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Question Paper Code : 10559

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2026.

Third Semester

Computer Science and Engineering (Data Science)

CD3291 — DATA STRUCTURES AND ALGORITHMS

(Common to Computer Science and Engineering (Artificial Intelligence and Machine Learning)/Computer Science and Engineering (Cyber Security)/Computer and Communication Engineering/Information Technology)

(Regulations 2021)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. Define Abstract Data Type (ADT).
2. What is meant by algorithm analysis?
3. List out the features of Doubly link list.
4. Mention two real-time applications of a queue.
5. What is the best-case, average-case and worst-case time complexity of bubble sort?
6. Define linear search.
7. What is a binary tree?
8. Distinguish between min-heap and max-heap.
9. Define degree, indegree and outdegree of a vertex.
10. What is a greedy algorithm? Give an example.

PART B — ($5 \times 13 = 65$ marks)

11. (a) Explain the role of classes and objects in Object-Oriented Programming. Write a Python program to define a "BankAccount" class with methods to deposit, withdraw, and display balance.

Or

- (b) (i) Describe Big-O, Omega, and Theta notations with graphical representations. (6)
- (ii) Analyze the merge sort algorithm using recurrence relation. (7)

12. (a) Explain the structure and operations of a singly linked list. Write pseudocode to insert and delete a node from a singly linked list.

Or

- (b) Write a Python program to implement a double-ended queue and explain its enqueue/dequeue operations at both ends.
13. (a) Write the Quick sort algorithm. Write its pseudocode and trace it for the array [45, 23, 53, 12, 64, 9, 87, 34, 25].

Or

- (b) A hash table has size = 10 and uses the primary hash function

$$h(k) = k \bmod 10$$

You are required to insert the following keys into the hash table : 23, 43, 13, 27, 37, 47, 57. Perform the insertions using collision resolution techniques – chaining, open addressing (linear probing, quadratic probing, double hashing).

14. (a) What is Binary Search Tree (BST)? Construct a BST using the sequence of keys 50, 30, 70, 20, 40, 60, 80. Show inorder, preorder, and postorder traversals. Explain how searching, insertion, and deletion are performed in BSTs.

Or

- (b) What is a heap? Explain how a max-heap is created from the array [10, 20, 5, 6, 1, 8, 9, 4]. Show the step-by-step heapification process.
15. (a) Explain Breadth-First Search (BFS) and Depth-First Search (DFS) algorithms with suitable examples. Show traversal order for the graph below :

$$A \rightarrow B, A \rightarrow C, B \rightarrow D, C \rightarrow E, D \rightarrow F, E \rightarrow F$$

Or

- (b) Use the following adjacency matrix to find shortest paths between all pairs of vertices using Dynamic Programming (Floyd-Warshall).

	A	B	C	D
A	0	3	∞	7
B	8	0	2	∞
C	5	∞	0	1
D	2	∞	∞	0

PART C — (1 × 15 = 15 marks)

16. (a) Write an algorithm to convert an infix expression to postfix form using a stack. Convert the following infix expression to postfix form and then evaluate the postfix expression using a stack. Show all intermediate stack contents in each step.

$$(A + B) * (C - D) / E + F$$

Given values :

$$A = 5, B = 3, C = 8, D = 2, E = 3, F = 4.$$

Or

- (b) Define AVL tree. Construct an AVL tree for the sequence 10, 20, 30, 40, 50, 25, 60, 22, 70, 15 showing all rotations. After forming the balanced AVL tree, perform the following deletions in order : 40, 25, 10. Rebalance the AVL tree after each deletion.

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