

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

Term-End Examination

December, 2024

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

Time : 3 Hours

Maximum Marks : 100

Note : (i) *Question No. 1 is compulsory.*

(ii) *Attempt any **three** questions from the rest.*

1. (a) Explain *five* characteristics of an algorithm briefly. 5

(b) Use Mathematical Induction to prove that : 5

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

- (c) Determine the iterative expression for the system of recurrences given below : 5

$$F(n) = 2F(n-1) + 1 \text{ for } n > 1;$$

$$F(1) = 1$$

- (d) Discuss Karatsuba method for integer multiplication with suitable example. 5

- (e) Explain the ‘principle of optimality’ in dynamic programming with suitable example. 5

- (f) Sort the following sequence in ascending order using insertion sort : 5

28, 13, 12, 25, 38, 11, 15, 9, 36

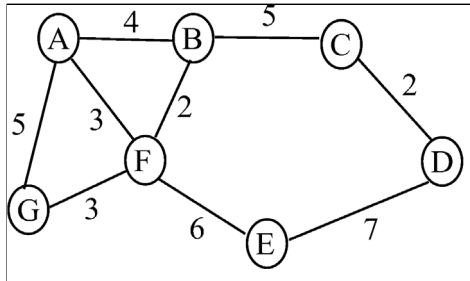
- (g) Construct a DFA for the following regular expression : 5

$$(0 + 1)^* (00 + 11) (0 + 1)^*$$

- (h) Differentiate between NP-complete and NP-hard problems. Give *one* example for each. 5

2. (a) Write Kruskal’s algorithm. Use Kruskal’s algorithm to construct a minimum

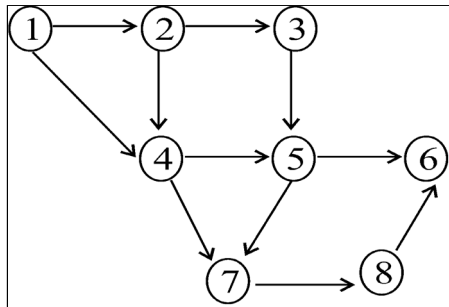
spanning tree from the following graph by using starting node 'A' : 10



- (b) Explain Strassen's matrix multiplication algorithm and apply the same to multiply the following two matrices : 10

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

3. (a) Write merge sort algorithm. Apply the same to sort the array of elements : 10
(2, 23, 14, 5, 18, 11, 10, 19, 06)
- (b) What is topological sort ? Obtain a logical ordering for the following graph : 10



4. Write short notes on the following : 4×5=20

- (i) DFS
- (ii) PDA
- (iii) Chomsky's classification of Grammar
- (iv) Regular Language

5. (a) Define a Turing Machine. Design a Turing
for the language : 10

$$L = \{a^n b^n c^n : n \geq 1\}.$$

(b) If L_1 and L_2 are two context free languages,
then show that $L_1 \cdot L_2$ is also a context free
language. 4

(c) Write short notes on the following : 6

- (i) Halting Problem of TM
- (ii) Post Correspondence Problem (PCP)

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