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1311E1145

Candidate's Seat No :_____

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

CC-401

Adv. Algorithams

November-2025

Time : 2-30 Hours] **[Max. Marks : 70**

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

Q.1 **(a)** What is an Algorithm? State the characteristics of an algorithm. State the difference between Posteriori and Priori analysis of an algorithm. **(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) Define Growth of Functions. Define the Asymptotic Notations: Big-oh (O), Big-Omega (ω), Big-Theta (θ) with its graphical representation. **(07)**

Q.2 **(a)** 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?

(b) 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: ?

OR

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

(b) 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.

P.T.O

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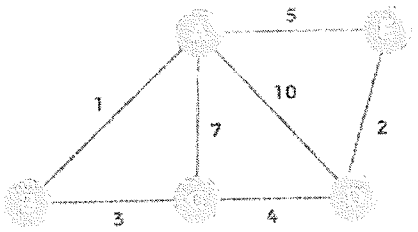
Q.3 (a) Define: Spanning tree. (07)

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.



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

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

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

Using Bubble sorting algorithm, answer the following questions:

(i) It depends on structure or content?

(ii) Internal/External sorting algorithm?

(iii)Stable/Unstable sorting algorithm?

(iv)Best-case and worst-case time complexity?

State the algorithm approach?

Q.4 (a) 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)

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

OR

(a) Prove that Clique 3-SAT is NP-complete. (07)

(b) What is Travelling Salesman Problem? Why it is NP hard Problem? (07)

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Q.5 Attempt any **SEVEN** out of **TWELVE:** **(14)**

(1) 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

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

(3) What is the number of spanning tree possible if G is complete Graph?

(4) Write the concept of "pivot" in the quicksort algorithm.

(5) What are the advantages and disadvantages of heap sort as a sorting algorithm?

(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) What are the applications of Huffman coding in real scenarios.

(8) What is the time complexity of the recurrence relation $T(n) = T\left(\frac{n}{4}\right) + T\left(\frac{n}{2}\right) + n$.

(9) Consider two strings $A = "qpqrr"$ and $B = "pqprqrp"$. Let X be the length of the longest common subsequence, then X is equal to _____.

A. 2

B. 3

C. 4

D. 5

(10) State (only) Cook's Theorem.

P.T.O

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(11) What is the worst-case time complexity of Strassen method?

A. $O(n^3)$

B. $O(n \log n)$

C. $O(n^{ln7})$

D. $O(\log n)$

(12) State (only) Vertex Covering Problem?

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