Reg. No.															

B.Tech. DEGREE EXAMINATION, NOVEMBER 2023
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 & 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. Among the following, select the Divide and Conquer algorithm? (A) Bubble Sort (B) Selection Sort (C) Heap Sort (D) Merge Sort	1	2	1
2. The worst-case time complexity of Quicksort is? (A) O(n) (B) O(1) (C) O(log 2n) (D) O(n^2)	1	4	1
3. When a pop () operation is called on an empty queue, what is the condition called? (A) Overflow (B) Underflow (C) Syntax Error (D) Garbage Value	1	3	1
4. Identify the slowest sorting technique among the following? (A) Merge Sort (B) Quick Sort (C) Bubble Sort (D) Selection Sort	1	1	1
5. Identify the best-case time complexity of selection sort? (A) O(n log n) (B) O(n^2) (C) O(n) (D) O(1)	1	4	1
6. Which of the following is NOT a point to be considered when designing an algorithm? (A) If this software is used correctly (B) If the hardware is used correctly (C) If there is more than one way to solve the problem (D) the programming language for the algorithm	1	3	1
7. Dynamic programming algorithms use the _____ to obtain a solution to the given problem instance (A) Optimistic method (B) Greedy method (C) Huffman coding (D) Recurrence method	1	2	2

8. The all-pairs _____ problem is to determine a matrix A such that (i,j) is the length of a shortest path from i to j 1 1 2
   (A) Backward approach (B) Forward approach
   (C) Brute force approach (D) Shortest path

9. Which of the following methods can be used to solve the Knapsack problem? 1 1 2
   (A) Brute force algorithm (B) Recursion
   (C) Dynamic programming (D) Brute force, recursion and dynamic programming

10. Given items as {value, weight} pairs {{60,20}, {50,25}, {20,5}}. The capacity of knapsack = 40. Find the maximum value output assuming items to be divisible and non-divisible respectively. 1 3 2
   (A) 100, 80 (B) 110, 70
   (C) 130, 110 (D) 110, 80

11. Which of the following is not a backtracking algorithm? 1 1 2
   (A) Knight tour problem (B) N queen problem
   (C) Tower of Hanoi (D) Coloring problem

12. In what manner is a state-space tree for a backtracking algorithm constructed? 1 1 2
   (A) Depth-direct search (B) Breadth-first search
   (C) Twice around the tree (D) Nearest neighbor first

13. Which of the following methods can be used to solve n-queens' problem? 1 1 2
   (A) Greedy algorithm (B) Divide and conquer
   (C) Iterative improvement (D) Backtracking

14. Let S be an NP-complete problem and Q and R be two other problems not known to b in NP. Q is polynomial time reducible to S and S is polynomial-time to R. Which one of the following statements is true? 1 1 4
   (A) R is NP-complete (B) R is NP-hard
   (C) Q is NP-complete (D) Q is NP-hard

15. Let X be a problem that belong to the class NP. Then which one of the following is true? 1 1 4
   (A) There is no polynomial time algorithm for X (B) If X can be solved deterministically in polynomial time, then P = NP
   (C) If X is NP-hard, then it is NP-complete (D) X may be undecidable

16. Randomized quick Sort sorts a given array of length n in _____ expected time. 1 1 4
   (A) O(1) (B) O(log n)
   (C) O(n) (D) O(n log n)

17. Which of the following statements are true? 1 1 4

(i) The problem of determining whether there exists a cycle in an undirected graph is in P

(ii) The problem of determining whether there exists a cycle in an undirect graph is in NP

(iii) If a problem A is NP-complete, there exists a non-deterministic polynomial time algorithm to solve A

(A) (i), (ii) and (iii) (B) (i) and (iii)
(C) (ii) and (iii) (D) (i) and (ii)

18. What does NP stand for? 1 1 4

(A) Non-polynomial (B) Non-positive
(C) Nondeterministic polynomial (D) Not perfect

19. To which of the following class does a CNF-satisfiability problem belong? 1 1 4

(A) NP class (B) P class
(C) NP complete (D) NP hard

20. If for an algorithm time complexity is given by O(1) then the complexity of it is _____. 1 1 4

(A) Constant (B) Polynomial
(C) Exponential (D) None of the above

PART – B (5 × 4 = 20 Marks)

Marks BL CO

Answer **ANY FIVE** Questions

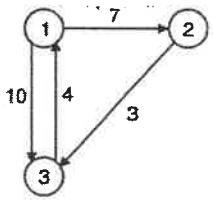
21. Solve the following recurrence relation using tree method 4 3 1

$T(n) = T(n-1) + \log n$,

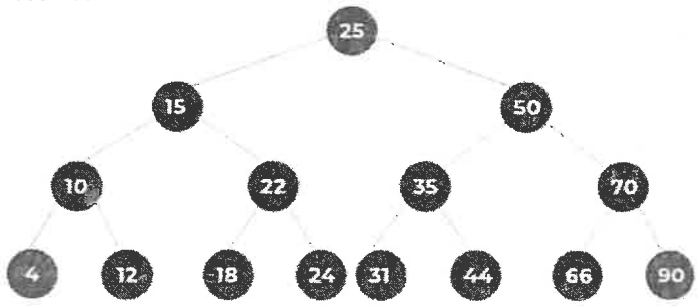
$T(1) = 0$

22. Collaborate how master method is better than recursion tree method. 4 2 1

23. Obtain all pair shortest path using Floyd's algorithm for given weighted graph. 4 3 2



24. Consider the following tree and write the traversal sequences in order, preorder and postorder. 4 2 3



25.	Compare and construct the NP hard vs NP complete.	4	3	4
26.	Explain in detail randomized quick sort algorithm with analysis.	4	3	5
27.	Elaborate on the topic quantum algorithm and discuss about the power of quantum algorithm.	4	3	5

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

		Marks	BL	CO
28. a.	Solve the following recurrence relation using substitution method $T(n) = 3T(n/3) + cn$, $T(1) = 1$	12	3	1
	(OR)			
b.	Solve the following recurrence relation using substitution method $T(n) = 4T(n-1) + 5$, $T(1) = 2$	12	3	1
29. a.	Given a Knapsack of a maximum capacity of M = 15 kgs and N = 7 items each with its own profit and weight, show the steps to throw items inside the Knapsack such that the final contents have the maximum profit.	12	3	1

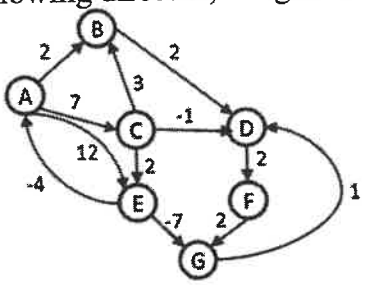
Object	1	2	3	4	5	6	7
Profit ($)	10	5	15	7	6	18	3
Weight (Kgs)	2	3	5	7	1	4	1

(OR)

b.	Consider a set of given jobs as shown below 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.					12	3	1

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

30. a.	Consider the following directed, weighted	12	3	2



(i) Even though the graph has negative weight edges, step through Dijkstra's algorithm to calculate supposedly shortest path 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. Also list the vertices in the order which you marked them known. (5 marks)

(ii) Dijkstra's algorithm found the wrong path to some of the vertices. For just the vertices where the wrong path was computed, indicate both the path that was computed and the correct path. (4 marks)

(iii) What single edge could be removed from the graph such that Dijkstra's algorithm would happen to compute correct answers for all vertices in the remaining graph? (3 marks)

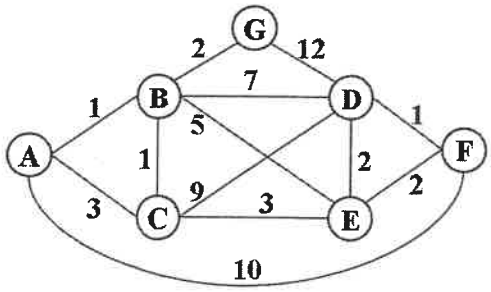
(OR)

b. Consider the following undirected, weighted graph: 12 3 2

(i) Step through Dijkstra's algorithm to calculate the single-source shortest paths from A to every other vertex. Show your steps in the table below. Cross out old values and write in new ones, from left to right within each cell, as the algorithm proceeds. (5 marks)

(ii) Also list the vertices in the order which you marked them known. (4 marks)

(iii) Finally, indicate the lowest-cast path from node A to node F. (3 marks)



31. a. Using an example, prove that satisfiability of Boolean formula 3-Conjunctive Normal Form (CNF) is NP — complete. 12 3 4

(OR)

b. Prove that Traveling Salesman Problem (TSP) is NP - complete. 12 3 4

32. a. Prove: The absolute approximate knapsack problem is NP-hard. 12 3 5

(OR)

b. Explain the working of randomized algorithm and approximation algorithm with suitable example for each. 12 3 5

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