Course Handout (2021-22 EVEN SEMESTER)

Subject Name/Code : DATA STRUCTURES AND ALGORITHMS (BTCS-T- ES-003) Branch/Sem/Batch :

: Bimal Kumar Meher , Debasmita Pradhan , Saumyaranjan Dash , Kasturi Dhal , Surajit Das Name of Faculty ; Kamalakanta Sethi , DEEPIKA RANI SAHU , Satyananda Champati Rai , TAPAS KUMAR

MAJI , RAJAN KUMAR MISHRA

Scope & Objective -:

To understand the abstract data types and to solve problems using data structures such as stacks, queues, linked lists, hash tables, binary trees, heaps, binary searchtrees, graphs and writing programs for these solutions.

Pre-Requisite -:

Detailed Syllabus:

Module#	CO	Topics	Hours
MODULE-1	CO-1	ntroduction to data structures, classification of data structures, algorithmicnotation, complexity of algorithms, asymptotic notations, abstract datatypes. Arrays - introduction, representation of arrays (row and columnmajor representation), basic operations on array (traverse, insert, delete, search), sparse matrix, representation of sparse matrix using triplet form, operations on sparse matrix (addition, transpose)	8
MODULE-2	CO-2	ADT Stack - stack model, representation of stack using array, basicoperations with analysis, applications- recursion, and conversion of infix topost fix expression, evaluation of postfix expression. ADT Queue - queuemodel, representation using array, basic operations with analysis, circularqueue, introduction to priority queue and double ended queue	8
MODULE-3	CO-3	Linked list - introduction, types of linked list (single, double, circular), representation in memory, operations on linked list (traverse, search, insert, delete, sort, merge) in each type with analysis. Representation of polynomialand its operations (addition, multiplication), implementation of stack and queue using linked list.	9
MODULE-4	CO-4	Tree - terminology, representation, binary tree - tree traversal algorithms with and without recursion. Binary search tree, Operations on Binary SearchTree with analysis, threaded binary tree, general tree, Height balanced tree(AVL tree), mway search trees, B-trees. Graph - terminology, representation(adjacency matrix, incidence matrix, path matrix, linked representation), graph traversal (BFS, DFS), Dijkstra's single source shortest path algorithm, Warshall's all pair shortest path algorithm, topological sort.	9
MODULE-5	CO-5	Sorting algorithms - bubble sort, selection sort, insertion sort, quick sort,merge sort, radix sort, heap sort. Hashing- hash functions and hashingtechniques.collision resolution techniques- linear probing, quadratic probing, chaining.	8
		Total	42 Hours

	#	Торіс		Chapter	Course Coverage	No of Classes
	Introduction to data structures, Classification of data structures				TRUE	1
	Algorithmic notation, Complexity of algorithms, Asymptotic notations				TRUE	1
3 Abstract Data Types		Abstract Data Types			TRUE	1

4	Arrays-Introduction, Representation of arrays, Basic operations on array	FALSE	1
5	Basic operations on array (Insert, Delete, Search)	FALSE	1
6	Sparse matrix, Representation of sparse matrix using triplet form	TRUE	1
7	Sparse matrix, Representation of sparse matrix using triplet form continued	TRUE	1
8	ADT Stack: Stack model. Representation of stack using array, Basic operations with	TRUE	1
9	Applications: Recursion, Evaluation of	TRUE	1
10	postfix expression Conversion of infinite postfix expression	TRUE	1
	Conversion of infix to postfix expression ADT Queue -Queue model, Representation		
11	using array	TRUE	1
12	Basic operations with analysis	TRUE	1
13	Circular Queue, Basic operation (Insert)	TRUE	1
14	Circular Queue, Basic operation (Delete)	FALSE	1
15	Introduction to priority Queue and double ended queue	TRUE	1
16	Linked list-Introduction, Types of linked list(Single , Double, circular) Representation in memory	TRUE	1
17	Operations on Single linked list (Traverse, Search)	TRUE	1
18	Insert operation on Single linked list	TRUE	1
19	Insert operation on Single linked list continued	FALSE	1
20	Delete operation on Single linked list	TRUE	1
21	Delete operation on Single linked list continued	FALSE	1
22	Operations on single linked list(Sort, Merge)	FALSE	1
23	Insert operation on double linked list	TRUE	1
24	Insert operation on double linked list continued	FALSE	1
25	Delete operation on double linked list	TRUE	1
26	Delete operation on double linked list continued	FALSE	1
27	Insert operation on circular linked list	TRUE	1
28	Delete operation on circular linked list	FALSE	1
29	Representation of polynomial and it's operations (Addition of two polynomials)	TRUE	1
30	Multiplication of two polynomials	FALSE	1
31	Implement of stack using linked list(Linked Stack)	TRUE	1
32	Implement of Queue using linked list(Linked Queue)	FALSE	1
33	Introduction to Tree(Terminology, Representation)	TRUE	1
34	Binary Tree and Tree traversal	TRUE	1
35	Binary Search Tree	TRUE	1
36	Operations on BST and Analysis	TRUE	1
37	Threaded Binary tree, General Tree	FALSE	1
38	AVL tree	TRUE	1
39	AVL Tree continued	TRUE	1
40	M-way Search tree, B-Tree	FALSE	1
41	Problem Solving of Tree	FALSE	1
42	Introduction to Graph	TRUE	1
43	Representation of Graph(Adjacency Matrix, Incidence Matrix)	TRUE	1
44	Representation of Graph(Linked Representation) , Path Matrix	TRUE	1

45	Graph Traversal(BFS,DFS)	TRUE	1
46	Warshall's all pair shortest path algorithm	TRUE	1
47	Topological Sort	TRUE	1
48	Sorting algorithms(Bubble Sort, Insertion sort)	TRUE	1
49	Quick Sort, and Analysis	TRUE	1
50	Merge Sort	TRUE	1
51	Radix sort, Introduction to Heap	TRUE	1
52	Heap Sort	TRUE	1
53	Concept of Hashing, Hash Function, and Hashing Techniques	TRUE	1
54	Collision Resolution techniques: Linear probing, Quadratic Probing	FALSE	1

Total no. of classes : 54

Text Book

E. Horowitz, S. Sahni, S. Anderson-Freed, Fundamentals of Data Structures in C, 2ndEdition, Universities Press, 2008, ., . M. A. Weiss, Data Structures and Algorithm Analysis in C, 2ndEdition, Pearson Education, 2002., ., .

Reference Book

A. M. Tenenbaum, Y. Langsam, and M. J. Augenstein, Data Structures Using C, 3rdEdition, PearsonEducation, 2007., ., .
J. P. Tremblay and P. G. Sorenson, An Introduction to Data Structures with Applications, 2ndEdition, McGraw Education, 2017, ., .
S. Lipschutz, Data Structures, 1stRevised Edition, McGraw Education, 2014, ., .

Online Reference Material(s):

https://nptel.ac.in/courses/106/106/106106127/https://nptel.ac.in/courses/106/102/106102064/https://nptel.ac.in/courses/106/106/106106130/https://www.geeksforgeeks.org/data-structures

Course Outcome:

CO-1	Analyze performance of algorithms and implement various operations on array and sparsematrix.
CO-2	Apply the basic operations of stacks and queues to solve real world problems
CO-3	Implement different types of linked list operations and their applications
CO-4	Represent data using trees & graphs to use them in various real life applications.
CO-5	Analyze various sorting algorithms and explore different hashing techniques.

Program Outcomes Relevent to the Course:

PO1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
PO2	Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
РО3	Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
P06	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7	Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PU8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Mapping of CO's to PO's: (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO6	PO12
CO-1	2	2	3	2	1	1
CO-2	3	3	3	2	1	1
CO-3	3	3	3	2	1	1
CO-4	3	2	3	3	2	1
CO-5	3	3	3	3	1	1