PRASAD V. POTLURI SIDDHARTHA INSTITUTE OF TECHNOLOGY KANURU, VIJAYAWADA

Department of Computer Science and Engineering

II B.Tech – II Semester

20CS3402  **Advanced Data Structures**

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| **CO** | **Statement** | **Skill** | **Blooms** | **Units** |
| **CO1** | |  | | --- | | Understand the basic principles and operations of data structures. | | Understand | L2 | 1,2,3,4,5 |
| **CO2** | |  | | --- | | Apply Hashing and String Matching techniques for solving problems effectively. | | Apply,  Communication | L3 | 1,5 |
| **CO3** | Apply the concepts of advanced Trees and Graphs for solving problems effectively. | Apply,  Communication | L3 | 2,3,4 |
| **CO4** | Analyze the given scenario and choose appropriate Data Structure for solving problems | Analyze,  Individual Performance, Communication | L4 | 4,5 |

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| **Advanced Data Structures** | | |
| **Unit No.** | **Contents** | **Mapped CO** |
| I | Hashing – General Idea, Hash Function, Separate Chaining, Hash Tables without linked lists: Linear Probing, Quadratic Probing, Double Hashing, Rehashing, Hash Tables in the Standard Library, Universal Hashing, Extendible Hashing. | **CO1,CO2** |
| II | Priority Queues (Heaps) – Model, Simple implementations, Binary Heap: Structure Property, Heap Order Property, Basic Heap Operations: insert, delete, Percolate down, Other Heap Operations. Binomial Queues: Binomial Queue Structure, Binomial Queue Operations, Implementation of Binomial Queue, Priority Queues in the Standard Library. | **CO1,CO3** |
| III | Trees – AVL: Single Rotation, Double Rotation, B-Trees. Multi-way Search Trees – 2-3 Trees: Searching for an Element in a 2-3 Tree, Inserting a New Element in a 2-3 Tree, Deleting an Element from a 2-3 Tree. Red-Black Trees – Properties of red-black trees, Rotations, Insertion, Deletion. | **CO1,CO3** |
| IV | Graphs Algorithms – Elementary Graph Algorithms: Topological sort, Single Source Shortest Path Algorithms: Dijkstra’s, Bellman-Ford, All-Pairs Shortest Paths: Floyd-Warshall’s Algorithm. | **CO1,CO3,CO4** |
| V | Disjoint Sets – Equivalence relation, Basic Data Structure, Simple Union and Find algorithms, Smart Union and Path compression algorithm. String Matching – The naive string-matching algorithm, The Rabin-Karp algorithm, The Knuth-Morris-Pratt algorithm | **CO1,CO2,CO4** |

**CO-PO Mapping**

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| **Contribution of Course Outcomes towards achievement of Program Outcomes** | | | | | | | | | | | | | | |
|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
| **CO1** | **3** |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **CO2** | **2** |  |  |  |  |  |  |  |  | **1** |  |  |  |  |
| **CO3** |  |  |  |  |  |  |  |  |  |  |  |  | **3** | **1** |
| **CO4** |  | **2** |  |  |  |  |  |  | **1** | **1** |  | **1** |  |  |

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**Strength of Correlation**

Distribution of marks weightage to PO’s through CO’s.

* The strength of correlation levels is based on percentage of marks distribution towards PO.

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| CIE | **Test** | **Test Number** | **Marks** |
| Objective Exam (10) | Objective Exam -1 | 10 |
| Objective Exam -2 | 10 |
| Assignment (5) | Assignment -1 | 5 |
| Assignment - 2 | 5 |
| Descriptive Exam (15) | Descriptive Exam - 1 | 15 |
| Descriptive Exam - 2 | 15 |

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| **CO** | **Skill** | **Blooms** | **Units** | **Assessing Tools can be used to measure CO (CIE)**  **Marks** | **Assessing Tools can be used to measure CO (SEE)**  **Marks** |
| CO1 | Understand | L2 | 1,2,3,4,5 | Objective Exam – (10)  Descriptive Exam-2.5 | 25 |
| CO2 | Apply,  Communication | L3 | 1,5  2 | Descriptive Exam – (2.5)  Assignment – 2(1.5+0.5) | 15 |
| CO3 | Apply | L3 | 2, 3,4  2,3,4 | Descriptive Exam-8.5  Assignment – 1 | 20 |
| CO4 | Analyze,  Individual Performance, Communication  Life-Long Learning | L4 | 4,5 | Descriptive Exam – 1.5  Assignment – 2(0.5+0.5+0.5+0.5) | 10 |

**Strength of Correlation**

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| --- | --- |
| **% of questions towards PO** | **Level (Weight)** |
| >=20% of total marks | 3 |
| >=10% and <20% of total marks | 2 |
| < 10% of total marks | 1 |

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| **CO** | **Skill** | **Bloom's** | **Units** | **Assessing tools can be used to measure CO (CIE) Marks** | | **CIE Total** | **Assessing tools can be used to measure CO (SEE) Marks** | **Total (CIE+SEE)** | **Percentage (%)** | **Strength of Correlation** | **PO** |
| CO1 | Understand | L2 | 1,2,3,4,5 | | Objective Exam – (10)  Descriptive Exam-2.5 | 12.5 | 25 | 37.5 | 37.5% | 3 | PO1 |
| CO2 | Apply,  Communication | L3 | 2,5 | | Descriptive Exam – (2.5)  Assignment – 2(1+0.5+0.5) | 2.5  0.5  0.5 | 15 | 17.5  0.5  0.5 | 18.5%  0.5%  0.5% | 2  1  1  1  1  1 | PO1,PO9  PO10  PO12  PSO1  PSO2 |
| CO3 | Apply | L3 | 2, 3,4 | | Descriptive Exam-8.5  Assignment – 1 | 8.5  1 | 20 | 29.5 | 29.5% | 2  1  1  1  1  1 | PO1,PO9  PO10  PO12  PSO1  PSO2 |
| CO4 | Analyze,  Individual Performance, Communication,  Life-Long Learning | L4 | 4,5 | | Descriptive Exam – 1.5  Assignment – 2 (0.5+0.5+0.5+0.5) | 2  1  0.5  0.5 | 10 | 12  1  0.5  0.5 | 12%  1%  0.5%  0.5% | 2  1  1  1  1 | PO2  PO9  PO10  PO12  PSO2 |

**Course Articulation Matrix:**

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| **Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)** | | | | | | | | | | | | | | |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| **CO1** | **3** |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **CO2** | **2** |  |  |  |  |  |  |  |  | **1** |  |  |  |  |
| **CO3** |  |  |  |  |  |  |  |  |  |  |  |  | **3** | **1** |
| **CO4** |  | **2** |  |  |  |  |  |  | **1** | **1** |  | **1** |  |  |
| **Average** | **2.5** | **2** |  |  |  |  |  |  | **1** | **1** |  | **1** | **3** | **1** |

Program Coordinator: Module Coordinator: Course Coordinator:

Students apply engineering fundamentals to analyze the performance (time/space complexity), select the appropriate structure for a given problem, and implement solutions in a structured, reliable manner. This showcases their ability to transform theoretical knowledge into practical, scalable engineering solutions.

CO-PO Jjustification

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| **CO 1** | Understand the basic principles and operations of data structures. |
| **PO1** | **Engineering Knowledge** – Apply knowledge of mathematics, science, and engineering fundamentals to solve complex problems.  Justification:  Students apply the fundamentals of engineering to anayze a given problem to find solution to real world scenarios by choosing appropriate data strutures hence this maps to PO1 |
| **CO2** | |  | | --- | | Apply Hashing and String Matching techniques for solving problems effectively. | |
| **PO1** | **Engineering Knowledge** – Apply knowledge of mathematics, science, and engineering fundamentals to solve complex problems.  Students apply the fundamentals of engineering to anayze a given problem to find solution to real world scenarios by choosing appropriate data strutures like hashing and string matching methods hence this maps to PO1 |
| **PO10** | **Communication** – Communicate effectively on complex engineering activities with the engineering community and society at large.  **Justification:** By incorporating report writing, presentations, discussions, students develop effective written and oral communication skills, ensuring that they can clearly interpret and convey the advanced concepts of data structures thereby aligning with PO10. |
| **CO3** | Apply the concepts of advanced Trees and Graphs for solving problems effectively. |
| **PSO1** | Apply the Knowledge of Computing Skills in building the Software Systems that meet the requirements of Industry and Society.  Justification  Advanced data structures and its algorithms are important to solve the complex probems that meet the domain of industry and society |
| **PSO2** | **Apply the Knowledge of Data Engineering and Communication Technologies for Developing Applications in the Domain of Smart and Intelligent Computing.**  **Justification: Advanced data structures and its algorithms** are crucial for applying computing skills to build software systems that meet industry and societal needs for obtaining efficient solutions to complex engineering problems in the domain of intelligent computing by using the knowledge and concepts of data strucures and its algorithms thus aligning with PSO2. |
| **CO4** | Apply the concepts of advanced Trees and Graphs for solving problems effectively. |
| **PO2** | **Problem Analysis** – Identify, formulate, and analyze engineering problems using principles of mathematics and science.  Justification  Students choose the most optimal data structure, and apply **analytical reasoning to find solutions to real world scenarios** which is the very essence of PO2 |
| **PO9** | **Individual and Team Work** – Function effectively as an individual and as a member or leader in diverse teams.  Justification  students learn to work in **teams with share** ideas, and integrate modules for a obtaining a solution Theyalso learn to demonstrate their data structure which builds confidence, leadership, and accountability in both **individual and team hence this maps to PO9** |
| **PO10** | **Communication** – Communicate effectively on complex engineering activities with the engineering community and society at large.  **Justification:** By incorporating report writing, presentations, discussions, students develop effective written and oral communication skills, ensuring that they can clearly interpret and convey the advanced concepts of data structures thereby aligning with PO10. |
| **PO12** | **Life-long Learning** – Recognize the need for, and have the ability to engage in, independent and life-long learning.  Justification  Advanced data structures like AVL trees, B-trees, and graph algorithms are used in applications like blockchain, bioinformatics, and network security. By learning to apply these structures, students adapt to **emerging technologies** and **continuous learning**, hence this maps to PO12. |

**Course Coordinators Module Coordinators Program Coordinator**

1. Dr S.Madhavi Dr G.Lalitha Kumari Dr B Lakshmi Ramani

2 Ms. Y. Surekha

3. Dr. M Sailaja