

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

**Term-End Examination**

**June, 2023**

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

*Time : 3 Hours*

*Maximum Marks : 100*

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

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1. (a) Write recursive binary search algorithm and analyse its run time complexity. 5  
(b) Solve the recurrence relation : 5

$$T(n) = 2T\left(\frac{n}{2}\right) + n; \quad n \geq 2$$
$$= 1 \quad ; \quad n < 2$$

- (c) List and explain any *five* properties of regular expression. 5  
(d) Construct a Turing machine (TM) to accept all languages of palindrome on set of alphabets  $\Sigma = (a, b)$ . 5

(e) Prove that best case for Bubble sort is worst case for Quick sort. 5

(f) Use Mathematical Induction to prove that  

$$\sum_{i=1}^n i = \frac{n(n+1)}{2}.$$
 5

(g) Define O (big Oh) notation. Verify the expression given below : 5

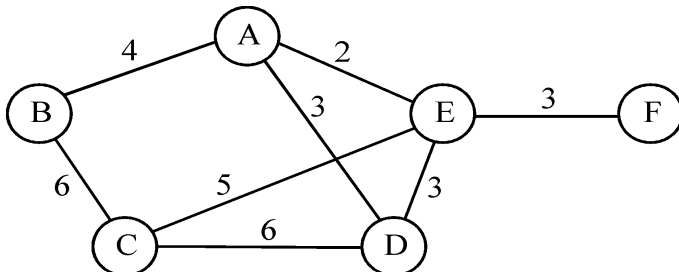
$$2n^2 + 3n + 1 = O(n^2)$$

(h) For a problem P, two algorithm  $A_1$  and  $A_2$  have time complexities  $T_1(n) = 5n^2$  and  $T_2(n) = 100n \log n$ . Find the range for  $n$  (the size of instance of the given problem P) for which  $A_1$  is more efficient than  $A_2$ . 5

2. (a) List and explain the Chomsky's classification of grammars. 10

(b) What is an ambiguous grammar ? How do you prove that a given grammar is ambiguous ? Explain with an example. 10

3. (a) Write Prim's algorithm. Evaluate its time complexity. Find the minimum spanning Tree for the graph shown below (using Pim's algorithm) : 10



[ 3 ]

- (b) Write Quick Sort Algorithm. Analyze the average case running time of Quick sort algorithm. Sort the following sequence of numbers, using Quick sort : 10

15, 10, 13, 9, 12, 7

4. (a) Discuss V. Strassen's matrix multiplication method of multiplying two matrices A and B, each of dimension  $(n \times n)$ . Also show that the time complexity is of order  $O(n^{2.81})$ , for Strassen's algorithm. 10

- (b) Differentiate between P, NP, NP-complete and NP-Hard class of problems. Give suitable example for each. 10

5. Write short notes on any *four* of the following :

5×4=20

- (a) Vertex cover problem
- (b) CLIQUE problem
- (c) Halting problem
- (d) Topological sort
- (e) Undecidable problems