UCS406: DATA STRUCTURES AND ALGORITHMS (with Project)

L	T	P	Cr
3	0	4	6.0

Linear Data Structures: Arrays, Records, Strings and string processing, References and aliasing, Linked lists, Strategies for choosing the appropriate data structure, Abstract data types and their implementation: Stacks, Queues, Priority queues, Sets, Maps.

Basic Analysis: Differences among best, expected, and worst case behaviours of an algorithm, Asymptotic analysis of upper and expected complexity bounds, Big O notation: formal definition and use, Little o, big omega and big theta notation , Complexity classes, such as constant, logarithmic, linear, quadratic, and exponential, Time and space trade-offs in algorithms, Recurrence relations , Analysis of iterative and recursive algorithms.

Searching and Sorting: Linear Search, Binary Search, Bubble Sort, Selection Sort, Insertion Sort, Shell Sort, Quick Sort, Heap Sort, Merge Sort, Counting Sort, Radix Sort.

Algorithmic Strategies with examples and problem solving: Brute-force algorithms with examples, Greedy algorithms with examples, Divide-and-conquer algorithms with examples, Recursive backtracking, Dynamic Programming with examples, Branch-and-bound with examples, Heuristics, Reduction: transform-and-conquer with examples.

Non-Linear Data Structures And Sorting Algorithms: Hash tables, including strategies for avoiding and resolving collisions, Binary search trees, Common operations on binary search trees such as select min, max, insert, delete, iterate over tree, Graphs and graph algorithms , Representations of graphs, Depth- and breadth-first traversals , Heaps ,Graphs and graph algorithms , Shortest-path algorithms (Dijkstra and Floyd) , Minimum spanning tree (Prim and Kruskal).

Problem Clauses: P, NP, NP- Hard and NP-complete, deterministic and non-deterministic polynomial time algorithm approximation and algorithm for some NP complete problems. Introduction to parallel algorithms, Genetic algorithms, intelligent algorithms.

Laboratory work: Implementation of Arrays, Recursion, Stacks, Queues, Lists, Binary trees, Sorting techniques, Searching techniques. Implementation of all the algorithmic techniques.

Project: It will contain a Project which should include designing a new data structure/algorithm/ language/tool to solve new problems & implementation. It can also involve creating visualizations for the existing data structures and algorithms. Quantum of project should reflect at least 60 hours of Work excluding any learning for the new techniques and technologies. It should be given to group of 2-4 students. Project should have continuous evaluation and should be spread over different components. There should be a formal project report. Evaluation components may include a poster, video presentation as well as concept of peer evaluation and reflection component.

Text Books:

1. *Corman, Leiserson & Rivest, Introduction to Algorithms, MIT Press (2009), 3rd edition.*
2. *Narasimha Karumanchi, Data Structures and Algorithms Made Easy" (2014), 2nd ed.*

Reference Books:

1. *Sahni, Sartaj, Data Structures, Algorithms and Applications in C++, Universities Press (2005), 2nd ed.*

Course Learning Outcome (CLO):

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

1. Implement the basic data structures and solve problems using fundamental algorithms.
2. Implement various search and sorting techniques.
3. Analyze the complexity of algorithms, to provide justification for that selection, and to implement the algorithm in a particular context.
4. Analyze, evaluate and choose appropriate data structure and algorithmic technique to solve real-world problems.

Evaluation Scheme:

S.No.	Evaluation Elements	Weightage (%)
1	MST	20
2	EST	40
3	Sessionals (Assignments/Projects/ Tutorials/Quizzes/Lab Evaluations)	40