

**MASTER OF COMPUTER
APPLICATIONS**

(MCA) (REVISED)

Term-End Examination

December, 2025

**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) What is an algorithm ? State the various characteristics of an algorithm with an example. 5
- (b) For a given problem P, two algorithms A₁ and A₂ have respectively time

complexities $T_1(n)$ and $T_2(n)$ in terms of size n , where :

$$T_1(n) = 4n^5 + 3n$$

and

$$T_2(n) = 2500 n^3 + 4n$$

Find the range for n , the size of an instance of the given problem for which A_1 is more efficient than A_2 . 5

- (c) Write a recursive algorithm to calculate factorial of any given number. 5
- (d) Prove that “Best case for bubble sort is worst case for quick sort”. 5
- (e) Briefly explain Kruskal’s algorithm for finding minimal spanning tree of a graph. 5
- (f) What is divide and conquer approach ? Compare it with dynamic programming. 5
- (g) Explain Push Down Automata (PDA) with suitable example. 5

(f) Design TM, M that recognizes the language L of all strings over $\{a, b, c\}$ with : 5

(i) Number of a 's = Number of b 's = Number of c 's; and

(ii) If (i) is satisfied, the final contents of the tape are the same as the input, i.e., the initial contents of the tape are also the final contents of the tape, else reject the string.

2. (a) Write an algorithm for topological sort with the help of an example. 10

(b) Write binary search algorithm. Explain how binary search method finds or fails to find the given sorted array : 10

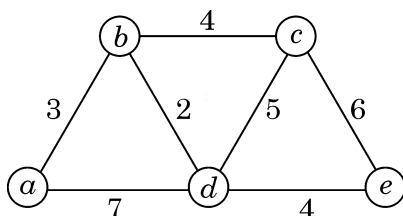
8, 12, 75, 26, 35, 48, 57, 78, 86, 93, 97, 108, 135, 168, 201

the following values :

(i) 15

(ii) 43

3. (a) Write and explain Dijkstra's algorithm and find the minimum distance of all the nodes from node 'a' which is taken as the source node for the following graph : 10



- (b) Define Context Free Grammar (CFG). Find CFG for the language over $\Sigma = \{a, b\}$: 10

- (i) All words of the form $a^x b^y a^z$, where $x, y, z = 1, 2, 3, \dots$ and $y = 5x + 7z$.
- (ii) For any two positive integers p and q , the language of all words of the form $a^x b^y a^z$, where $x, y, z = 1, 2, 3, \dots$ and $y = px + qz$.

4. (a) Define NP-complete and NP-hard problems. Show that the clique problem is an NP-complete problem. 10
- (b) Explain Halting problem. Is halting problem undecidable ? Justify your answer. 10
5. Write short notes on any *four* of the following : 4×5=20
- (i) Asymptotic notations
 - (ii) Finite Automata
 - (iii) Knapsack problem
 - (iv) Strassen's algorithm
 - (v) Randomized quick sort algorithm

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