

**MASTER OF COMPUTER
APPLICATION (MCA) (REVISED)**

Term-End Examination

June, 2024

**MCS-031 : DESIGN AND ANALYSIS OF
ALGORITHMS**

Time : 3 Hours

Maximum Marks : 100

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

1. (a) Use Mathematical Induction to prove the following expression : 5

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

- (b) Write and explain recursive algorithm to find the factorial of any given no. $n \geq 0$. 5
- (c) Write binary search algorithm and evaluate its time complexity for the best and worst cases. 5
- (d) Differentiate between Dynamic Programming and Greedy Approach to solve different problems. 5

- (e) Prove that the run time complexity of : 5

$$T(n) = n^3 + 20n + 1$$

is $O(n^3)$.

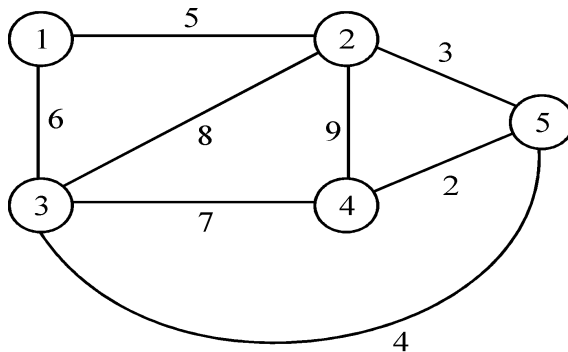
- (f) What is an algorithm ? Explain the characteristics of algorithm with the help of an example. 5

- (g) Differentiate between P and NP class of problems with example. 5

- (h) If $S = (a, aa, aaa)$ and $T = \{bb, bbb\}$, then prove that :

$$ST = \{abb, abbb, aabb, aabbb, aaabb, aaabbb\}. \quad 5$$

2. (a) Differentiate between Kruskal's and Prim's algorithms. Apply Kruskal's algorithm to find the minimum spanning tree for the following graph : 10



- (b) Differentiate between iteration and recursion. Write pseudo code for iterative and recursive approaches to find the factorial of a number provided by the user.

10

3. (a) Explain how dynamic programming can be used to solve matrix chain multiplication. Apply the algorithm to multiply following :

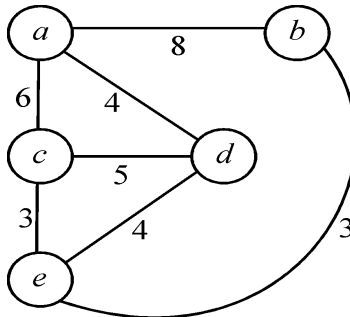
10

(M_1, M_2, M_3, M_4) with dimension :

(5×3), (3×7), (7×10), (10×15)

- (b) Using Dijkstra algorithm, find the minimum distance of all the nodes from node 'a' which is taken as the source node for the following graph :

10

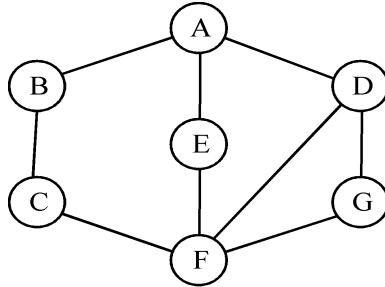


4. (a) Explain growth rate of the functions. Arrange the following growth rate in increasing order of time :

4

$O(n^2), O(2^n), O(\log n), O(l), O(n \log n)$

- (b) Discuss Chomsky classification for Type 0, Type 1, Type 2 and Type 3 grammar. 8
- (c) Using DFS, traverse all the nodes for the following graph by using 'A' as the starting node : 8



5. (a) What is PDA ? How is it different from FA ? 5
- (b) If L_1 and L_2 are context free language (CFL). Prove that $L_1 \cup L_2$ is also context free. 5
- (c) Write short notes on any *two* of the following : $5 \times 2 = 10$
- (i) Halting problem
 - (ii) Randomized Quick sort
 - (iii) Vertex cover problem
 - (iv) Principle of Optimality