Reg. No.															

B.Tech/ M.Tech (Integrated) DEGREE EXAMINATION, MAY 2024

Fourth Semester

21CSC204J – DESIGN AND ANALYSIS OF ALGORITHMS

(For the candidates admitted from the academic year 2022-2023 onwards)

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 40^{th} minute.

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

Time: 3 Hours

Max. Marks: 75

PART – A (20 × 1 = 20Marks)

Answer **ALL** Questions

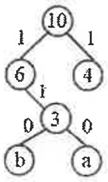
Q.	Question	Marks	BL	CO	PO
1.	______ of the algorithm is the function defined by the minimum number of steps taken on any instance of size n. (A) Worst-case complexity (B) Best-case complexity (C) Average-case complexity (D) Average-best case complexity	1	1	1	1

2.	Compute the time complexity for the following code:
	sum = 0;
	for (i = 0; i < n; i++)
	for (j = 0; j < n; j++)
	sum ++;
	(A) O(n) (B) O(n log n)
	(C) O (log n) (D) $O(n^2)$
		1	3	1	2

3.	Which of the following is linear asymptotic notations? (A) O(1) (B) O(log n) (C) O (n) (D) O(n log n)	1	1	1	1
4.	The master theorem (A) Assumes the subproblems are unequal sizes (B) Can be used if the subproblems are of equal sizes (C) Cannot be used for divide and conquer algorithms (D) Cannot be used for asymptotic complexity analysis	1	1	1	1
5.	Merge sort uses which of the following technique to implement sorting? (A) Back tracking (B) Greedy algorithm (C) Divide and conquer (D) Dynamic partitioning	1	1	2	2
6.	What is the recurrence relation used in Strassen's matrix multiplication? (A) $7T(n/2)+\theta(n^2)$ (B) $8T(n/2)+\theta(n^2)$ (C) $7T(n/2)+0(n^2)$ (D) $8T(n/2)+0(n^2)$	1	1	2	2
7.	Find the maximum sub-array sum for the given elements. {2, –1, 3, –4, 1, –2, –1, 5, –4} (A) 3 (B) 5 (C) 8 (D) 6	1	3	2	2

8. The time taken to find the 'n' points that lie in a convex hull is _______. 1 1 2 1
   (A) O(n)
   (B) O(n log n)
   (C) $O(n^2)$
   (D) O(log n)

9. Using Huffman coding, compute the codeword for character 'a' in the given tree. 1 3 3 3



   (A) 010
   (B) 100
   (C) 011
   (D) 101

10. Which of the following is false in the case of a spanning tree of a graph G? 1 2 3 2
   (A) It is tree that spans G
   (B) It can be either cyclic or acyclic
   (C) It is a subgraph of G
   (D) It includes every vertex of G

11. Which of the following can be solved using dynamic programming? 1 2 3 2
   (A) Merge sort
   (B) Binary search
   (C) Longest common subsequence
   (D) Quick sort

12. Consider the matrices P, Q and R which are 10×20, 20×30 and 30×40 matrices respectively. What is the minimum number of multiplications required to multiple the three matrices? 1 3 3 2
   (A) 12000
   (B) 18000
   (C) 24000
   (D) 32000

13. What happens when a backtracking algorithm reaches a complete solution? 1 2 4 2
   (A) It backtracks to the root
   (B) It continues searching for the other possible solutions
   (C) It traverses from a different route
   (D) Recursively traverses through the same route

14. Travelling salesman problem is an example of _______. 1 1 4 1
   (A) Divide and conquer
   (B) Recursive approach
   (C) Dynamic algorithm
   (D) Greedy algorithm

15. A person wants to visit some places. He starts from a vertex and then wants to visit every place connected to this vertex and so on. What algorithm the should use? 1 4 4 1
   (A) Breadth first search
   (B) Depth first search
   (C) Prim's algorithm
   (D) Kruskal's algorithm

16. In what time can the Hamiltonian path problem can be solved using dynamic programming? 1 1 4 1
   (A) O(N)
   (B) $O(N^2)$
   (C) $O(N^2\ 2^N)$
   (D) O(N log N)

17. What is the purpose of using randomized quick sort over standard quick sort? 1 2 5 1
   (A) To avoid worst case time complexity
   (B) To avoid worst case space complexity
   (C) To improve average case time complexity
   (D) To improve accuracy of output

18.	Pick the correct basic principle in Rabin Karp algorithm. (A) Sorting (B) Augmenting (C) Dynamic programming (D) Hashing	1	1	5	2
19.	______ is the class of decision problems that can be solved by non-deterministic polynomial algorithm. (A) NP (B) P (C) NP-hard (D) NP-Complete	1	1	5	1
20.	Under what condition any set A will be a subset of B? (A) If all elements of set B are also present in set A (B) If all elements of set A are also present in set B (C) If A contains more elements than B (D) If B contains more elements than A	1	1	5	1

PART – B (5 × 8 = 40 Marks)

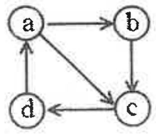
Answer **ALL** Questions

	Marks	BL	CO	PO
21. a. Solve the following recurrence relation and compute the time complexity		3	1	3
(i) $T(n)=2T(n\|2)+cn$	4			
(ii) $T(n)=2T(n-1)+c$	4			
(OR)				
b. Write the algorithm of insertion sort and trace the algorithm for the array elements listed below. arr [ ] = {21, 7, 12, 10, 6, 16, 24}	8	3	1	2
22. a. Apply mastered theorem and find the time complexity for the following		4	2	2
(i) $T(n)=3T(n\|2)+n^2$	2			
(ii) $T(n)=4T(n\|2)+n^2$	2			
(iii) $T(n)=16T(n\|4)+n$	2			
(iv) $T(n)=2^n T(n\|2)+n^5$	2			
(OR)				
b. Illustrate quick sort algorithm for the example given below and explain the time complexity for best case, average case and worst case. a [ ] = {56, 26, 93, 17, 77, 31, 44, 55, 20}	8	4	2	3
23. a. Write the greedy fractional knapsack algorithm and solve the following problem using knapsack algorithm, Number of items : 5 Sack capacity : 100	8	3	3	2

Value	20	30	66	40	60
Weight	10	20	30	40	50

	Marks	BL	CO	PO
(OR)				
b. Construct the longest common subsequence table for the sequence X = {A, B, C, B, D, A, B} and Y = {B, D, C, A, B, A}	8	3	3	2
24. a. Write the algorithm for N-queen's problem and illustrate the same with appropriate example for 4×4 board.	8	2	4	1
(OR)				

b. Obtain the transitive closure for the following digraph using Floyd-Warshall algorithm. 8 3 4 2

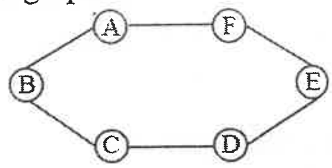


25. a. Discuss the following terms with suitable example 8 1 5 1

(i) P (ii) NP (iii) NP-complete (iv) NP-Hard problems

(OR)

b. What is Hamiltonian cycle? Explain the algorithm to find the Hamiltonian cycle in a given connected graph. 8 4 5 2



PART – C (1 × 15 = 15 Marks)

Answer **ANY ONE** Question

	Marks	BL	CO	PO

26. Consider the following cityscape challenge. Imagine a miniature archipelago of seven islands (lets name them A thro G). The local government want to build bridges between there islands to ensure connectivity. However, the cost of bridge construction varies based on the distance and the terrain between each pair of islands. Apply minimum spanning tree (Prim's /Kruskal's) algorithms and device a optimal solution for the problem. 15 3 3 3

Island connections	Cost
A-B	7
A-D	5
B-C	8
B-D	9
B-E	7
C-E	5
D-E	15
D-F	6
E-F	8
E-G	9
F-G	11

27. A fruit seller visited a street in a city. He started selling various fruits to people who live there. A buyer bought 1 kg of apple and 2 kgs of oranges for rupees 90 and 70 respectively. The buyer gave 200 rupees to the fruit seller. And he is waiting for the seller to give the remaining amount to him. Seller is having the following denomination of coins with him. Device a subset sum algorithm to help the fruit seller to reader the exact change to the buyer. 15 3 4 3

Denomination of coins	Count of coins
1	7
2	5
5	3
10	2

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