**Computer Science and Engineering**

**Subject Name: DATA STRUCTURE**

**Regulation Year: 2021-22**

**Course Code: Credit:** 02

**Course Category: Core Theory Contact hours:** Theory 03Hrs/Week

**Recommended Pre-requisite:**Computer Programming

**COURSE OUTCOMES:**

**CO1:**Understandof linear data structure such as Queue and Stack for solving problems.

**CO2:**Analyse linear data structure such as Linked List for solving problems.

**CO3:**Apply non-linear data structure such as Tree for solving problems.

**CO4:**Apply non-linear data structure such as Graph for solving problems.

**CO5:**Create a program using different sorting and searching mechanisms.

**COXX**

**Course Details:**

**UNIT 1: Introduction to Data structure: (7 Hrs)**

**U1.1**. Introduction, Abstract data types with example (Types: Primitive, Non primitive, Linear, Nonlinear, Static, Dynamic Data structures). Stack: Fundamentals of stack, representation using array, Applications of stack: Recursion, Expression conversions and evaluations etc., Queue: Fundamentals of queue, representation using array, Circular queues, Double ended queues concepts and operations, Applications of queue to solve problems.

U1.2. Self Study: 3-Tuple representation of Sparse matrix, Sparse Matrix: Addition and Fast transpose, Priority Queue.

**UNIT2: Introduction to Linked lists: (7 Hrs)**

**U2.1** Single linked lists: operations and implementation. Double linked list: operations and implementations. Circular list: concepts and implementation, Applications: Stack & Queue implementation using linked list, Polynomial Manipulation using linked list.

U2.2. Self Study: Dynamic storage management-garbage collection and compaction.

### UNIT 3: Trees (7 Hrs)

**U3.1**Basic terminology, representation using array and linked list, Tree Traversals: Recursive and Non recursive, Operations on binary tree: Finding Height, Leaf nodes, counting no of nodes etc., Construction of binary tree from traversals, Binary Search trees (BST): Insertion, deletion of a node from BST, Height Balanced Tree (AVL): Rotations on AVL tree, M-way search trees: B trees, B+ tree

U3.2. Self Study: Optimal Binary Search Tree (OBST), Threaded Binary tree (TBT): Creation and traversals on TBT, Red-Black Trees, and Expressiontree.

### UNIT 4: Graph (7 Hrs)

**U4.1**Graphs: Graph terminology, Representation of graphs, Path matrix, Warshall’s algorithm (shortest path algorithm). Traversals: BFS (breadth first search), DFS (depth first search), Shortest Paths: Single Source all destinations (Dijkstra’s Algorithm).

**U4.2. Self Study** :Prim’s Algorithm, Bellman’s Ford Algorithm (all source shortest path)

### Unit 5: Sorting & Searching (7 Hrs)

**U5.1** Searching techniques – Linear and Binary search methods(recursive and non-recursive).Sorting techniques –Quick sort,Selection Sort, Heaps: Max Heap, Min Heap, Heap Sort . Hashing – Different hash functions, Collision resolution techniques.

**U5.2. Self Study:**, Bubble Sort, Insertion Sort, Radix sort, Merge sort, Topological Sort

**Note:** Five assignments to be given to the students on self study, comprising of one assignment from each unit.

**Text books:**

1. “Data Structure: A Pseudo code approach with C”,Richard F. Gilberg and Behrouz A. Forouzan, Thomson publication., Second Edition.
2. “Data structure in C”, A.M.Tanenbaum, Y. Langsam, M. J. Augenstein, PHI publication / Pearson publication., Seventh Edition.

**Reference Books:**

1. “Data Structures with C”– (Schaums Series),  [Seymour Lipschutz](https://www.amazon.in/s/ref=dp_byline_sr_book_1?ie=UTF8&field-author=Seymour+Lipschutz&search-alias=stripbooks) Tata-McGraw-Hill., First Edition.
2. “Fundamentals of data structure in C”– Horowitz, Sahani & Freed, Computer Science Press., Second Edition.
3. “Data Structure Through C: A Practical Approach” by G. S. Baluja, DhanpatRai Publications., First Edition.
4. ”Data Structures & Algorithms; Concepts, Techniques & Algorithms ” by Pai, Tata McGraw Hill., First Edition.
5. “Data Structures Using C”, Reema Thareja, Oxford University Press, Second Edition.

**Open Sources:**

1. https://nptel.ac.in/courses/106/104/106104128/ (Introduction to Programming in C)
2. <https://nptel.ac.in/courses/106/105/106105171/> (Problem solving through Programming in C)

**Course Designed by:**Madhusmita Sahu, Mamata Das, Anjana Mishra

**Course Approved by:**

**Computer Science and Engineering**

**Subject Name: DATA STRUCTURE LABORATORY**

**Regulation Year: 2021-22**

**Course Code: Credit: 02**

**Course Category: Core Sessional Contact hours:** Laboratory 03Hrs/Week

**Recommended Pre-requisite:** Computer Programming

**COURSE OUTCOMES:**

**CO1:**Implementation of linear data structure for solving problems.

**CO2:**Implementation of non-linear data structure for solving problems

**CO3:**Use different sorting and searching mechanisms by analyzing suitability.

**CO4:**Develop C programming using data structure techniques.

**List of Sample Programs:**

**Experiment No. 1**

1. Design a menu driven program in C to implement different operations on array.

**Experiment No. 2**

1. Implement different operations on two dimensional arrays using C code.
2. Write a program in C to implement the three tuple representation of a Sparse Matrix.

**Experiment No. 3**

1. Write a program in C to implement stack performing Push, Pop and Peep operations.
2. Write a program in C to implement different operations on queue using array.

**Experiment No. 4**

Write a program in C that uses Stack operations to perform the following:

1. Convert infix expression to postfix expression
2. Evaluate the postfix expression.

**Experiment No. 5**

Write a C program that uses functions to perform the following operations on Single linked list:

Creation ii) Insertion iii) Deletion iv) Traversal v) Reversing a single linked list.

**Experiment No. 6**

Write a C program that uses functions to perform the following operations on Double linked list:

Creation ii) Insertion iii) Deletion iv) Traversal in both ways.

**Experiment No. 7**

Write a C program that uses functions to perform the following operations on Binary Search Tree:

Creation ii) Insertion iii) Deletion

iv)Traversal of B.S.T (In-order, Pre-order and Post-order)

**Experiment No. 8**.

Write a program in C to implement Linear, Binary search using both recursive and non-recursive functions.

**Experiment No. 9**

Implementation of Bubble sort, Insertion sort, Selection sort algorithms using programming in C.

**Experiment No. 10**

Implementation of Quick Sort and Merge Sort algorithms using programming in C.

**List of Experiments which can be given as lab assignment to the students**.

1. Write a program in C to implement double ended queue using array.
2. Write a program in C to implement circular linked list.
3. Implement BFS and DFS traversals on Graph using programming in C.
4. Implementation of Heap Sort using C code.

**Text books:**

* + - 1. “Data Structure- A Pseudo code approach with C” by Gilberg and Forouzan, Thomson publication.
      2. “Data structure in C” by Tanenbaum, PHI publication / Pearson publication.

1. ”Data Structures & Algorithms; Concepts, Techniques & Algorithms ” by Pai,Tata McGraw Hill.
2. “Data Structures Using C”, ReemaThareja, Oxford University Press

**Reference Books:**

1. “Fundamental of Data Structure”– (Schaums Series) Tata-McGraw-Hill.

2. “Fundamentals of data structure in C”– Horowitz, Sahani& Freed, Computer Science Press.

3. “Data Structure Through C: A Practical Approach” by G. S. Baluja, DhanpatRai Publications.

**Open Sources**

<https://www.wctmgurgaon.com/wctm/dsa%20lab-it-labmanual.pdf>

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**Course Approved by:**