| Course code | Data Structures and Algorithms | L | T | P | J | C |
|---|---|---|---|---|---|---|
| CSE2011 | | 3 | 0 | 2 | 0 | 4 |
| Pre-requisite | Nil | Syllabus version | | | | |
| | | v. xx.xx | | | | |

**Course Objectives:**

1. To understand the basic concepts of data structures and algorithms.
2. To differentiate linear and non-linear data structures and the operations upon them.
3. Ability to perform sorting and searchingin a given set ofdata items.
4. To comprehend the necessity of time complexity in algorithms.

**Expected Course Outcome:**

1. Understanding the fundamental analysis and time complexity for a given problem.
2. Articulate linear data structures and legal operations permitted on them.
3. Articulate non-linear data structures and legal operations permitted on them.
4. Applyinga suitable algorithm for searching and sorting.
5. Understanding graph algorithms, operations, and applications.
6. Understanding the importance of hashing.
7. Applying the basic data structures to understand advanced data structure operations and applications.
8. Application ofappropriate data structures to find solutions to practical problems.

**Student Learning Outcomes (SLO): 1,5,6,9,11**

1. Having an ability to apply mathematics and science in engineering applications.
5. Having design thinking capability.
6. Having an ability to design a component or a product applying all the relevant standards and with realistic constraints.
9. Having problem solving ability- solving social issues and engineering problems.
11. Having an interest in lifelong learning.

| Module:1 | Introduction to Algorithms and Analysis | 6 hours | CO:1 |
|---|---|---|---|

Overview and importance of algorithms and data structures. Fundamentals of algorithm analysis, Space and time complexity of an algorithm, Types of asymptotic notations and orders of growth, Algorithm efficiency – best case, worst case, average case, Analysis of non-recursive and recursive algorithms, Asymptotic analysis for recurrence relation – Recursive Tree Method.

| Module:2 | Linear Data Structures | 8 hours | CO: 2,8 |
|---|---|---|---|

Array- 1D and 2D array , Stack - Applications of stack: Expression Evaluation - Conversion of Infix to postfix and prefix expression, Tower of Hanoi.

Queue - Types of Queue: Circular Queue, Double Ended Queue (deQueue), Applications – Priority Queue using Arrays - List - Singly linked lists – Doubly linked lists - Circular linked lists, Applications -Polynomial Manipulation - Josephus problem(permutation)

| Module:3 | Sorting and Search Techniques | 8 hours | CO:4,8 |
|---|---|---|---|

Searching - Linear Search and binary search, Applications - Finding square root of ‘n’-Longest

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|---|---|---|---|
| Common Prefix<br>Sorting – Insertion sort - Selection sort – Bubble sort – (Counting Sort) - Quick sort- Merge sort , Analysis, Applications - Finding the 'n' closest pair's | | | |
| | | | |
| **Module:4** | **Non-linear Data Structures - Trees** | **6 hours** | **CO:5,8** |
| Tree - Terminology, Binary Tree – Terminology and Properties, Tree Traversals, Expression Trees – Binary Search Trees – operations in BST – insertion, deletion, finding min and max, Finding the kth minimum element in a BST, Applications – Dictionary | | | |
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| **Module:5** | **Non-linear Data Structures - Graphs** | **6 hours** | **CO:3,8** |
| Graph – basic definition and Terminology – Representation of Graph – Graph Traversal: Breadth First Search (BFS), Depth First Search (DFS) - Minimum Spanning Tree: Prim's, Kruskal's- Single Source Shortest Path: Dijkstra's Algorithm. | | | |
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| **Module:6** | **Hashing** | **4 hours** | **CO:6,8** |
| Hash functions, open hashing-separate chaining, closed hashing - linear probing, quadratic probing, double hashing, random probing, rehashing, extendible hashing, Applications – Dictionary-Telephone directory | | | |
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| **Module:7** | **Heaps and Balanced Binary Search Trees** | **5 hours** | **CO:7,8** |
| Heaps - Heap sort, Applications -Priority Queue using Heaps<br>AVL trees – Terminology - basic operations(rotation, insertion and deletion | | | |
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| **Module:8** | **Recent Trends** | **2 hours** | **CO:8** |
| Recent trends in algorithms and data structures | | | |
| | **Total Lecture hours:** | **45 hours** | |

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| **Text Book(s)** | |
| 1. | Thomas H. Cormen, C.E. Leiserson, R L.Rivest and C. Stein, Introduction to Algorithms , Third edition, MIT Press, 2009. |
| 2 | Mark A. Weiss,Data Structures & Algorithm Analysis in C++, 3rd edition, 2008, PEARSON. |
| **Reference Books** | |
| 1. | Kurt Mehlhorn, and Peter Sanders – Algorithms and Data Sturctures The Basic Toolbox, Springer-Verlag Berlin Heidelberg, 2008. |
| 2. | Horowitz, Sahni, and S. Anderson-Freed , Fundamentals of Data Structures in C UNIVERSITIES PRESS,Second Edition,2008. |
| Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar | |

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| **List of Experiments (Indicative)** | | **CO:3,4,5** |
| 1. | Implementation of Stack and its applications | 4 hours |
| 2. | Implementation of queue and its applications | 4 hours |

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|---|---|---|---|---|
| 3. | Linked List | | | 4 hours |
| 4. | Searching algorithm | | | 2 hours |
| 5. | Sorting algorithm – insertion, bubble, selection etc. | | | 2 hours |
| 6. | Randomized Quick sort and merge sort | | | 2 hours |
| 7. | Binary Tree traversals | | | 2 hours |
| 8. | Binary search tree | | | 2 hours |
| 9. | DFS, BFS | | | 3 hours |
| 10. | Minimum Spanning Tree – Prim's and Kruskal's | | | 3hours |
| 11. | Single source shortest path algorithm – Connected Components and finding a cycle in a graph | | | 2 hours |
| | | | Total Laboratory Hours | 30 hours |
| Mode of evaluation: | | | | |
| Recommended by Board of Studies | 09-09-2020 | | | |
| Approved by Academic Council | No. 59 | Date | 24-09-2020 | |