2 | 2 | 3 | 2 | 2 | - | - | - | 2 | 2 | 2 | 3 | 3 | 2 |
| **CO2** | **K2** | 3 | 2 | 1 | 1 | 2 | - | - | - | 2 | 2 | 2 | 2 | 3 | 2 |
| **CO3** | **K2** | 3 | 2 | 1 | 2 | 2 | - | - | - | 1 | 1 | 3 | 2 | 2 | 3 |
| **CO4** | **K3** | 3 | 2 | 1 | 1 | 2 | - | - | - | 2 | 2 | 2 | 1 | 2 | 2 |
| **CO5** | **K3** | 3 | 2 | 2 | 1 | 2 | - | - | - | 3 | 2 | 2 | 3 | 3 | 1 |
| **Weighted Average** | | 3 | 2 | 1 | 2 | 2 | - | - | - | 2 | 2 | 2 | 2 | 3 | 2 |

**3 – Strong 2- Moderate 1- Weak**

## Reference Books:


1. Mukesh Singhal, Niranjan G.Shivaratri, "Advanced concepts in operating systems: Distributed, Database and multiprocessor operating systems", TMH, 2001
2. Andrew S.Tanenbaum, "Modern operating system", PHI, 2003
3. Pradeep K.Sinha, "Distributed operating system-Concepts and design", PHI, 2003.


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| M.E | M23CSE208- DIGITAL IMAGE PROCESSING | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**Course Objectives:**

1 To study fundamental concepts of digital image processing.
2 To understand and learn image processing operations and restoration.
3 To use the concepts of Feature Extraction
4 To study the concepts of Image Compression.
5 To expose students to current trends in the field of image segmentation.

**UNIT I INTRODUCTION 9**

Examples of fields that use digital image processing, fundamental steps in digital image processing, components of image processing system. Image transformation: A simple image formation model, image sampling and quantization, basic relationships between pixels. Image enhancement in the spatial domain: Basic gray-level transformation, histogram processing, object boundary and shape representations, basic spatial filtering, smoothing, and sharpening spatial filters, combining the spatial enhancement methods.

**Suggested Activities:**

- Discussion of Mathematical Transforms.
- Numerical problem solving using Fourier Transform.
- Numerical problem solving in Image Enhancement.
- External learning – Image Noise and its types.

**UNIT II IMAGE RESTORATION 9**

A model of the image degradation/restoration process, noise models, restoration in the presence of noise–only spatial filtering, Weiner filtering, constrained least squares filtering; Introduction to the Fourier transform and the frequency domain, estimating the degradation function. Color Image Processing: Color fundamentals, pseudo color image processing, basics of full–color image processing, color transforms, smoothing and sharpening, color segmentation

**Suggested Activities:**

- Discussion on Image Artifacts and Blur.
- Discussion of Role of Wavelet Transforms in Filter and Analysis.
- Numerical problem solving in Wavelet Transforms.

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- External learning – Image restoration algorithms.

**Suggested Evaluation Methods:**

- Tutorial – Wavelet transforms.
- Assignment problems on order statistics and multi-resolution expansions.
- Quizzes on wavelet transforms.

**UNIT III FEATURE EXTRACTION 9**

Detection of discontinuities – Edge linking and Boundary detection- Thresholding- -Edge based segmentation-Region based Segmentation- matching-Advanced optimal border and surface detection- Use of motion in segmentation. Image Morphology – Boundary descriptors- Regional descriptors, Detecting DoG features and extracting SIFT descriptors.

**Suggested Activities:**

- External learning – Feature selection and reduction.
- External learning – Image salient features.
- Assignment on numerical problems in texture computation.

**Suggested Evaluation Methods:**

- Assignment problems on feature extraction and reduction.
- Quizzes on feature selection and extraction

**UNIT IV IMAGE COMPRESSION 9**

Fundamentals, image compression models, error-free compression, lossy predictive coding, image compression standards Morphological Image Processing: Preliminaries, dilation, erosion, open and closing, hit or miss transformation, basic morphological algorithms, Texture - Patterns and Pattern classes - Recognition based on matching.

**Suggested Activities:**

- Flipped classroom on different image coding techniques.
- Practical – Demonstration of EXIF format for given camera.
- Practical – Implementing effects quantization, color change.
- Case study of Google's WebP image format.

**Suggested Evaluation Methods:**

- Evaluation of the practical implementations.
- Assignment on image file formats

**UNIT V IMAGE SEGMENTATION 9**

Detection of discontinuous, edge linking and boundary detection, thresholding, region–based segmentation. Object Recognition: Patterns and patterns classes, recognition based on decision– theoretic methods, matching, optimum statistical classifiers, Morphological processing- erosion and dilation.

**Suggested Activities:**

- Flipped classroom on importance of segmentation.

**Suggested Evaluation Methods:**

- Tutorial – Image segmentation and edge detection.9

## Course Outcomes:

Students will be able to

**CO1:** Apply knowledge of Mathematics for image processing operations

**CO2:** Make use of techniques for image restoration.

**CO3**: Choose and extract salient features of images.

**CO4**: Identify appropriate tools (Contemporary) for image compression and analysis.

**CO5**: Outline segmentation techniques and do object recognition

**CO Mapping with PO & PSO**

| CO/PO & PSO | | PO1 (K3) | PO2 (K4) | PO3 (K5) | PO4 (K5) | PO5 (K6) | PO6 (K3) (A3) | PO7 (K2) (A3) | PO8 (K3) (A3) | PO9 (A3) | PO10 (A3) | PO11 (K3) (A3) | PO12 (A3) | PSO1 (K4) (A3) | PSO2 (K3) (A3) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **K3** | 2 | 2 | 3 | 2 | 2 | - | - | - | 2 | 2 | 2 | 3 | 3 | 2 |
| **CO2** | **K3** | 3 | 2 | 1 | 1 | 2 | - | - | - | 2 | 2 | 2 | 2 | 3 | 2 |
| **CO3** | **K3** | 3 | 2 | 1 | 2 | 2 | - | - | - | 1 | 1 | 3 | 2 | 2 | 3 |
| **CO4** | **K3** | 3 | 2 | 1 | 1 | 2 | - | - | - | 2 | 2 | 2 | 1 | 2 | 2 |
| **CO5** | **K2** | 3 | 2 | 2 | 1 | 2 | - | - | - | 3 | 2 | 2 | 3 | 3 | 1 |
| **Weighted Average** | | 3 | 2 | 1 | 2 | 2 | - | - | - | 2 | 2 | 2 | 2 | 3 | 2 |

**3 – Strong** **2- Moderate** **1- Weak**

## Reference Books:

1. Digital Image Processing, Rafeal C.Gonzalez, Richard E.Woods, Second Edition, Pearson Education/PHI., 2002
2. Digital Image Processing, Sridhar S, Second Edition, Oxford University Press, 2016

Approved by BoS Chairman

3. Introduction to Digital Image Processing with Matlab, Alasdair McAndrew, Thomson Course Technology, .Brooks/Cole 2004
4. Milan Sonka, Vaclav Hlavac, Roger Boyle, “Image Processing, Analysis and Machine Vision”, Second Edition, Thompson Learning, 2007.
5. Digital Image Processing using Matlab, Rafeal C.Gonzalez, Richard E.Woods, Steven L. Eddins, Pearson Education.Second Edition, 2017




Approved by BoS Chairman

| M.E | M23CSE209-HIGH PERFORMANCE COMPUTING FOR BIG DATA | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**Course Objectives:**

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

**UNIT I INTRODUCTION** **9**

The Emerging IT Trends- IOT/IOE-Apache Hadoop for big data analytics-Big data into big insights and actions – Emergence of BDA discipline – strategic implications of big data – BDA Challenges – HPC paradigms – Cluster computing – Grid Computing – Cloud computing – Heterogeneous computing – Mainframes for HPC - Supercomputing for BDA – Appliances for BDA.

**UNIT II NETWORK & SOFTWARE INFRASTRUCTURE FOR HIGH PERFORMANCE BDA** **9**

Design of Network Infrastructure for high performance BDA – Network Virtualization – Software Defined Networking – Network Functions Virtualization – WAN optimization for transfer of big data-started with SANs- storage infrastructure requirements for storing big data – FC SAN – IP SAN – NAS – GFS – Panasas – Luster file system – Introduction to cloud storage.

**UNIT III REAL TIME ANALYTICS USING HIGH PERFORMANCE COMPUTING** **9**

Technologies that support Real time analytics – MOA: Massive online analysis – GPFS: General parallel file system – Client case studies – Key distinctions – Machine data analytics – operational analytics – HPC Architecture models – In Database analytics – In memory analytics

**UNIT IV SECURITY AND TECHNOLOGIES** **9**

Security, Privacy and Trust for user – generated content: The challenges and solutions – Role of real time big data processing in the IoT – End to End Security Framework for big sensing data streams – Clustering in big data.

**UNIT V EMERGING BIG DATA APPLICATIONS** **9**

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Deep learning Accelerators – Accelerators for clustering applications in machine learning - Accelerators for classification algorithms in machine learning – Accelerators for Big data Genome Sequencing

**Total Instructional hours: 45**

**Course Outcomes:**

Students will be able to

**CO1:** Illustrate the basics concepts of High Performance computing systems.

**CO2:** Apply the concepts of network and software infrastructure for high performance computing

**CO3:** Show real time analytics using high performance computing

CO4: Apply the security models and big data applications in high performance computing

**CO5:** Classify the emerging big data applications.

**CO Mapping with PO & PSO**

| CO/PO & PSO | | PO1 (K3) | PO2 (K4) | PO3 (K5) | PO4 (K5) | PO5 (K6) | PO6 (K3) (A3) | PO7 (K2) (A3) | PO8 (K3) (A3) | PO9 (A3) | PO10 (A3) | PO11 (K3) (A3) | PO12 (A3) | PSO1 (K4) (A3) | PSO2 (K3) (A3) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | K2 | 3 | 3 | 2 | 2 | 1 | - | - | - | - | - | 1 | 1 | 3 | 2 |
| CO2 | K3 | 3 | 2 | 2 | 2 | 1 | - | - | - | - | - | 1 | 1 | 3 | 2 |
| CO3 | K2 | 3 | 2 | 2 | 1 | 1 | - | - | - | - | - | 1 | 1 | 3 | 2 |
| CO4 | K3 | 3 | 2 | 1 | 1 | 1 | - | - | - | - | - | 1 | 1 | 3 | 2 |
| CO5 | K2 | 2 | 1 | 1 | 1 | 1 | - | - | - | - | - | 1 | 1 | 3 | 2 |
| Weighted Average | | 3 | 2 | 2 | 1 | 1 | - | - | - | - | - | 1 | 1 | 3 | 2 |

**3 – Strong** **2- Moderate** **1- Weak**

**Reference Books:**


1. High performance computing: Modern systems and practices", Thomas Sterling, Matthew Anderson, Morgan Kaufmann publishers,1st Edition,2017
2. 2. High Performance Computing for Big Data: Methodologies and Applications", Chao wang ,CRC Press,1st Edition,2018
3. Pethuru Raj, Anupama Raman, Dhivya Nagaraj and Siddhartha Duggirala, High- Performance Big-Data Analytics: Computing Systems and Approaches, Springer, 1st Edition, 2015.
4. Big Data Management and Processing", Kuan-Ching Li , Hai Jiang, Albert Y. Zomaya, CRC Press,1st Edition,2017.


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| M.E | M23CSE210- INFORMATION RETRIEVAL TECHNIQUES | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**Course Objectives:**

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

**UNIT I INTRODUCTION: MOTIVATION 9**

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

**UNIT II MODELING 9**

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

**UNIT III INDEXING 9**

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

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

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

**UNIT V SEARCHING THE WEB 9**

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

**Total Instructional hours: 45**

**Course Outcomes:**

Students will be able to

**CO1:** Build an Information Retrieval system using the available tools.

**CO2:** Identify and design the various components of an Information Retrieval system.

**CO3:** Compare the different types of IR Models.

**CO4:** Apply machine learning techniques to text classification and clustering which is used for efficient Information Retrieval.

**CO5:** Select an efficient search engine and analyze the Web content structure.

**CO Mapping with PO & PSO**

| CO/PO & PSO | | PO1 (K3) | PO2 (K4) | PO3 (K5) | PO4 (K5) | PO5 (K6) | PO6 (K3) (A3) | PO7 (K2) (A3) | PO8 (K3) (A3) | PO9 (A3) | PO10 (A3) | PO11 (K3) (A3) | PO12 (A3) | PSO1 (K4) (A3) | PSO2 (K3) (A3) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | K3 | 3 | 2 | 3 | 2 | 1 | - | - | - | - | - | 1 | 1 | 3 | 2 |
| CO2 | K3 | 3 | 3 | 2 | 2 | 1 | - | - | - | - | - | 1 | 1 | 3 | 2 |
| CO3 | K3 | 3 | 2 | 2 | 2 | 1 | - | - | - | - | - | 1 | 1 | 3 | 2 |
| CO4 | K3 | 2 | 1 | 2 | 2 | 1 | - | - | - | - | - | 1 | 1 | 3 | 2 |
| CO5 | K3 | 2 | 2 | 1 | 2 | 1 | - | - | - | - | - | 1 | 1 | 3 | 2 |
| Weighted Average | | 3 | 2 | 2 | 2 | 1 | - | - | - | - | - | 1 | 1 | 3 | 3 |

**3 – Strong** **2- Moderate** **1- Weak**

**Reference Books:**

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

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| M.E | M23CSE211- SOFTWARE QUALITY ASSURANCE | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**Course Objectives:**

1. Be exposed to the software quality factors, quality assurance architecture and SQA components.
2. Understand the integration of SQA components into the project life cycle.
3. Be familiar with the software quality infrastructure.
4. Be exposed to the management components of software quality.
5. Be familiar with the Quality standards, certifications and assessments

**UNIT I INTRODUCTION TO SOFTWARE QUALITY & ARCHITECTURE 9**

Need for Software quality – Software quality assurance (SQA) – Software quality factors- McCall's quality model – SQA system components – Pre project quality components – Development and quality plans.

**UNIT II SQA COMPONENTS AND PROJECT LIFE CYCLE 9**

Integrating quality activities in the project life cycle – Reviews – Software Testing – Quality of software maintenance components – Quality assurance for external participants contribution – CASE tools for software quality Management.

**UNIT III SOFTWARE QUALITY INFRASTRUCTURE 9**

Procedures and work instructions – Supporting quality devices - Staff training and certification - Corrective and preventive actions – Configuration management – Software change control – Configuration management audit -Documentation control.

**UNIT IV SOFTWARE QUALITY MANAGEMENT & METRICS 9**

Project process control – Software quality metrics – Cost of software quality – Classical quality cost model – Extended model – Application and Problems in application of Cost model

**UNIT V STANDARDS, CERTIFICATIONS & ASSESSMENTS 9**

Quality management standards – ISO 9001 and ISO 9000-3 –Capability Maturity Models – CMM and CMMI assessment methodologies - Bootstrap methodology – SPICE Project – SQA project process standards – Organization of Quality Assurance – Role of management in SQA – SQA units and other actors in SQA systems.

**Total Instructional hours: 45**

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**Course Outcomes:**

Students will be able to

**CO1:** Utilize the concepts of SQA in software development life cycle

**CO2:** Demonstrate their capability to adopt quality standards

**CO3**: Identify the quality of software products

**CO4:** Apply the concepts in preparing the quality plan & documents.

**CO5:** Experiment with the product meets company's quality standards and client's expectations and demands

**CO Mapping with PO & PSO**

| CO/PO & PSO | | PO1 (K3) | PO2 (K4) | PO3 (K5) | PO 4 (K5) | PO 5 (K6) | PO6 (K3) (A3) | PO7 (K2) (A3) | PO8 (K3) (A3) | PO9 (A3) | PO10 (A3) | PO11 (K3) (A3) | PO12 (A3) | PSO1 (K4) (A3) | PSO2 (K3) (A3) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **K3** | 3 | 2 | 2 | 2 | 1 | - | - | - | - | - | 1 | 1 | 3 | 2 |
| **CO2** | **K2** | 3 | 3 | 2 | 2 | 1 | - | - | - | - | - | 1 | 1 | 3 | 2 |
| **CO3** | **K3** | 3 | 2 | 2 | 2 | 1 | - | - | - | - | - | 1 | 1 | 3 | 2 |
| **CO4** | **K3** | 2 | 1 | 2 | 2 | 1 | - | - | - | - | - | 1 | 1 | 3 | 2 |
| **CO5** | **K3** | 2 | 2 | 1 | 1 | 1 | - | - | - | - | - | 1 | 1 | 3 | 2 |
| **Weighted Average** | | 3 | 2 | 2 | 2 | 1 | - | - | - | - | - | 1 | 1 | 3 | 2 |

**3 – Strong** **2- Moderate** **1- Weak**

**Reference Books:**


1. Kshirasagar Naim and Priyadarshini Tripathy, Software Testing and Quality Assurance Theory and Practice, John Wiley & Sons Inc., 2008
2. Mordechai Ben-Menachem “Software Quality: Producing Practical Consistent Software, International Thompson Computer Press, 2014
3. Daniel Galin, Software Quality Assurance, Pearson Publication, 2009.
4. Alan C. Gillies, “Software Quality: Theory and Management”, International Thomson Computer Press, 2011.


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| M.E | M23CSE212- AUTONOMOUS SYSTEMS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**Course Objectives:**

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

**UNIT I INTRODUCTION AND FUNCTIONAL ARCHITECTURE 9**

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

**UNIT II PERCEPTION FOR AUTONOMOUS SYSTEMS 9**

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

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

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

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

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

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

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

**Total Instructional hours: 45**

**Course Outcomes:**

Students will be able to

**CO1:** Choose architecture and modeling of autonomous systems

**CO2:** Make use of localization mapping techniques for autonomous systems

**CO3:** Develop solutions for autonomous systems control.

**CO4:** Analyze Robot Transformations, Sensors and Cell Design

**CO5:** Explain the working principles of Micro/Nano Robotic system

**CO Mapping with PO & PSO**

| CO/PO & PSO | | PO1 (K3) | PO2 (K4) | PO3 (K5) | PO4 (K5) | PO5 (K6) | PO6 (K3) (A3) | PO7 (K2) (A3) | PO8 (K3) (A3) | PO9 (A3) | PO10 (A3) | PO11 (K3) (A3) | PO12 (A3) | PSO1 (K4) (A3) | PSO2 (K3) (A3) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | K3 | 3 | 2 | 2 | 2 | 1 | - | - | - | - | - | 1 | 1 | 3 | 2 |
| CO2 | K3 | 3 | 3 | 2 | 2 | 1 | - | - | - | - | - | 1 | 1 | 3 | 2 |
| CO3 | K3 | 3 | 2 | 2 | 1 | 1 | - | - | - | - | - | 1 | 1 | 3 | 2 |
| CO4 | K4 | 2 | 1 | 2 | 2 | 1 | - | - | - | - | - | 1 | 1 | 3 | 2 |
| CO5 | K2 | 2 | 2 | 1 | 1 | 1 | - | - | - | - | - | 1 | 1 | 3 | 2 |
| Weighted Average | | 3 | 2 | 2 | 2 | 1 | - | - | - | - | - | 1 | 1 | 3 | 2 |

**3 – Strong 2- Moderate 1- Weak**

**Reference Books:**


1. Markus Maurer, Autonomous driving: technical, legal and social aspects. Springer, 2016
2. Jha, Theory, Design and Applications of Unmanned Aerial Vehicles, CRC Press, 2016
3. S.R. Deb, Robotics Technology and flexible automation, Tata McGraw-Hill Education.,2009
4. Mikell P Groover & Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, Industrial Robotics, Technology programming and Applications, McGraw Hill, 2012.


Approved by BoS Chairman

5. Karsten Berns, Ewald Puttkamer, Springer, Autonomous Land Vehicles: Steps towards Service Robots, 2009
6. Daniel Watzenig and Martin Horn (Eds.), Automated Driving: Safer and More Efficient Future Driving, Springer, 2017



Approved by BoS Chairman

| M.E | M23CSE213- WEB ANALYTICS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**Course Objectives:**

1. To understand the Web analytics platform, and their evolution.
2. To learn about the various Data Streams Data.
3. To learn about the benefits of surveys and capturing of data
4. To understand Common metrics of web as well as KPI related concepts.
5. To learn about the various Web analytics versions.

**UNIT I INTRODUCTION** **9**

Definition, Process, Key terms: Site references, Keywords and Key phrases; building block terms: Visit characterization terms, Content characterization terms, Conversion metrics; Categories: Offsite web, on site web; Web analytics platform, Web analytics evolution, Need for web analytics, Advantages, Limitations.

**UNIT II DATA COLLECTION** **9**

Click stream Data: Web logs, Web Beacons, JavaScript tags, Packet Sniffing; Outcomes Data: E-commerce, Lead generation, Brand/Advocacy and Support; Research data: Mindset, Organizational structure, Timing; Competitive Data: Panel-Based measurement, ISP-based measurement, Search Engine data.

**UNIT III QUALITATIVE ANALYSIS** **9**

Heuristic evaluations: Conducting a heuristic evaluation, Benefits of heuristic evaluations; Site Visits: Conducting a site visit, Benefits of site visits; Surveys: Website surveys, Post-visit surveys, creating and running a survey, Benefits of surveys. Capturing data: Web logs or JavaScript's tags, Separate data serving and data capture, Type and size of data, Innovation, Integration, Selecting optimal web analytic tool, Understanding click stream data quality, Identifying unique page definition, Using cookies, Link coding issues.

**UNIT IV WEB METRICS** **9**

Common metrics: Hits, Page views, Visits, Unique visitors, Unique page views, Bounce, Bounce rate, Page/visit, Average time on site, New visits; Optimization (e-commerce, non e-commerce

sites): Improving bounce rates, Optimizing adwords campaigns; Real time report, Audience report, Traffic source report, Custom campaigns, Content report, Google analytics, Introduction to KPI, characteristics, Need for KPI, Perspective of KPI, Uses of KPI. Relevant Technologies: Internet & TCP/IP, Client / Server Computing, HTTP (Hypertext Transfer Protocol), Server Log Files & Cookies, Web Bugs.

**UNIT V WEB ANALYTICS 2.0 9**

Web analytics 1.0, Limitations of web analytics 1.0, Introduction to analytic 2.0, Competitive intelligence analysis : CI data sources, Toolbar data, Panel data ,ISP data, Search engine data, Hybrid data, Website traffic analysis: Comparing long term traffic trends, Analyzing competitive site overlap and opportunities. Google Analytics: Brief introduction and working, Adwords, Benchmarking, Categories of traffic: Organic traffic, Paid traffic; Google website optimizer, Implementation technology, Limitations, Performance concerns, Privacy issues.

**Total Instructional hours: 45**

**Course Outcomes:**

Students will be able to

**CO1:** Demonstrate the Web analytics platform, and their evolution.

**CO2:** Make use of the various Data Streams Data.

**CO3:** Explain the survey of capturing of data will benefit.

**CO4:** Illustrate Common metrics of web as well as KPI related concepts.

**CO5:** Apply various Web analytics versions in existence.

**CO Mapping with PO & PSO**

| CO/PO & PSO | | PO1 (K3) | PO2 (K4) | PO3 (K5) | PO 4 (K5) | PO5 (K6) | PO6 (K3) (A3) | PO7 (K2) (A3) | PO8 (K3) (A3) | PO9 (A3) | PO10 (A3) | PO11 (K3) (A3) | PO12 (A3) | PSO1 (K4) (A3) | PSO2 (K3) (A3) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | K2 | 3 | 2 | 2 | 2 | 1 | - | - | - | - | - | 1 | 1 | 3 | 2 |
| CO2 | K3 | 3 | 3 | 2 | 1 | 1 | - | - | - | - | - | 1 | 1 | 3 | 2 |
| CO3 | K2 | 3 | 2 | 2 | 1 | 1 | - | - | - | - | - | 1 | 1 | 3 | 2 |
| CO4 | K2 | 2 | 1 | 1 | 1 | 1 | - | - | - | - | - | 1 | 1 | 3 | 2 |
| CO5 | K3 | 2 | 2 | 1 | 1 | 1 | - | - | - | - | - | 1 | 1 | 3 | 2 |
| Weighted Average | | 3 | 2 | 2 | 1 | 1 | - | - | - | - | - | 1 | 1 | 3 | 2 |

**3 – Strong 2- Moderate 1- Weak**

Approved by BoS Chairman

**Reference Books:**

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



Approved by BoS Chairman

| M.E | M23CSE214- COGNITIVE COMPUTING | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**Course Objectives:**

1. To familiarize Use the Innovation Canvas to justify potentially successful products.
2. To learn various ways in which to develop a product idea.
3. To understand about how Big Data can play vital role in Cognitive Computing
4. To know about the business applications of Cognitive Computing
5. To get into all applications of Cognitive Computing

**UNIT I FOUNDATION OF COGNITIVE COMPUTING 9**

Foundation of Cognitive Computing: cognitive computing as a new generation, the uses of cognitive systems, system cognitive, gaining insights from data, Artificial Intelligence as the foundation of cognitive computing, understanding cognition Design Principles for Cognitive Systems: Components of a cognitive system, building the corpus, bringing data into cognitive system, machine learning, hypotheses generation and scoring, presentation, and visualization services

**UNIT II NATURAL LANGUAGE PROCESSING IN COGNITIVE SYSTEMS 9**

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

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

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

**UNIT IV BUSINESS IMPLICATIONS OF COGNITIVE COMPUTING 9**

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

**UNIT V APPLICATION OF COGNITIVE COMPUTING 9**

Building a cognitive health care application: Foundations of cognitive computing for healthcare, constituents in healthcare ecosystem, learning from patterns in healthcare Data, Building on a foundation of big data analytics, cognitive applications across the health care eco system, starting with a cognitive application for healthcare, using cognitive applications to improve health and wellness, using a cognitive application to enhance the electronic medical record Using cognitive application to improve clinical teaching

**Total Instructional hours: 45**

**Course Outcomes:**

Students will be able to

**CO1:** Explain applications in Cognitive Computing.

**CO2:** Demonstrate Natural language processor role in Cognitive computing.

**CO3:** Explain future directions of Cognitive Computing

**CO4:** Identify the process of taking a product to market

**CO5:** Select the applications involved in this domain.

**CO Mapping with PO & PSO**

| CO/PO & PSO | | PO1 (K3) | PO2 (K4) | PO3 (K5) | PO4 (K5) | PO5 (K6) | PO6 (K3) (A3) | PO7 (K2) (A3) | PO8 (K3) (A3) | PO9 (A3) | PO10 (A3) | PO11 (K3) (A3) | PO12 (A3) | PSO1 (K4) (A3) | PSO2 (K3) (A3) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | K2 | 3 | 2 | 2 | 2 | 1 | - | - | - | - | - | 1 | 1 | 3 | 2 |
| CO2 | K2 | 3 | 3 | 2 | 1 | 1 | - | - | - | - | - | 1 | 1 | 3 | 2 |
| CO3 | K2 | 3 | 2 | 1 | 1 | 1 | - | - | - | - | - | 1 | 1 | 3 | 2 |
| CO4 | K3 | 2 | 1 | 1 | 1 | 1 | - | - | - | - | - | 1 | 1 | 3 | 2 |
| CO5 | K3 | 2 | 2 | 1 | 1 | 1 | - | - | - | - | - | 1 | 1 | 3 | 2 |
| Weighted Average | | 3 | 2 | 1 | 1 | 1 | - | - | - | - | - | 1 | 1 | 3 | 2 |

Approved by BoS Chairman

**3 – Strong** **2- Moderate** **1- Weak**

**Reference Books:**

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



Approved by BoS Chairman

| M.E | M23CSE215- QUANTUM COMPUTING | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**Course Objectives:**

1. To introduce the building blocks of Quantum computers and highlight the paradigm change between conventional computing and quantum computing
2. To understand the Quantum state transformations and the algorithms
3. To understand entangled quantum subsystems and properties of entangled states
4. To explore the applications of quantum computing

**UNIT I QUANTUM BUILDING BLOCKS 9**

The Quantum Mechanics of Photon Polarization, Single-Qubit Quantum Systems, Quantum State Spaces, Entangled States, Multiple-Qubit Systems, Measurement of Multiple-Qubit States, EPR Paradox and Bell's Theorem, Bloch sphere

**UNIT II QUANTUM STATE TRANSFORMATIONS 9**

Unitary Transformations, Quantum Gates, Unitary Transformations as Quantum Circuits, Reversible Classical Computations to Quantum Computations, Language for Quantum Implementations.

**UNIT III QUANTUM ALGORITHMS 9**

Computing with Superpositions, Quantum Subroutines, Quantum Fourier Transformations, Shor's Algorithm and Generalizations, Grover's Algorithm and Generalizations

**UNIT IV ENTANGLED SUBSYSTEMS AND ROBUST QUANTUM COMPUTATION 9**

Quantum Subsystems, Properties of Entangled States, Quantum Error Correction, Graph states and codes, CSS Codes, Stabilizer Codes, Fault Tolerance and Robust Quantum Computing

**UNIT V QUANTUM INFORMATION PROCESSING 9**

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

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**Total Instructional hours: 45**

**Course Outcomes:**

Students will be able to

**CO1:** Outline the basics principles of quantum computing

**CO2:** Identify the difference between conventional and quantum computing

**CO3:** Interpret the steps of quantum computing algorithms

**CO4:** Summarize the quantum computation techniques

**CO5:** Compare the classes of problems to be solved by quantum computers

**CO Mapping with PO & PSO**

| CO/PO & PSO | | PO1 (K3) | PO2 (K4) | PO3 (K5) | PO4 (K5) | PO5 (K6) | PO6 (K3) (A3) | PO7 (K2) (A3) | PO8 (K3) (A3) | PO9 (A3) | PO10 (A3) | PO11 (K3) (A3) | PO12 (A3) | PSO1 (K4) (A3) | PSO2 (K3) (A3) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **K2** | 3 | 2 | 3 | 2 | 2 | - | - | - | 2 | 2 | 3 | 3 | 2 | 2 |
| **CO2** | **K3** | 3 | 2 | 2 | 2 | 2 | - | - | - | 2 | 2 | 2 | 2 | 3 | 2 |
| **CO3** | **K2** | 2 | 2 | 2 | 2 | 2 | - | - | - | 2 | 2 | 3 | 2 | 2 | 3 |
| **CO4** | **K2** | 3 | 2 | 3 | 2 | 2 | - | - | - | 2 | 2 | 2 | 2 | 2 | 2 |
| **CO5** | **K2** | 2 | 2 | 2 | 1 | 2 | - | - | - | 2 | 2 | 2 | 3 | 3 | 2 |
| **Weighted Average** | | 2 | 3 | 2 | 2 | 2 | 2 | - | - | - | 2 | 2 | 2 | 2 | 2 |

**3 – Strong** **2- Moderate** **1- Weak**

**Reference Books:**


1. John Gribbin, Computing with Quantum Cats: From Colossus to Qubits, 2021
2. William (Chuck) Easttom, Quantum Computing Fundamentals, 2021
3. Parag Lala, Quantum Computing, 2019
4. Eleanor Rieffel and Wolfgang Polak, QUANTUM COMPUTING A Gentle Introduction, 2011
5. Nielsen M. A., Quantum Computation and Quantum Information, Cambridge University Press.2002
6. Benenti G., Casati G. and Strini G., Principles of Quantum Computation and Information, Vol. I: Basic Concepts, Vol II: Basic Tools and Special Topics, World Scientific. 2004
7. Pittenger A. O., An Introduction to Quantum Computing Algorithms 2000


Approved by BoS Chairman

| M.E | M23CSE216- BIG DATA MINING AND ANALYTICS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**Course Objectives:**

1. To understand the computational approaches to Modeling, Feature Extraction.
2. To understand the need and application of Map Reduce.
3. To understand the various search algorithms applicable to Big Data.
4. To analyze and interpret streaming data and handle large data sets in main memory.
5. To learn the various clustering techniques applicable to Big Data.

**UNIT I DATA MINING AND LARGE SCALE FILES** **9**

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

**UNIT II SIMILAR ITEMS** **9**

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

**UNIT III MINING DATA STREAMS** **9**

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

**UNIT IV LINK ANALYSIS AND FREQUENT ITEMSETS** **9**

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

**UNIT V CLUSTERING** **9**

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

**Total Instructional hours: 45**

**Course Outcomes:**

Students will be able to

CO1: Identify algorithms by employing Map Reduce technique for solving Big Data problems.

CO2: Demonstrate algorithms for Big Data by deciding on the apt Features set

CO3: Develop algorithms for handling petabytes of datasets

CO4: Classify algorithms and propose optimized memory based solutions for Big Data

CO5: Infer solutions for problems in Big Data using appropriate clustering techniques.

**CO Mapping with PO & PSO**

| CO/PO & PSO | | PO1 (K3) | PO2 (K4) | PO3 (K5) | PO4 (K5) | PO5 (K6) | PO6 (K3) (A3) | PO7 (K2) (A3) | PO8 (K3) (A3) | PO9 (A3) | PO10 (A3) | PO11 (K3) (A3) | PO12 (A3) | PSO1 (K4) (A3) | PSO2 (K3) (A3) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | K3 | 3 | 2 | 3 | 2 | 2 | - | - | - | 2 | 2 | 3 | 3 | 2 | 2 |
| CO2 | K2 | 3 | 2 | 2 | 2 | 2 | - | - | - | 2 | 2 | 2 | 2 | 3 | 2 |
| CO3 | K3 | 2 | 2 | 2 | 2 | 2 | - | - | - | 2 | 2 | 3 | 2 | 2 | 3 |
| CO4 | K2 | 3 | 2 | 3 | 2 | 2 | - | - | - | 2 | 2 | 2 | 2 | 2 | 2 |
| CO5 | K2 | 2 | 2 | 2 | 1 | 2 | - | - | - | 2 | 2 | 2 | 3 | 3 | 2 |
| Weighted Average | | 2 | 3 | 2 | 2 | 2 | 2 | - | - | - | 2 | 2 | 2 | 2 | 2 |

**3 – Strong** **2- Moderate** **1- Weak**

**REFERENCES:**


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


Approved by BoS Chairman

| M.E | M23CSP201 – SOFTWARE ENGINEERING LABORATORY | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 4 | 2 |

**Course Objectives:**

1. To impart state-of-the-art knowledge on Software Engineering
2. To use UML in an interactive manner through the Web..
3. To present case studies to demonstrate practical applications of different concepts
4. To provide a scope to students where they can solve small, real-life problems

**List of Experiments:**

| Expt. No. | Description of the Experiments |
|---|---|
| 1. | FORWARD ENGINEERING<br>Students have to form a team with a batch size of two or three and take up a case study based project to analyze, plan, design UML models and create a prototypical model (identifying deliverables) by coding the developed designs and finally documenting considering any one example of the following<br>domains:-<br>1. Academics (Course Registration System, Student marks analyzingsystem)<br>2. Health Care ( Expert system to prescribe medicines for given symptoms,<br>Remote Diagnostics, Patient/Hospital ManagementSystem)<br>3. Finance (Banking:ATM/NetBanking,<br>UPI:PayTM/PhonePay,Stocks:Zerodha)<br>4. E-Commerce ( various online shopping portals likeFlipKart/Amazon/Myntra)<br>5. Logistics (Postal/Courier:IndiaPost/DTDC/UPS/FedEx,Freight:Maersk)<br>6. Hospitality (Tourism Management:Telangana Tourism/Incredible India,Event anagement:MeraEvents/BookMyShow/Explara/EventBrite)<br>7. Social Networking ( LinkedIn, FaceBook, Shaadi.com, BharatMatrimony,Tinder)<br>8. Customer Support (Banking Ombudsman,Indian Consumer ComplaintsForum)<br>9. Booking/Ticketing(Food:Zomato/Swiggy/BigBasket/Grofers/JioMart, Hotel:OYO/Trivago or Travel:{Cars:Uber/OLA/Zoom, Railways:IRCTC, Buses:OnlineTSRTC/RedBus/AbhiBus, Flights:MakeMyTrip/Goibibo, Ships:Lakport}) |
| 2. | REVERSE ENGINEERING:<br>Students have to refer any project repository: GitLab /GitHub,execute the code in order to observe its functionalities/features/requirements and by |

the help of any tool derive the designs from the code for understanding the relationships among various subsystems/classes/components and if the tool partially generates models
then identify by associating elements to judge/mark the appropriate relationships.

3. TESTING: Prepare Test Plan and develop Test Case Hierarchy to monitor or uncover/report errors using manual/automated testing tools

**Total Instructional hours: 30**

**Course Outcomes:**

Students will be able to

**CO1:** Interpret variety of approaches and perspectives of system development

**CO2:** Identify the requirements which are relevant to the design of the system

**CO3:** Model software design with a set of objects and their relationships using structural modeling

**CO4:** Take part in using the advanced and behavioral modeling to develop case study

**CO5:** Build activities with the help of architectural modeling

**CO Mapping with PO & PSO**

**3 – Strong** **2- Moderate** **1- Weak**

| CO/PO & PSO | | PO1 (K3) | PO2 (K4) | PO3 (K5) | PO4 (K5) | PO5 (K6) | PO6 (K3) (A3) | PO7 (K2) (A3) | PO8 (K3) (A3) | PO9 (A3) | PO10 (A3) | PO11 (K3) (A3) | PO12 (A3) | PSO1 (K4) (A3) | PSO2 (K3) (A3) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | K2 | 3 | 2 | 2 | 2 | 1 | - | - | - | 2 | 2 | 2 | 2 | 2 | 1 |
| CO2 | K3 | 3 | 3 | 2 | 2 | 2 | - | - | - | 2 | 2 | 2 | 1 | 3 | 1 |
| CO3 | K3 | 3 | 3 | 2 | 2 | 1 | - | - | - | 2 | 2 | 2 | 1 | 2 | 2 |
| CO4 | K4 | 3 | 2 | 2 | 2 | 1 | - | - | - | 2 | 2 | 2 | 1 | 2 | 1 |
| CO5 | K3 | 3 | 2 | 2 | 1 | 1 | - | - | - | 2 | 2 | 2 | 2 | 2 | 1 |
| Weighted Average | | 3 | 2 | 2 | 2 | 1 | - | - | - | 2 | 2 | 2 | 1 | 2 | 1 |

**List of Equipment Required:**

**Requirements for a Batch of 25 Students**

| Sl. No. | Description of the Equipment | Quantity required (Nos.) |
|---|---|---|
| 1. | Dell Optiplex 380 PCs<br>Operating systems: Windows* 7 or later, macOS, and Linux.<br>Software Required: StarUML/Umbrello, NetBeans/Eclipse IDE, XAMPP/MEANstack, JUnit, JMeter, Selenium, Bugzilla | 25 |

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| M.E | M23CSP202 – TERM PAPER AND SEMINAR | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 2 | 1 |

**Course Objectives:**

1. To work on a specific technical topic of research interest for oral presentation
2. To acquire technical writing abilities for seminars and conferences.
3. To publish quality papers and reputed journals.
4. In this course, students will develop their scientific and technical reading and writing skills that they need to understand and construct research articles.
5. A term paper requires a student to obtain information from a variety of sources (i.e., Journals, dictionaries, reference books) and then place it in logically developed ideas.

**The work involves the following steps:**

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

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

Activities to be carried Out.

| Activity | Instructions | Submission week | Evaluation |
|---|---|---|---|
| Selection of area of interest and Topic | You are requested to select an area of interest, topic and state an objective | 2nd week | 3 % Based on clarity of thought, current relevance and clarity in writing |

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| | | | |
|---|---|---|---|
| Stating an Objective | | | |
| Collecting Information about your area & topic | 1. List 1 Special Interest Groups or professional society<br>2. List 2 journals<br>3. List 2 conferences, symposia or workshops<br>4. List 1 thesis title<br>5. List 3 web presences (mailing lists, forums, news sites)<br>6. List 3 authors who publish regularly in your area<br>7. Attach a call for papers (CFP) from your area. | 3rd week | 3%<br>( the selected information must be area specific and of international and national standard) |
| Collection of Journal papers in the topic in the context of the objective – collect 20 & then filter | • You have to provide a complete list of references you will be using- Based on your objective -Search various digital libraries and Google Scholar<br>• When picking papers to read - try to:<br>• Pick papers that are related to each other in some ways and/or that are in the same field so that you can write a meaningful survey out of them,<br>• Favour papers from well-known journals and conferences,<br>• Favour “first” or “foundational” papers in the field (as indicated in other people’s survey paper),<br>• Favour more recent papers,<br>• Pick a recent survey of the field so you can quickly gain an overview,<br>• Find relationships with respect to each | 4th week | 6%<br>( the list of standard papers and reason for selection) |

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| | | | |
|---|---|---|---|
| | other and to your topic area (classification scheme/categorization)<br>• Mark in the hard copy of papers whether complete work or section/sections of the paper are being considered | | |
| Reading and notes for first 5 papers | Reading Paper Process<br>• For each paper form a Table answering the following questions:<br>• What is the main topic of the article?<br>• What was/were the main issue(s) the author said they want to discuss?<br>• Why did the author claim it was important?<br>• How does the work build on other's work, in the author's opinion?<br>• What simplifying assumptions does the author claim to be making?<br>• What did the author do?<br>• How did the author claim they were going to evaluate their work and compare it to others?<br>• What did the author say were the limitations of their research?<br>• What did the author say were the important directions for future research?<br>Conclude with limitations/issues not addressed by the paper ( from the perspective of your survey) | 5th week | 8%<br>( the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper) |
| Reading and notes for | Repeat Reading Paper Process | 6th week | 8%<br>( the table given |

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| | | | |
|---|---|---|---|
| next 5 papers | | | should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper) |
| Reading and notes for final 5 papers | Repeat Reading Paper Process | 7th week | 8% ( the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper) |
| Draft outline 1 and Linking papers | Prepare a draft Outline, your survey goals, along with a classification / categorization diagram | 8th week | 8% ( this component will be evaluated based on the linking and classification among the papers) |
| Abstract | Prepare a draft abstract and give a presentation | 9th week | 6% (Clarity, purpose and conclusion) 6% Presentation & Viva Voce |
| Introduction Background | Write an introduction and background sections | 10th week | 5% ( clarity) |
| Sections of the paper | Write the sections of your paper based on the classification / categorization diagram in keeping with the goals of your survey | 11th week | 10% (this component will be evaluated based on the linking and classification among |



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| | | | |
|---|---|---|---|
| | | | the papers) |
| Your conclusions | Write your conclusions and future work | 12th week | 5% ( conclusions – clarity and your ideas) |
| Final Draft | Complete the final draft of your paper | 13th week | 10% (formatting, English, Clarity and linking) 4% Plagiarism Check Report |
| Seminar | A brief 15 slides on your paper | 14th and 15th week | 10% (based on presentation and Viva-voce) |

**Course Outcomes:**

Students will be able to **Total Instructional hours: 30**

**CO1:** Identify domain specific objective.

**CO2:** Summarize the literature survey.

**CO3:** Analyze different methodologies.

**CO4:** Organize final draft of the research paper

**CO5:** List presentation for the research undergone

**CO Mapping with PO & PSO**

**3 – Strong** **2- Moderate** **1- Weak**

| CO/PO & PSO | | PO1 (K3) | PO2 (K4) | PO3 (K5) | PO4 (K5) | PO5 (K6) | PO6 (K3) (A3) | PO7 (K2) (A3) | PO8 (K3) (A3) | PO9 (A3) | PO10 (A3) | PO11 (K3) (A3) | PO12 (A3) | PSO1 (K4) (A3) | (K3) (A3) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **K2** | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 2 | 1 | 2 | 2 | 2 | 1 |
| **CO2** | **K2** | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 2 | 1 | 2 | 2 | 3 | 1 |
| **CO3** | **K4** | 2 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 2 | 1 | 2 | 2 | 2 | 2 |
| **CO4** | **K3** | 3 | 3 | 3 | 2 | 3 | 3 | 1 | 1 | 2 | 1 | 2 | 2 | 2 | 1 |
| **CO5** | **K4** | 3 | 2 | 2 | 3 | 2 | 3 | 1 | 1 | 2 | 1 | 2 | 2 | 2 | 1 |
| **Weighted Average** | | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 2 | 1 | 2 | 2 | 2 | 1 |

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