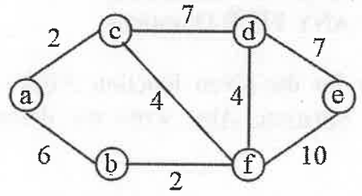
29. a. Given an integer array nums, find the contiguous subarray (conditioning at least one number) which has the largest sum and return its sum. A subarray is a contiguous part of an array. Input: nums = [–2, 1, –3, 4, –1, 2, 1, –5, 4] that returns the maximum sum of the subarray. Write the algorithm and time complexity analysis. | 12 | 4 | 2 | 3 |

(OR)

b. Given a set of points S in the plane, partitioned into two subsets S_1 and S_2. Solve the problem to find minimum distances of d_1 (for S_1) and d_2 (for S_2) using closest pair algorithm. Apply the algorithm to return the minimum distance of closest pair algorithm and derive the time complexity. | 12 | 4 | 2 | 3 |

30. a. Given a connected and undirected graph. Consider the graph below and show the construction of minimum spanning tree using Kruskals algorithm with the pseudo code. | 12 | 4 | 3 | 4 |



(OR)

b. The capacity of the knapsack bag is w = 3. The weights and profits of the three items are given in the below table. Apply dynamic programming algorithm for the above 0/1 knapsack problem. | 12 | 4 | 3 | 4 |

Items	Weight	Profits
1	1	1
2	2	6
3	4	4

31. a. Demonstrate 8-queens algorithm with example and draw state space tree. | 12 | 3 | 4 | 4 |

(OR)

b. Illustrate travelling salesman problem using branch and bound technique with example. | 12 | 3 | 4 | 4 |

32. a.i. Explain about Rabin Karp string matching algorithm with example. | 6 | 3 | 5 | 1 |

ii. Summarize randomized algorithm for hiring problem. | 6 | 3 | 5 | 1 |

(OR)

b. Write short notes on | | 3 | 5 | 1 |

(i) P | 3
(ii) NP-hard | 3
(iii) NP-complete | 3
(iv) Reducibility | 3

* * * * *

Reg. No.														

B.Tech. DEGREE EXAMINATION, MAY 2023

Fourth Semester

18AIC206J – ANALYSIS AND DESIGN 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 & 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	PO

1. Define the rule f(n) to prove for every n in mathematical induction | 1 | 1 | 1 | 1 |

(A) Induction hypothesis (B) Induction base
(C) Induction step (D) Proven solution

2. Identify the correct order of growth from slowest to fastest | 1 | 2 | 1 | 1 |

(A) $\log n, n\log n, n^3, n^2$ (B) $n^3, n^2, 2^n, n!$
(C) $n, n\log n, n^2, 2^n$ (D) $1, n, \log n, n^2$

3. def f ( ) | 1 | 2 | 1 | 1 |

```
ans = 0;
for i = 1 to n
    for j = 1 to log (i)
        ans + = 1;
    print (ans);
```

(A) O (n^3) (B) O (n)
(C) O (n^2) (D) O (n log n)

4. _____ is much more valuable than a thousand tests, since it guarantees that the program will work correctly for all possible inputs. | 1 | 2 | 1 | 1 |

(A) Proof by contrapositive (B) Poof by contradiction
(C) Proof by completeness (D) Proof by correctness

5. Merge sort is written using temporary arrays, it is called _____. | 1 | 2 | 2 | 3 |

(A) Two array merge (B) Stable sort
(C) Insort version of merge (D) Three way arrange

6. The most important condition for which closest pair is calculated for the points (P_i, P_j) is? | 1 | 2 | 2 | 2 |

(A) i > j (B) i ! = j
(C) i = j (D) i < j

7. In divide and conquer, the time for merging the sub problems is? | 1 | 2 | 2 | 2 |

(A) O (n) (B) O (n log n)
(C) O (n^2) (D) O (log n)

8. How many cases are there under master's theorem? 1 1 2 2
(A) 2 (B) 3
(C) 4 (D) 5

9. Which of the following is the property of a dynamic programming problem? 1 1 3 1
(A) Optimal substructure (B) Overlapping subproblems
(C) Greedy approach (D) Both optimal substructure and overlapping sub problems

10. What is correct? 1 2 3 2

Algorithm		Design paradigm	
1.	Dijsktra's shortest path	a.	Greedy design
2.	Floyd arashall's A/c pair shorted path	b.	Divide and conquer
3.	Kruskal's minimum spanning tree	c.	Dynamic programming
4.	Merge sort algorithm		

(A) 1 - a, 2 - b, 3 - c, 4 - c (B) 1 - a, 2 - c, 3 - a, 4 - b
(C) 1 - c, 2 - b, 3 - a, 4 - b (D) 1 - a, 2 - b, 3 - a, 4 - c

11. What is the time complexity of the brute force algorithm that is used to find the longest common subsequence? 1 2 3 2
(A) O (n) (B) O (n^2)
(C) O (n^3) (D) O (2^n)

12. A test is made up of the characters a, b, c, d, e each occurring with the probability 0.11, 0.40, 0.16, 0.09 and 0.24. The optimal Huffman coding technique will have the average length of 1 3 3 2
(A) 2.40 (B) 2.16
(C) 2.26 (D) 2.15

13. In how many directions do queens attack each other? 1 1 4 2
(A) 1 (B) 2
(C) 3 (D) 4

14. Backtracking algorithm is implemented by constructing a tree of choices called as 1 2 4 2
(A) State space tree (B) State chart tree
(C) Node tree (D) Backtracking tree

15. In what manner is a state space tree constructed for a backtracking algorithm? 1 1 4 4
(A) Depth first search (B) Breadth first search
(C) Twice around the tree (D) Nearest neighbour first

16. The travelling salesman problem can be solved using 1 1 4 2
(A) A spanning tree (B) A minimum spanning tree
(C) Bellman-ford algorithm (D) DFS traversal

17. If an NP hard problem can be solved in polynomial time, then all _____ problems can be solved in polynomial time. 1 2 5 1
(A) NP problem (B) NP complete
(C) N complete (D) N hard

18. What is the worst case running time of Rabin Karp algorithm? 1 2 5 1
(A) θ (n) (B) θ (n – m)
(C) θ (n – m +1) m) (D) θ (n log m)

19. Which of the following is incorrect about randomized quicksort? 1 2 5 1
(A) It has the same time complexity as standard quicksort (B) It has the same space complexity as standard quicksort
(C) It is an in-place sorting algorithm (D) It cannot have a time complexity of $O(n^2)$ in any case

20. The Knapsack problem is an example of 1 2 5 1
(A) Greedy algorithm (B) 2D dynamic programming
(C) 1D dynamic programming (D) Divide and conquer

PART – B (5 × 4 = 20 Marks) Marks BL CO PO
Answer **ANY FIVE** Questions

21. Analyze the growth of order for the given function $F(n)=2n^2+5$ and $g(n)=7n$ using big omega notation. Also write the definition of big omega notation. 4 4 1 2

22. Multiply the following two matrices using Strassen's multiplication method $A=\begin{pmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{pmatrix}$ $B=\begin{pmatrix} b_{11} & b_{12} \\ b_{21} & b_{22} \end{pmatrix}$. 4 3 2 2

23. Illustrate 0/1 Knapsack algorithm with time complexity analysis. 4 3 3 1

24. Draw the state space tree for 4-queens problem. 4 4 4 2

25. What is NP-hard problem? How to handle NP-hard problems to find solution? 4 3 5 1

26. Write the algorithm and derive the time complexity of merge sort. 4 3 2 2

27. List the advantages and disadvantages of randomized algorithm and greedy approach. 4 3 5 2

PART – C (5 × 12 = 60 Marks) Marks BL CO PO
Answer **ALL** Questions

28. a.i. Explain all asymptotic notations with example. 6 3 1 1

ii. Write both recursive and non-recursive algorithm to compute Fibonacci series. Compare their performance. 6 3 1 2

(OR)

b. Solve the following recurrence relation 4 1 2
(i) $T(n)=T(n-1)+n$ using forward and backward substitution method 6
(ii) $T(n)=T(n/2)+n$ using recursion tree method 6