# Data Structure

## SWAYAM Prabha Course Code- KCS301

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| **PROFESSOR'S NAME** | Akhilesh Kumar Srivastava<br>Puneet Kumar Goyal |
| **DEPARTMENT** | Computer Science & Engineering |
| **INSTITUTE** | ABES Engineering College, Ghaziabad |
| **COURSE OUTLINE** | Data Structure is a building block of Computer Science fundamentals. The course series offers the understanding of Algorithm, Time and space analysis and introduction to standard Data Structures like Array, Stack, Queue, Linked List, Tree and Graphs. The course also covers the various Sorting and Searching techniques that is extremely essential in solving the real world problems related to Computer Science. |

**COURSE DETAILS**

| S. No. | Module ID/ Lecture ID | Lecture Title/Topic |
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| **1** | Lecture 1 | Introduction to Data Structures |
| **2** | Lecture 2 | Introduction to Data Structures, ADT |
| **3** | Lecture 3 | Algorithm, Time and Space Complexity, Asymtotic Notations |
| **4** | Lecture 4 | Time and Space Complexity, Time Space Trade-off |
| **5** | Lecture 5 | Array Address Calculation, 1-D, 2-D Array (Row Major, Column Major) |
| **6** | Lecture 6 | Array Address Calculation, 3-D Array, Row Major, Column Major |
| **7** | Lecture 7 | Array Insertion, Deletion and Traversal |
| 8 | Lecture 8 | Application of arrays, Sparse Matrices and their representations |
| 9 | Lecture 9 | Introduction to Linked List, Comparison with Array |
| 10 | Lecture 10 | Singly/Linear Linked List: Insertion, Traversal |
| 11 | Lecture 11 | Singly/Linear Linked List: Deletion, Search |
| 12 | Lecture 12 | Circular Linked List: Insertion, Traversal |
| 13 | Lecture 13 | Circular Linked List: Deletion, Search |
| 14 | Lecture 14 | Doubly Linked List: Insertion, Traversal |
| 15 | Lecture 15 | Doubly Linked List: Deletion, Polynomial Arithmetic |
| 16 | Lecture 16 | Stack, Stack Applications: Reverse of String, Palindrome check, Binary, Octal, hexadecimal conversion, Parenthesis check using Stack |
| 17 | Lecture 17 | Primitive Operations on stack: Array implementation, Linked List Implementation of Stack |
| 18 | Lecture 18 | Evaluation of Postfix Expression, Prefix Expression, Introduction to Precedence function |
| 19 | Lecture 19 | Infix to Postfix Conversion |
| 20 | Lecture 20 | Infix to Prefix Conversion |

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| 21 | Lecture 21 | Recursion, Factorial, Power, GCD, concept of head, tail and body recursion, Time and space Complexity of Recursion |
| 22 | Lecture 22 | Fibonacci Series, understanding the run time of Fibonacci term through recursion, improving the run time |
| 23 | Lecture 23 | Towers of Hanoi: story and Recursive solution, time and space complexity |
| 24 | Lecture 24 | Queue Data Structure, Applications, Linear Queue, Circular Queue Array representation |
| 25 | Lecture 25 | Linked List Implementation of Queue, (through linear and circular) Double Ended Queue |
| 26 | Lecture 26 | Priority Queue: Array, Linked List and Heap Implementation |
| 27 | Lecture 27 | Concept and application of Searching, Linear and Binary Search, Time and Space Analysis |
| 28 | Lecture 28 | Concept of Hashing and Hash functions, Collision resolution in Hashing, Open addressing and separate chaining |
| 29 | Lecture 29 | Bubble, Selection Sort Time and space Analysis |
| 30 | Lecture 30 | Insertion Sort, Time and space Analysis, comparison of Bubble, Selection and Insertion sort |
| 31 | Lecture 31 | Divide and conquer, Merge Sort, Time and space Analysis |
| 32 | Lecture 32 | Concept of Quick Sort, Partition, Run Time Analysis |
| 33 | Lecture 33 | Space Complexity of Quick Sort, Improving run time of Quick Sort through Randomization and Median element |
| 34 | Lecture 34 | Heap Sort, Time and space Analysis |
| 35 | Lecture 35 | Counting and Radix Sort, Concept of Internal and External Sort |
| 36 | Lecture 36 | Graph Terminology, Adjacency Matrix, Incidence matrix and Adjacency List representation |
| 37 | Lecture 37 | Graph Traversal: BFS, Application of BFS |
| 38 | Lecture 38 | Graph Traversal DFS, Application of DFS |
| 39 | Lecture 39 | Minimal Spanning Tree: Prim's Algorithm, |
| 40 | Lecture 40 | Minimal Spanning Tree: Kruskal Algorithm, Connected Components of a Graph |
| 41 | Lecture 41 | All pairs shortest path: Warshall Algorithm, |
| 42 | Lecture 42 | Transitive Closure of a graph, Single source shortest Path: Dijikstra Algorithm, |
| 43 | Lecture 43 | Basic Terminology in Binary Tree, Strictly Binary Tree, Complete Binary Tree, Almost Complete Binary Tree, Height, count of nodes |
| 44 | Lecture 44 | Tree Traversal: Preorder, Inorder, Postorder, Tree from Traversal |
| 45 | Lecture 45 | Application of Binary Tree: Huffman coding, Threaded Binary Tree, Application of Threaded Binary Tree |
| 46 | Lecture 46 | Binary Search Tree: Search, Insertion, Traversal, |
| 47 | Lecture 47 | Binary Search Tree: Successor, Deletion |

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| 48 | Lecture 48 | AVL Tree, Rotation, Insertion in AVL Tree, AVL Tree Algorithms |
| 49 | Lecture 49 | B-Tree: properties, Insertion in B-Tree |

**References:**


1. Aaron M. Tenenbaum, Yedidyah Langsam and Moshe J. Augenstein, "Data Structures Using C and C++", PHI Learning Private Limited, Delhi India
2. Horowitz and Sahani, "Fundamentals of Data Structures", Galgotia Publications Pvt Ltd Delhi India.
3. Lipschutz, "Data Structures" Schaum's Outline Series, Tata McGraw-hill Education (India) Pvt. Ltd.
4. Thomas H. Coreman, Charles E. Leiserson and Ronald L. Rivest, "Introduction to Algorithms", Printice Hall of India


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