Reg. No.															

B.Tech./M.Tech(Integrated) DEGREE EXAMINATION, JULY 2023

Fourth Semester

21CSC204J - DESIGN AND ANALYSIS OF ALGORITHMS

(For the candidates admitted from the academic year 2021-2022 & 2022-2023)

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: 75

PART – A (20 × 1 = 20Marks)

Answer **ALL** Questions

	Marks	BL	CO	PO
1. What is the advantage of recursive approach than an iterative approach? (A) Consumes less memory (B) Less code and easy to implement (C) Consumes more memory (D) Easy to test and debug during iteration	1	1	2	1
2. Which one is the correct order of increasing growth? (A) O(1), O(log n), O(log log n), O((log n)^2) (B) O(1), O(log log n), O((log n)^2), O(log n) (C) O(1), O(log log n), O(log n), O((log n)^2) (D) O(1), O(log n), O((log n)^2), O(log log n)	1	2	1	2
3. _____ refers to an algorithm should be a well defined and ordered procedure that consists of a set of instructions in a specific order. (A) Definiteness (B) Correctness (C) Finiteness (D) Effectiveness	1	1	1	2
4. Problem solving starts from subproblems of the given problem to the global problem is (A) Top-down design (B) Bottom-up design (C) Mixed design (D) Variable design	1	1	1	2
5. The algorithms like merge sort, quick sort and binary search are based on (A) Greedy algorithm (B) Divide and conquer algorithm (C) Dynamic programming approach (D) Hash table	1	1	1	2
6. The algorithm which has time complexity of O (n log n) for best, worst, and average cases is (A) Merge sort (B) Quick sort (C) Insertion sort (D) Selection sort	1	1	2	2
7. The time complexities of binary search are given as (A) Best Case: ɵ(n) , Average Case : ɵ(nlogn) and Worst Case: ɵ(n logn) (B) Best Case: ɵ(nlogn) , Average Case : ɵ(n) and Worst Case: ɵ(nlogn) (C) Best Case: ɵ(1) , Average Case : ɵ(logn) and Worst Case: ɵ(logn) (D) Best Case: ɵ(n) , Average Case : ɵ(n) and Worst Case: ɵ(nlogn)	1	1	2	2

8. Dynamic programming is used to solve the problem, when the input has _____ 1 2 2 2
   (A) optimal substructure (B) overlapping subproblems
   (C) both optimal substructure and overlapping subproblems (D) neither optimal substructure and overlapping subproblems

9. Find the Maximum Subarray Sum for the following array elements in array A= { -15, -3, -1, -2, -4, -8, -9} 1 2 3 2
   (A) -15 (B) -1
   (C) -42 (D) -23

10. Algorithm A1 can compute min-max in a1 comparison without divide and conquer. Algorithm A2 can compute min-max ina2 comparison with divide and conquer. What could be the relation between al and a2 considering the worst-case scenarios? 1 3 2 2
   (A) a1 < a2 (B) a1 > a2
   (C) a1 = a2 (D) Depends on the input

11. What is the time complexity of fractional knapsack problem in greedy approach? 1 2 2 2
   (A) O (n log n) (B) O(n)
   (C) O (log n) (D) O(log)

12. Which of the following design techniques guarantees optimal solution? 1 1 3 2
   (A) Greedy (B) Divide and Conquer
   (C) Dynamic Programming (D) Brute Force

13. If the number of keys in optimal binary search tree is 3. How many numbers of trees are possible? 1 1 3 2
   (A) 2 (B) 3
   (C) 4 (D) 5

14. For a 6-node graph, how many number of edges is required to construct a minimum spanning tree? 1 1 3 2
   (A) 6 (B) 5
   (C) 7 (D) 12

15. Pick the maximum subarray sum for {-1,3,4, -5,9} 1 2 3 2
   (A) 13 (B) 17
   (C) 1 (D) 11

16. The data structure used in the standard implementation of Depth First Search is? 1 2 1 3
   (A) Tree (B) Linklist
   (C) Queue (D) Stach

17. Which of the following is known to be not an NP-Hard Problem? 1 1 2 3
   (A) Vertex Cover Problem (B) 0/1 Knapsack Problem
   (C) Maximal Independent Set Problem (D) Travelling Salesman Problem

18. Choose the correct statement from the following 1 2 2 2
   (A) branch and bound is more efficient than backtracking (B) branch and bound is not suitable where a greedy algorithm is not
   (C) Branch and bound is a problem solving technique generally used for solving combinatorial optimization (D) backtracking divides a problem into at least 2 new restricted sub problems

19. In n-queen problem, for how many values of "n" the queen can be placed in such a way one doesn't hit the other? 1 1 2 2

(A) 0 (B) 1
(C) 2 (D) 3

20. _____ is the classification of decision problems that can be solved by non-deterministic polynomial-time algorithms 1 1 2 2

(A) NP (B) P
(C) Hard (D) Complete

PART – B (5 × 8 = 40 Marks) Marks BL CO PO

Answer **ALL** Questions

21. a. Deduce the time complexity of a given relation using Recursion Tree approach. 8 3 1 2

$T(n) = T(n/3) + T(2n/3) + n; n>1$
$1 ; n=1$

(OR)

b. Examine the following pseudocode and calculate the time complexity using operation count method. 8 3 1 2

```
Begin
sum=0;
    for (i=4;i
        for (j=0;j<=i;j++)
    sum++;
    end for
end for
end
```

22. a. Find the time complexity of the following recurrence relations through proper steps of master's theorem. 8 3 2 2

i) $T(n)=4T(n/4) +n$ (4 Marks)
ii) $T(n)= 4T(n/2) +n^2$ (4 Marks)

(OR)

b. Given a set of items, each with a weight and a value, apply a greedy based technique to determine a subset of items to include in a collection so that the total weight is less than or equal to a given limit and the total value is as large as possible. In this case, items can be broken into smaller pieces and write the pseudocode for it. 8 3 3 2

Capacity W = 60 and the list of provided items are shown in the following table.

Items	A	B	C	D
Profit	280	100	120	120
Weight	40	10	20	24

23. a. Consider the chain of matrices P, Q, R and S which are 2×3, 3×4, 4×3, and 3×2 matrices respectively. Which of the following parenthesizing is optimal for obtaining the minimum number of multiplications required to multiply the four matrices? 8 3 3 2

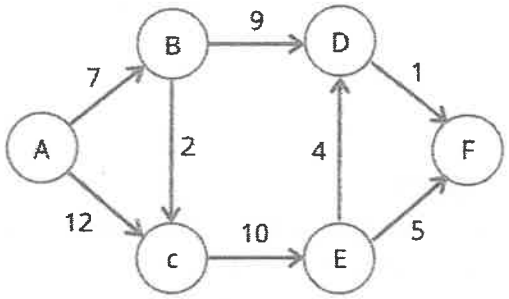
i) (P Q) (R S) (4 Marks)
ii) P (Q R) S (4 Marks)

(OR)

b.	Consider two strings X= "PQRSTPQRS" and Y= "PRATPBRQRPS". Determine the length of the longest common subsequence using appropriate design technique? Explain the time complexity analysis.	8	3	3	2
24. a.	Write Rabin-Karp Algorithm and Perform Pattern matching for the following using Rabin Karp Algorithm.	8	4	5	2
	(OR)				
b.	Construct a graph with atleast 5 vertices and 10 edges, and give the vertex cover for the graph and explain.	8	4	5	2
25. a.	Consider the sum-of-subset problem, n=4, Sum=13 and w1=3, w2=4, w3=5 and w4=6. Find a solution to the problem using backtracking. Show the state-space tree leading to the solution. Also, the number of nodes in the tree in the order of recursion calls.	8	4	4	3
	(OR)				
b.	Write short note on the following: (i) Non-deterministic Polynomial class problems with NP-hard and NP-complete (4 Marks) (ii) Satisfiability problems with example (4 Marks)	8	4	5	3

PART – C (1 × 15 = 15 Marks)
Answer **ANY ONE** Questions

		Marks	BL	CO	PO
26.	Write the algorithm for Backtracking. Print all the Hamiltonian Cycles present in the below graph with a complete state space tree.	15	2	4	3



27.	Rishabh is working on a drone delivery system for a large city. The drones need to be able to navigate through the city while avoiding obstacles such as buildings and trees quickly and efficiently. Suggest an algorithm using divide and conquer method to determine whether the drones planned path intersects with any obstacles. Also provide the time complexity analysis. (Note: Your algorithm must be able to identify the tall buildings and trees).	15	3	2	3

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