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B.Tech DEGREE EXAMINATION, MAY 2024

Fifth Semester

18CSC361J - DESIGN AND ANALYSIS OF ALGORITHMS

(For the candidates admitted during the academic year 2018-2019 to 2021-2022)

Note:

i. **Part - A** should be answered in OMR sheet within first 40 minutes and OMR sheet should be handed over to hall invigilator at the end of 40th minute.

ii. **Part - B** and **Part - C** should be answered in answer booklet.

Time: 3 Hours **Max. Marks: 100**

PART - A (20 × 1 = 20 Marks)

Answer **all** Questions

		Marks	BL	CO
1.	What will be effect of involving pop ( ) on an empty queue? (A) Overflow (B) Underflow (C) Syntax Error (D) Garbage Value	1	2	1
2.	What is the maximum number of swaps that can be performed in the Selection Sort algorithm? (A) n - 1 (B) n (C) 1 (D) n - 2	1	1	1
3.	_____ is the maximum amount of time an algorithm takes to execute a specific set of inputs. (A) Running time (B) Average case time complexity (C) Worst case time complexity (D) Best case time complexity	1	1	1
4.	Which of the following is not a design consideration of an algorithm? (A) If this software is used correctly (B) Ifn the hardware is used correctly (C) If there is more than one way to solve the problem (D) Simple programming language must be used	1	1	1
5.	_____ within the limit deals with the behavior of a function for sufficiently large values of its parameter. (A) Asymptotic notation (B) Big-Oh notation (C) Omega notation (D) Theta notation	1	1	1
6.	_____ is the worst case time complexity of Prim's algorithm if adjacency matrix is used. (A) O (log V) (B) O(V^2) (C) O(E^2) (D) O (V log E)	1	2	1
7.	Which of the following does not follow Dynamic Programming? (A) Bellman–Ford Algorithm for single source shortest path (B) Floyd Warshall Algorithm for all pairs shortest paths (C) 0-1 Knapsack problem (D) Prim's Minimum Spanning Tree	1	1	2
8.	Which of the following is NOT true about comparison-based sorting algorithms? (A) The minimum possible time complexity of a comparison-based sorting algorithm is O(n log n) for a random input array (B) Any comparison-based sorting algorithm can be made stable by using position as a criteria when two elements are compared (C) Counting Sort is not a comparison-based sorting algorithm (D) Heap Sort is not a comparison-based sorting algorithm.	1	1	2

9. What happens when the backtracking algorithm reaches a complete solution? 1 1 2
(A) It backtracks to the root
(B) It continues searching for other possible solutions
(C) It traverses from a different route
(D) It traverses the same route

10. The problem of finding a subset of positive integers whose sum is equal to a given positive integer is called as _____. 1 1 2
(A) n- queen problem
(B) Subset sum problem
(C) Knapsack problem
(D) Hamiltonian circuit problem

11. Time Complexity of Breadth First Search is _____ where V - number of vertices, E - number of edges. 1 1 2
(A) O(V+E)
(B) O(V)
(C) O(E)
(D) O(VE)

12. When a top-down approach of dynamic programming is applied to a problem, it usually _____ 1 1 2
(A) Decreases both, the time complexity, and the space complexity
(B) Decreases the time complexity and increases the space complexity
(C) Increases the time complexity and decreases the space complexity
(D) Increases both, the time complexity, and the space complexity

13. The in-order and pre-order traversal of a binary tree are d b e a f c g and a b d e c f g, respectively, then the post-order traversal of the binary tree is: 1 1 2
(A) d e b f g c a
(B) e d f g b c a
(C) e d b f g c a
(D) d e f g b c a

14. Consider two decision problems $Q1$, $Q2$ such that $Q1$ reduces in polynomial time to 3 - SAT and 3 - SAT reduces in polynomial time to $Q2$. Then which one of the following is consistent with the above statement? 1 1 4
(A) $Q1$ is in NP, $Q2$ is NP hard
(B) $Q2$ is in NP, $Q1$ is NP hard
(C) Both $Q1$ and $Q2$ are in NP
(D) Both $Q1$ and $Q2$ are NP hard

15. Problems that can be solved in polynomial time are known as _____. 1 1 4
(A) Intractable
(B) Tractable
(C) Decision
(D) Complete

16. The sum and composition of two polynomials are always polynomials. What can be said about this statement? 1 1 5
(A) True
(B) False
(C) Sometimes
(D) Cannot decide

17. For maximization, the accuracy ratio of Approximation algorithm if there exists a constant k such that, for every instance I of P, 1 1 5
(i) A*(I) Optimal value for the instance I
(ii) A(I) Value for the instance I generated by A. This can be expressed as
(A) $A^*(I)/A(I) \leq k$.
(B) $|A^*(I) - A(I)| \leq k$.
(C) $|A^*(I) + A(I)| \leq k$.
(D) $A(I)/A^*(I) \leq k$

18. Identify the worst case time complexity of a quick sort algorithm. 1 2 5
(A) O(N)
(B) O(N log N)
(C) $O(N^2)$
(D) O(log N)

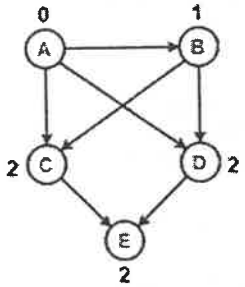
19. What is the basic principle in the Rabin Karp algorithm? 1 2 5
(A) Hashing
(B) Sorting
(C) Augmenting
(D) Dynamic Programming

20. Which type of algorithm output is always correct and running time is random? 1 2 5
(A) Absolute approximation algorithm
(B) Monte Carlo algorithm
(C) Atlantic City Algorithm
(D) Las Vegas algorithm

PART - B (5 × 4 = 20 Marks)

Answer **any 5** Questions

	Marks	BL	CO
21. State Master's theorem. When can it be used?	4	2	1
22. Write notes on asymptotic notations.	4	3	1
23. Differentiate between branch and bound and greedy technique.	4	3	2
24. Find the shortest path using topological sorting. Describe the steps in detail.	4	1	2



25. Differentiate between P and NP Problems with clear examples.	4	3	4
26. Explain when a problem is in NP and NP Hard. Also briefly explain when a problem is NP Complete.	4	3	4
27. Explain randomized version of Quick sort.	4	3	5

PART - C (5 × 12 = 60 Marks)

Answer **all** Questions

	Marks	BL	CO
28. (a) Solve the following recurrence relation using tree method $T(n) = T(n-1) + \log n$, $T(1) = 0$	12	3	1
(OR)			
(b) Solve the following recurrence relation using substitution method $T(n) = 2T(n-1) + 1$, $T(1) = 3$			
29. (a) Given a Knapsack of a maximum capacity of M = 15 kg and N = 7 items each with its own profit and weight. Throw items inside the Knapsack such that the final contents have the maximum profit.	12	2	2

Object.No	1	2	3	4	5	6	7
Profit ($)	10	5	15	7	6	18	3
Weight (kgs)	2	3	5	7	1	4	1

(OR)

(b) Consider a set of given jobs as shown in the following table. Find a sequence of jobs, which will be completed within their deadlines and will give maximum profit. Each job is associated with a deadline and profit.

Job	J1	J2	J3	J4	J5
Deadline	2	1	3	2	1
Profit	60	100	20	40	20

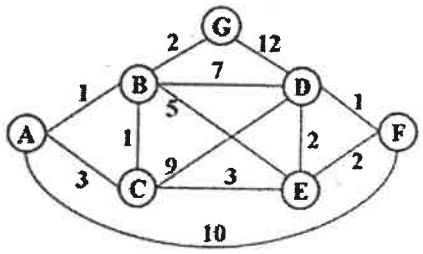
30. (a) Apply Floyd's method to find the shortest path for the below-mentioned all pairs — 12 | 3 | 2

$$\begin{array}{c} \\ 1 \\ 2 \\ 3 \\ 4 \end{array} \begin{array}{c} \begin{array}{cccc} 1 & 2 & 3 & 4 \end{array} \\ \begin{bmatrix} 0 & \infty & 3 & \infty \\ 2 & 0 & \infty & \infty \\ \infty & 7 & 0 & 1 \\ 6 & \infty & \infty & 0 \end{bmatrix} \end{array}$$

(OR)

(b) Consider the following undirected, weighted graph:

1. Step through Dijkstra's algorithm to calculate the single-source shortest paths from A to every other vertex. Show your steps in a table. Cross out old values and write in new ones, from left to right within each cell, as the algorithm proceeds. (5 marks)
2. Also list the vertices in the order which you marked them known. (4 marks)
3. Finally, indicate the lowest-cast path from node A to node F. (3 marks)



31. (a) Explain the approximation algorithm for the Travelling salesman problem (TSP) — 12 | 3 | 5

(OR)

(b) Prove that traveling salesman problem is NP complete.

32. (a) List Polynomial-Time Approximation Scheme (PTAS) algorithm for every $\varepsilon > 0$. Explain the relation between ε and running time of the algorithm. — 12 | 3 | 5

(OR)

(b) Explain in detail randomized quicksort algorithm with analysis.

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