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St. Claret College

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UG END SEMESTER EXAMINATION-MAY 2026
BCA: IV SEMESTER
CA 4225:DESIGN AND ANALYSIS OF ALGORITHM

TIME: 3 hours. **MAX. MARKS: 80**

This paper contains THREE printed pages and FOUR parts

Instructions:
1. **Verify and ensure that the question paper is completely printed.**
2. **Any discrepancies or questions about the exam paper must be reported to the COE within 1 hour after the examination.**
3. **Students must check the course title and course code before answering the questions.**

PART-A

Answer ALL questions. Each answer carries one mark. **[10 x 1 =10]**

1. Which of the following asymptotic notations represents the upper bound of an algorithm's growth rate?
   a) Big-O (O) b) Big-Omega (Ω) c) Big-Theta (Θ) d) Little-o (o)
2. What is the time complexity of sequential search in the worst case?
   a) O(1) b) O (log n) c) O(n) d) $O(n^2)$
3. The Master's theorem is used to solve recurrences of the form:
   a) T(n) = aT(n/b) + f(n) b) T(n) = T(n-1) + n
   c) T(n) = 2T(n/2) + n log n d) Both a and c
4. Which sorting algorithm has the best-case time complexity of O (n log n) and worst-case of $O(n^2)$?
   a) Merge sort b) Quick sort c) Heap sort d) Bubble sort
5. Kruskal's algorithm is used to find:
   a) Shortest path in a graph b) Minimum spanning tree
   c) Maximum flow in a network d) Topological order
6. The activity selection problem is solved optimally using which design technique
   a) Divide and conquer b) Dynamic programming c) Greedy method d) Backtracking
7. Floyd-Warshall algorithm computes:
   a) Single-source shortest path b) All-pairs shortest paths
   c) Minimum spanning tree d) Topological sorting
8. In DFS of a directed graph, if we encounter a back edge, it indicates:
   a) The graph is disconnected b) A cycle exists
   c) Topological order is possible d) None of the above
9. Which of the following is NP-complete?
   a) Sorting an array b) Finding shortest path in a graph
   c) Traveling salesman problem d) Binary search
10. The n-Queen problem is typically solved using:
    a) Greedy method b) Dynamic programming c) Backtracking d) Divide and conquer

PART-B

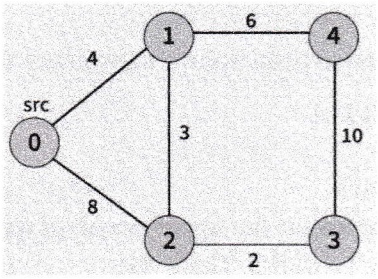
Answer any FIVE questions. Each answer carries TWO marks. **[5 x 2 = 10]**

11. Define asymptotic notation.
12. Analyse the worst-case time complexity of bubble sort.
13. Discuss minimum spanning tree (MST).
14. Describe greedy algorithm with an example.
15. Differentiate BFS and DFS.
16. What is a non-deterministic algorithm?
17. Explain the concept of branch-and-bound with an example.

PART-C

Answer any FOUR questions. Each answer carries FIVE marks. **[4 x 5 = 20]**

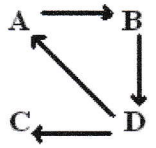
18. Demonstrate the working of selection sort for the given elements: {15, 6, 3, 21, 17, 12, 1}
19. Apply Dijkstra's algorithm to find the shortest paths from source vertex 0 to all other vertices in the following graph.



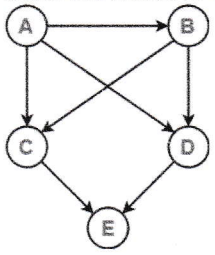
20. Consider the following set of activities with their respective start and finish times. Using the greedy design technique, find the maximum number of non-overlapping activities.

Activity	A1	A2	A3	A4	A5	A6	A7	A8
Start Time (si)	1	3	0	5	3	8	8	2
Finish Time (fi)	4	5	6	7	8	11	12	13

21. Find the transitive closure of the given directed graph using Warshall's algorithm.



22. Find the number of different topological orderings possible for the given graph:



23. Solve the 4-Queen problem using backtracking. Draw the state space tree and show all valid solutions.

PART-D

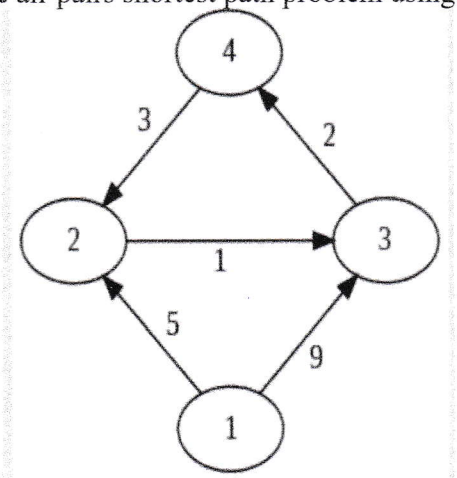
Answer any FOUR questions. Each answer carries TEN marks. **[4 x 10 =40]**

24. Explain quick sort algorithm with an example. Analyse the best case and worst-case efficiencies.

25. Multiply the given matrices using Strassen's matrix multiplication method.

$$A = \begin{bmatrix} 2 & 4 \\ 3 & 2 \end{bmatrix} \quad B = \begin{bmatrix} 1 & 2 \\ 3 & 2 \end{bmatrix}$$

26. Solve the all-pairs shortest path problem using Floyd's algorithm.



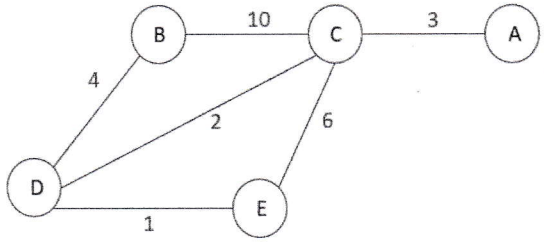
27. Consider a knapsack with a maximum capacity of M = 8. Using the greedy approach, determine the optimal subset of items.

Item	**A**	**B**	**C**	**D**
Profit	2	4	7	10
Weight	1	3	5	7

28. Solve the assignment problem for the given cost matrix using the branch and bound technique.

	Job 1	**Job 2**	**Job 3**	**Job 4**
Person A	9	2	7	8
Person B	6	4	3	7
Person C	5	8	1	8
Person D	7	6	9	4

29. a) Apply Prim's algorithm to find the minimum spanning tree for the following: [5]



b) Draw a Venn diagram showing the relationship between P, NP, NP-Complete, and NP-Hard problems. Define each class and provide one classic example for each. [5]