GUJARAT TECHNOLOGICAL UNIVERSITY

Programme Name: Post Graduate Diploma in Data Science
Level: PG Diploma
Branch: Data Science
Subject Code : DS01080011
Subject Name : Data Structures and Algorithm

w. e. f. Academic Year:	2025-26
Semester:	1
Category of the Course:	Compulsory

Prerequisite	Students are expected to have a basic understanding of programming concepts and experience with at least one programming language such as C, C++, Java, or Python.
Rationale	To learn about how to choose appropriate data structures, understand the ADT/libraries, and use it to design algorithms for a specific problem.
	To understand the necessary mathematical abstraction to solve problems.
	The student should be able to choose appropriate algorithms and use it for a specific problem.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Differentiate primitive and non-primitive structures.	R
02	Design and apply appropriate data structures for solving computing problems.	A
03	Apply sorting and searching algorithms to the small and large data sets.	E
04	Explain the major graph algorithms and their analyses. Employ graphs to model data science problems wherever appropriate.	N

**Revised Bloom's Taxonomy (RBT)*

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA / CA (M)	PA/CA (I)	ESE (V)	
4	0	2	5	70	30	-	50	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	Introduction to Data Structure Data Management concepts, Data types – primitive and non-primitive, Performance Analysis and Measurement, Average, best and worst case analysis, Types of Data Structures- Linear & Non Linear Data Structures	5	8%
2.	Linear Data Structures Array: Representation of arrays, Applications of arrays, sparse matrix and its representation Stack: Stack-Definitions & Concepts, Operations on Stacks, Applications of Stacks, Polish Expression, Reverse Polish Expression, Recursion, Tower of Hanoi Queue: Representation of Queue, Operations on Queue, Circular Queue, Priority Queue, Double Ended Queue, Applications of Queue Linked List: Singly Linked List, Doubly Linked list, Circular linked list, Applications of linked list	20	40%
3.	Nonlinear Data Structures Tree-Definitions and Concepts, Representation of binary tree, Binary tree traversal, Binary search trees, Applications of Trees, AVL trees, 2-3 trees, Graph-Matrix Representation of Graphs, Graph Traversal Methods, Spanning Trees, Shortest path, Minimal spanning tree	15	25%
4.	Sorting & Searching Bubble Sort, Selection Sort, Quick Sort, Merge Sort, Sequential Search, Binary Search	8	16%
5.	Greedy Algorithms General Characteristics of greedy algorithms, Activity selection problem, The Knapsack Problem, Job Scheduling Problem, Huffman code	5	8%
6.	Dynamic Programming Introduction, The Principle of Optimality, Knapsack problem, All Points Shortest path, Matrix chain multiplication.	4	5%
	Total	**52**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	U Level	A Level	N Level	E Level	C Level
5	15	25	25	20	10

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

1. Fundamentals of Data Structures in C++ by Sartaj Sahani Galgotia Publications Pvt. Ltd., 2009
2. Introduction to Algorithms by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein PHI, Second edition
3. Fundamental of Algorithms by Gills Brassard, Paul Bratley PHI
4. Fundamentals of Computer Algorithms by Horowitz, Sahni Galgotia Publications Pvt. Ltd., 2001 ed.
5. An Introduction to Data Structures with Applications by Jean-Paul Tremblay & Paul G. Sorenson Publisher-Tata McGraw Hill

(b) Open source software and website:

1. VisuAlgo https://visualgo.net
2. AlgoExpert https://www.algoexpert.io/
3. Algorithm Visualizer https://algorithm-visualizer.org/

(c) Suggested Course Practical List:

Suggested list of Practical (at least 10 practical are to be performed by students. These practical should cover majority of all topics of syllabus.)
This is the suggested list of practical but it may not be limited only to this list.

1. Implement a program for stack that performs following operations using array.
   (a) PUSH (b) POP (c) PEEP (d) CHANGE (e) DISPLAY
2. Implement a program to convert infix notation to postfix notation using stack
3. Write a program to implement QUEUE using arrays that performs following operations (a) INSERT (b) DELETE (c) DISPLAY
4. Write a program to implement Circular Queue using arrays that performs following operations. (a) INSERT (b) DELETE (c) DISPLAY

5. Write a menu driven program to implement following operations on the singly linked list.
   (a) Insert a node at the front of the linked list.
   (b) Insert a node at the end of the linked list.
   (c) Insert a node such that linked list is in ascending order.(according to info. Field)
   (d) Delete a first node of the linked list.
   (e) Delete a node before specified position.
   (f) Delete a node after specified position.
6. Write a program to implement following operations on the doubly linked list.
   (a) Insert a node at the front of the linked list.
   (b) Insert a node at the end of the linked list.
   (c) Delete a last node of the linked list.
   (d) Delete a node before specified position
7. Write a program to implement following operations on the circular linked list.
   (a) Insert a node at the end of the linked list.
   (b) Insert a node before specified position.
   (c) Delete a first node of the linked list.
   (d) Delete a node after specified position.
8. Write a program which create binary search tree.
9. Write a program to implement Quick Sort, Merge Sort and Bubble Sort.
10. Write a program to implement binary knapsack problem with greedy and dynamic programming.
11. Write a program to implement activity selection problem with greedy method.
12. Write a program to implement matrix chain multiplication with dynamic programming.

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