DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
UNIVERSITY INSTITUTE OF ENGINEERING AND TECHNOLOGY
C.S.J.M. UNIVERSITY, KANPUR

B. Tech-CSE and CSE-AI (2k22 batch) 3rd year
Design and Analysis of Algorithms (CSE-S302)

End Semester (odd) Examination, 2024

Time: 3 Hours **Max. Marks: 50**

Note: All questions are compulsory.

SEC-A

(10 marks) (10 questions of 1 mark each)

1. What is time complexity of fun()?

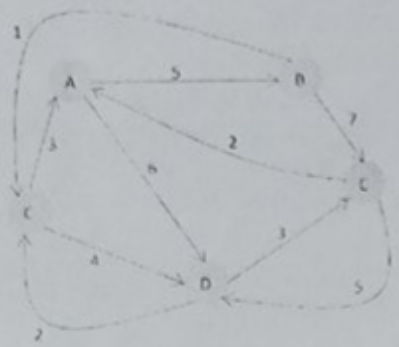
```
int fun(int n)
{
  int count = 0;
  for (int i = n; i > 0; i /= 2)
    for (int j = 0; j < i; j++)
      count += 1;
  return count;
}
```

2. Which of the following standard algorithms is not Dynamic Programming based?
   a. Bellman-Ford algorithm
   b. Floyd-Warshall algorithm
   c. 0/1 Knapsack problem
   d. Prim's Minimum Spanning Tree algorithm
3. Which data structure is used in Breadth-First Search?
4. What are the characteristics of greedy method?
5. Find time complexity using Recursion Tree method.
   $T(n) = 2T(n/2) + n$
6. What is knapsack problem?
7. What is Travelling Salesman problem?
8. Let X be a problem that belongs to the class NP. Then which one of the following is TRUE?
   a. There is no polynomial time algorithm for X
   b. If X can be solved in deterministically in polynomial time, then P = NP
   c. If X is NP-hard, then it is NP-complete
   d. X may be undecidable
9. What is the worst case time complexity of selection sort?
10. Arrange the time complexities in ascending order: $n^{3/2}$, 2^n, $n^{\log n}$, nlogn

SEC-B

(20 marks) (5 questions of 4 marks each)

11. Discuss Strassen's matrix multiplication with an example and derive its time complexity.
12. Apply Floyd Warshall's algorithm to find all pair shortest path for the graph given below.



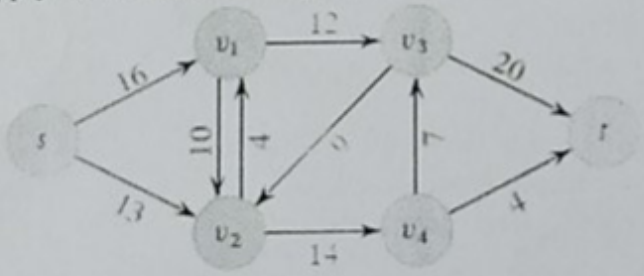
13. Find an optimal solution for following 0/1 knapsack problem using dynamic programming, Number of objects n=4, Knapsack capacity M=5, Weights (w1, w2, w3, w4) = (2,3,4,5) & Profit (p1, p2, p3, p4) = (3,4,5,6)
14. Explain the concept of scheduling algorithm. Calculate the total profit for the following problem using Greedy Approach Tasks given (T1..... T9). Deadline (7, 2, 5, 3, 4, 5, 2, 7, 3) and Profit (15, 20, 30, 18, 18, 10, 23, 16, 25) respectively.
15. What is longest common subsequence problem. Determine an LCS of (1, 0, 0, 1, 0, 1, 0, 1) and (0, 1, 0; 1, 1, 0, 1, 1, 0).

SEC-C

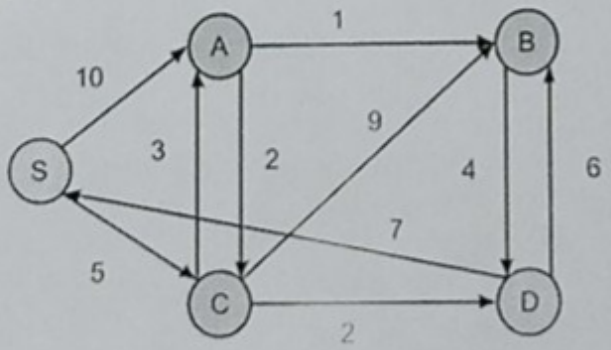
(20 marks) (2 questions of 10 marks each)

16.

A. Apply Ford-Fulkerson algorithm to determine maximum flow.



B. Apply Djikstra algorithm on the following graph (Take vertex S as source vertex):



17. :

A. Find an optimal parenthesization of a matrix-chain product whose sequence of dimensions is (30, 35, 15, 5, 10, 20, 25).

B. Write a algorithm to implement the Quicksort algorithm for an array of integers. Describe the worst-case time complexity of Quicksort and explain when it occurs.

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Subject- Design and Analysis of Algorithms (CSE-S302) **Branch: CSE and CSE-AI**

Semester- 2024-2025 (Odd Semester) Year: **III Year (Semester V)**

First Mid Semester Examination, 10-09-2024, Shift-IV

Time: 1:30 hours Maximum Marks: 30

Note: All questions are compulsory.

Section A

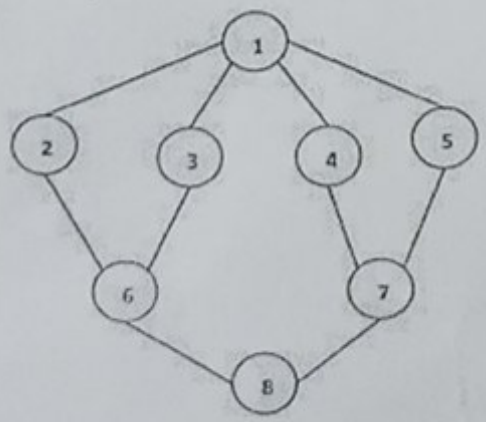
Each question in this section carries 01 marks

1. Define O-notation.
2. What is binary search? Show that that worst case time complexity of binary search is O(log n).
3. Give an algorithm to find out the largest element in a list of numbers.
4. Differentiate between best and worst case complexity.
5. What is stable matching problem?
6. What is the best case and worst case of bubble sort?
7. Build max-heap from the array A = {12, 3, 45, 1, 56, 4, 89}
8. Write Kruskal's algorithm.
9. What is the worst case time complexity of BFS?

Section B

Each question in this section carries 03 marks

10. Describe the Master's theorem. Solve the following recurrence relations using Master's theorem.
    (a) $T(n) = 4T(n/2) + n$ (b) $T(n) = 2T(n/2) + n\log n$
11. Sort the following list in increasing order of numbers
    9, 94, 45, 47, 28, 98, 65, 42
    Using each of the following methods
    (i) Insertion sort
    (ii) Selection sort
12. How DFS performs traversal in graph? Perform DFS on the following graph.



Section C

Each question in this section carries 06 marks

13. What is stable matching problem? Describe Gale-Shapley algorithm for stable matching problem.
Let Y = {John, Smith, Tony} be men and Y = {Anna, Bethany, Rose} be women. Let the men have the following preferences:

Man	First	Second	Third
John	Bethany	Anna	Rose
Smith	Bethany	Rose	Anna
Tony	Rose	Bethany	Anna

Here's are the women preferences:

Woman	First	Second	Third
Anna	Smith	Tony	John
Bethany	Tony	John	Smith
Rose	Smith	Tony	John

Find stable matching according to Gale-Shapley algorithm.

14. What is minimum spanning tree? Write algorithm for Prim's algorithm. Apply Prim's algorithm to find minimum spanning tree