

**Indian Institute of Information Technology, Surat.**  
**Supplementary Examinations, July 2019**  
**B Tech II (CSE) - Fourth semester**  
**Course: CS403 - Design and Analysis of Algorithms**

Dated: 11 July 2019

Time: 02:00 pm to 05:00 pm

Max Marks: 100

**Instructions:**

1. Write your B Tech Admission No/Roll No and other details clearly on the answer books while write your BTech Admission No on the question paper, too.
2. Assume any necessary data but give proper justifications.
3. Be precise and clear in answering the questions.

Q.1

- (a) Prove or disprove following statements with proper justification (Any two) [6]
- (i)  $1 + 2 + 3 + \dots + n = \Theta(n^2)$
- (ii) If  $T_1(n) = O(f(n))$  &  $T_2(n) = O(g(n))$  then  $T_1(n) + T_2(n) = \max(O(f(n)), O(g(n)))$
- (iii)  $n^{1.001} + n \log n = \theta(n^{1.001})$
- (b) Explain  $\theta$  notation. To show that  $\frac{1}{2}n^2 - 3n = \theta(n^2)$  find the best fit values for the constant  $c_1$ ,  $c_2$  and  $n_0$ . [6]

Q.2

- (a) Define Huffman tree. Provide an algorithm to construct a Huffman Tree. Construct a Huffman tree for the following by tracing your algorithm. [9]

a	b	c	d	e	f
6	2	3	3	4	9

- (b) Discuss Greedy algorithm. Discuss the greedy algorithm for the Huffman encoding in the context of above numerical example. [6]

Q.3 Attempt any One. [16]

- (a) Discuss the polynomial multiplication and show that it is convolution of two series of numbers. Calculate the polynomial multiplication for  $X_1(n) = \{2, 1, 2, 1\}$  and  $X_2(n) = \{1, 2, 3, 4\}$  using coefficient based representation and point value representation. Derive the coefficients of result polynomial using Fast Fourier Transform. Write an algorithm using Divide and Conquer technique and analyse computational complexity.
- (b) Compute the optimal sequence for the matrix multiplication for the following matrices:  $A_{5 \times 3}$   $B_{3 \times 6}$   $C_{6 \times 7}$   $D_{7 \times 3}$   $E_{3 \times 5}$ . Show all the steps and necessary calculations for constructing the solution.

- Q.4 Using a dynamic programming approach find the solution for the problem of separating a sequence of words into a series of lines that comprise a paragraph. The objective is to avoid a lot of extra spaces on any line. This is an important problem in computerized typesetting. Discuss the computational complexity of the solution in detail. [9]

- Q.5 Given a list of items, it is required to pack the Knapsack (bag) in such a manner as to get the maximum (optimum) total value. Each item of the list has associated weight and value. It should be noted that total weight that we can carry is not more than the fixed weight  $W$ . To pack the Knapsack we have to consider the weight of item as well as its value. Find the solution using [8]

Dynamic Programming approach where it is assumed that the item is selected or discarded for packing, i.e. 0/1 Knapsack problem.

Q.6 For the following problems derive the solution using Divide and Conquer method with computational complexity analysis and demonstrate through an example. [10]

- (i) Mix-Max problem
- (ii) Quick Sort method

Q.7 Answer the following. [15]

Design an algorithm for assignment problem using Branch and Bound technique. In assignment problem  $n$  people are assigned  $n$  tasks. It is required to find the minimum total cost of assignment where each person has exactly one task to perform. For solving this problem, the cost matrix is shown here. Column indicates task and row indicates person. Given a cost matrix  $C$  where  $C_{ij}$  refers to the minimum cost for person  $P_i$  to perform task  $T_j$  where  $i$  and  $j$  varies from 1 to  $n$ .

5	8	4
3	7	2
4	10	5

Q.8 Answer the following. [15]

- (a) Discuss the hiring problem and perform probabilistic based analysis.
- (b) Perform amortized analysis for a  $k$  bit counter having an increment by one operation.