No. of Printed Pages : 5

MCS-211

MASTER OF COMPUTER APPLICATION (MCA–NEW) Term-End Examination June, 2024

MCS–211 : DESIGN AND ANALYSIS OF ALGORITHMS

Time : 3 Hours *Maximum Marks : 100*

Weightate : 70%

Note : *Question No.* ***1*** *is compulsory. Attempt any* ***three*** *questions from the rest.*

---

1. (a) Use mathematical induction to prove that : 5

$$\sum_{i=1}^{n} i^2 = \frac{n(n+1)(2n+1)}{6}$$

(b) Write recursive binary search algorithms and analyse its complexity in worst case scenario. 5

(c) What is an algorithm ? Explain characteristics of an algorithm with the help of an example. 5

(d) Multiply the following two matrix using Strassen's algorithm : 5

$$\begin{bmatrix} 5 & 6 \\ -4 & 3 \end{bmatrix} \text{ and } \begin{bmatrix} -7 & 6 \\ 5 & 9 \end{bmatrix}$$

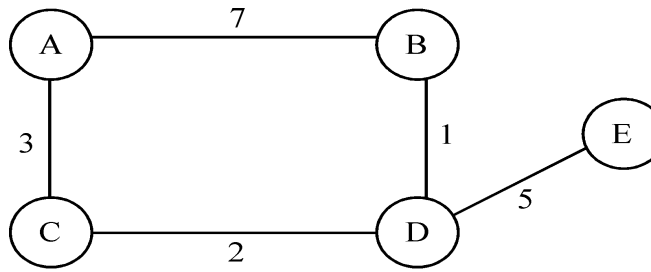
(e) What are P and NP class of problems ? Differentiate between NP-Hard and NP-Complete problems. 5

(f) Explain quick sort algorithm using suitable example. 5

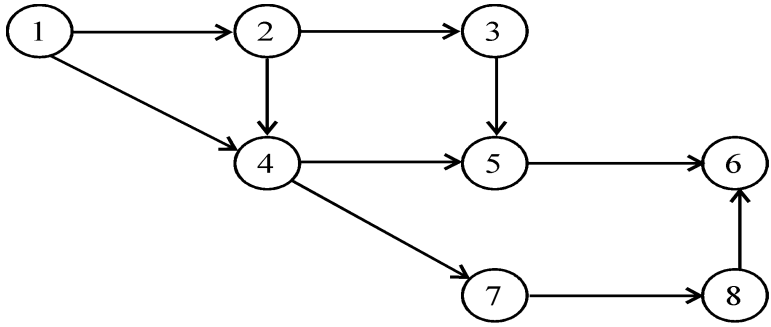
(g) Multiply the following two numbers using Karatsuba's algorithm. 5

(h) What is string matching algorithm ? Derive its best case time complexity. 5

2. (a) What is Minimum Spanning Tree ? Write Prim's algorithm for finding Minimum Spanning Tree and find its time complexity. Also find MST of the following graph using Prim's algorithm : 10



(b) Write an algorithm for topological sort. Obtain a topological ordering for the following graph : 10



3. (a) "The best-case analysis is not as important as the worst-case analysis of an algorithm." Yes or No. Justify your answer with the help of an example. 10

(b) Sort the following sequence of numbers, using selection sort. Also find the number of comparisons and copy operations required by the algorithm is sorting this list : 10

28, 13, 12, 28, 35, 11, 15, 9, 36

4. (a) Explain the 0/1 Knapsack problem. Solve the following 0/1 Knapsack problem : 10

Given number of objects $n = 6$

Capacity of Knapsack (M) = 12

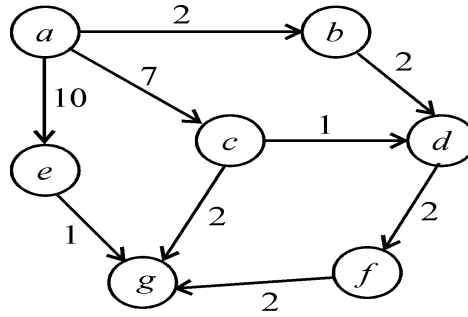
$(P_1, P_2, P_3, P_4, P_5, P_6) = (1, 6, 18, 22, 28, 43)$ and $(W_1, W_2, W_3, W_4, W_5, W_6) = (1, 2, 5, 6, 7, 10)$, where P_i's and W_i's are the profit and weights of the corresponding objects.

(b) Give a divide and conquer based algorithm to find the ith smallest element in an array of size n : 10

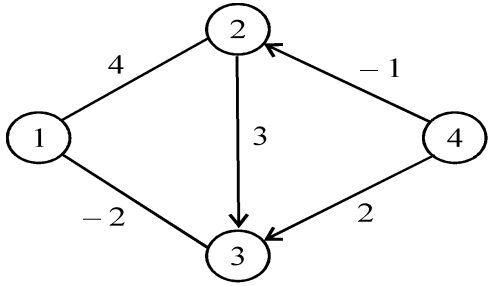
Trace your algorithm to find 3rd smallest in the array :

A = (10, 2, 5, 15, 50, 6, 20, 25)

5. (a) Write Dijkstra's algorithm to find the shortest path in a graph. Apply Dijkstra's algorithm on the following graph : 10



(b) Apply Floyd Warshall Algorithm (FWA) to find the shortest path distance between every pair of vertices in the following directed weighted on graph : 10



Also, find the time complexity of an algorithm.