

Int. M.Sc. (AIML) Sem.-7 Examination

CC-401 - Adv. Algorithms

Time : 2-30 Hours]

November-2025

[Max. Marks : 70

Instructions: All questions are compulsory. Use of non-programmable scientific calculator is allowed.

Q.1 (a) Define Growth of Functions. Define the Asymptotic Notations: Big-oh (O), Big-Omega (ω), Big-Theta (θ) with its graphical representation. (07)

(b) Calculate the time Complexity of Selection Sort and Quick Sort with suitable example. (07)

OR

(a) Calculate the time Complexity of Insertion Sort and Merge Sort with suitable example. (07)

(b) What is an Algorithm? State the characteristics of an algorithm. State the difference between Posteriori and Priori analysis of an algorithm. (07)

Q.2 (a) What is Huffman Coding? (07)

Consider the message with 100 characters in which characters a, b, c, d, e and f are used with frequency 50,10,30,5,3 and 2 respectively. Find the number of bits required for Huffman encoding of above message. Also, find the average bits required to represent each character.

(b) Discuss in brief: the difference between Divide and Conquer method and Dynamic Programming algorithm approach. (07)

OR

(a) Explain the concept of Matrix Chain Multiplication algorithm. Consider the following array and give the suitable output: (07)

(i) Input: arr[] = {2, 1, 3, 4}, Output: ?

(ii) Input: arr[] = {2, 1, 3}, Output: ?

(iii) Input: arr[] = {3, 4}, Output: ?

(b) Define the Longest Common Subsequence (LCS) problem in algorithm design. (07)

Consider two strings $X = "A, B, C, B, D, A, B"$ and $Y = "B, D, C, A, B, A"$.

Find the longest common subsequence?

E1144-2

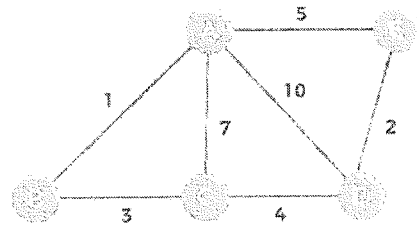
- Q.3 (a) Discuss the time complexity of Traditional and Strassen method with suitable example. (07)
Find the matrix multiplication using Strassen method

$$A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix} \quad B = \begin{bmatrix} 5 & 6 \\ 7 & 8 \end{bmatrix}$$

- (b) Define: Spanning tree. (07)

Consider the graph, find the minimum cost of the spanning tree by using Kruskal Algorithm.

State one important difference while applying Kruskal and Prim's algorithm. What is the time complexity of Kruskal Algorithm.



OR

- (a) Explain the concept of Dijkstra's algorithm. Write the application of Dijkstra's algorithm in real-world scenarios. (07)
- (b) Consider the array (07)

6	5	3	1	8	7	2	4
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Using Bubble sorting algorithm, answer the following questions:

- It depends on structure or content?
- Internal/External sorting algorithm?
- Stable/Unstable sorting algorithm?
- Best-case and worst-case time complexity?
- State the algorithm approach?

- Q.4 (a) Define NP-Complete and NP-Hard problems. Explain with diagram the concept of P, NP, NP-Complete and NP-Hard. (07)

- (b) State Master method for solving recurrences. Using Master's method find the worst time complexity of the recurrence $T(n) = 8T\left(\frac{n}{2}\right) + n^2$ (07)

OR

- (a) What is Travelling Salesman Problem? Why it is NP hard Problem? (07)
- (b) Prove that Clique 3-SAT is NP-complete. (07)

Q.5 Attempt any SEVEN out of TWELVE:

(14)

- (1) What are the applications of Huffman coding in real scenarios.
- (2) State (only) Vertex Covering Problem?
- (3) What is the time complexity of the recurrence relation $T(n) = T\left(\frac{n}{4}\right) + T\left(\frac{n}{2}\right) + n$.
- (4) State (only) Cook's Theorem.
- (5) Consider two strings $A = "qpqrr"$ and $B = "pqprrqp"$. Let X be the length of the longest common subsequence, then X is equal to _____.
 - A. 2
 - B. 3
 - C. 4
 - D. 5
- (6) What is the time complexity of the following code:


```
def func(n):
    for i in range (n):
        for j in range (n):
            print (i, j)
```

 - A. $O(n)$
 - B. $O(n \log n)$
 - C. $O(n^2)$
 - D. $O(n^3)$
- (7) Which of the following asymptotic notations holds the property of Reflexivity, Symmetry and Transitivity?
 - A. Big Oh notations
 - B. Big Theta notations
 - C. Big Omega notations
 - D. Small Oh notations
- (8) What is the number of spanning tree possible if G is complete Graph?

E1144-4

- (9) Which of the following sorting algorithms is based on Divide and Conquer algorithmic approach?
- A. Bubble sort
 - B. Selection Sort
 - C. Insertion sort
 - D. Quick sort
- (10) Write the concept of "pivot" in the quicksort algorithm.
- (11) What is the worst-case time complexity of Strassen method?
- A. $O(n^3)$
 - B. $O(n \log n)$
 - C. $O(n^{\ln 7})$
 - D. $O(\log n)$
- (12) Define the Longest Common Subsequence (LCS) problem in algorithm design.
