Roll Number:_____

Thapar Institute of Engineering & Technology
Department of Computer Science and Engineering
MID SEMESTER EXAMINATION

B. E. **(2nd Yr. COE/CSE, 3rd Yr. EM)**
16th March, 2023
Thursday, Time– 10:30 To 12:30 PM
Time: 2 Hours, Max Marks: 25

Course Code: UCS415
Course Name: Design and Analysis of Algorithms
Name of Faculty: Rajesh Mehta, Tarunpreet Bhatia, Randheer Bagi, Anil Singh, Vaibhav Pandey, Manisha Panjeta, Shruti Aggarwal

Note: Attempt all Questions in sequence. Answer all sub-parts of each question at one place. Do mention Page No. of your attempt at front page of your answer sheet. Assume missing data (if any).

Q.1	Solve the following recurrence relation using substitution/back-substitution method. $T(n) = 5T\left(\frac{n}{5}\right) + \frac{n}{\log n}$,where T(1) = 1	(3)
Q.2	Consider a sequence of n elements $(n = 13)$, $A = \{-7, -11, 6, -1, 8, -3, 1, -1, 4, -1, 5, 7, 0\}$. You have to determine the maximum $Sum(i,j)$ where $Sum(i,j) = \sum_{k=i}^{j} A[k]$ *and* $1 \le i \le j \le n$ using Divide and Conquer approach. Show algorithmic steps with the help of appropriate data structure and write the recurrence relation.	(3)
Q.3	Consider the text message as shown in the Table 1. Apply and verify the text compression algorithm which is based on idea that more number of common letters required fewer bits and less common letters required more number of bits. Assume that the blank space is considered as "-" with frequency 1. Draw the appropriate data structure to find the length of message after compression. How many bits are required for transferring this message before and after compression? Also, deduce the compression ratio. **Table 1** M I S S I S S I P P I - R I V E R	(4)
Q.4	LPS (Longest Palindrome Subsequence) is the maximum length of a common subsequence of a given sequences/strings which is palindrome. For example if the input string is "ABCDAC" then the longest palindrome subsequence is "CAC". Design and apply an efficient algorithm using dynamic programming (DP) approach for the LPS problem on the given input string. Compare the worst case run time complexity of DP and Brute Force Method for LPS problem.	(4)
Q.5	Given a sequence of 4 matrices A_1, A_2, A_3 and A_4 and an array of dimensions as d[] = {5, 4, 3, 2, 6}. Your task is to find an optimal parenthesization of multiplying given matrices so that it would take a minimum number of multiplications using bottom-up approach. You need to show the intermediate computations.	(4)

Q.6 Consider the four items with given weights and profits (as shown in Table 2) in the context of 0-1 Knapsack problem. (4)

Table 2

Item	1	2	3	4
Weight	5	3	4	2
Profit	5	6	8	3

a) Write the recursive equation to find the optimum value of items that can be packed in a knapsack of a given capacity using bottom-up approach. Also find the optimum value of items that can be packed in a knapsack of capacity of 7 (seven).
b) Also, write the algorithm for finding the optimal set of items in the knapsack.

Q.7 An interview is scheduled on a particular day where each candidate is to be interviewed by a single interviewer. The start time and end time of the interview for each candidate is given in Table 3. Design and apply the efficient algorithm for determining the minimum number of interviewers to interview all the candidates, with a minimum of 3 candidates for each interviewer. You need to also show the candidate list for each interviewer. (3)

Table 3

Candidate	Interview Start Time	Interview End Time
1	9: 10 am	10:10 am
2	11: 00 am	11: 20 am
3	10:30 am	10: 45 am
4	12: 00 pm	12: 30 pm
5	11:20 am	11: 55am
6	10:10 am	10: 30 am
7	10: 45 am	11: 15 am
8	11:30 am	12:00 pm
9	9:00 am	10: 00 am
10	12:40 pm	1:00 pm
11	10:10 am	11:00 am
12	9:55 am	10: 30 am
13	11:05 am	11:35 am
14	11:35 am	12: 00 pm