

CSN-212 Design and Analysis of Algorithms

[A] Mid Term Exam (Max Marks 100)

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Instructions: Please read the following instructions **very carefully** before attempting the questions.

1. There are choices in questions carrying different marks. Among any set of choices, only the first **UNCROSSED** answer would be considered, and the rest ignored.
2. On the first left page describe the choice attempted for each question and its page numbers. Add page numbers to all used pages of your answer sheet, and clearly mark the **END** and **Rough Work**.
3. For any answer not written contiguously, clearly mention the next part "continue on page X".

Answer the following questions, carefully notice the choices amongst the subparts of a question.

1. Answer exactly **ONE** of the following **TWO** questions:

Maximum Marks: 20

- (a) **[20 Marks] Median of Medians.** Describe and analyze a $\Theta(n)$ time algorithm to compute the k^{th} ranked element of an unsorted array having n elements.
- (b) **[10 Marks] Non-Dominating Points.** Describe and analyze an algorithm to compute the set of non-dominating points among n points in a 2D plane, where a point (x_i, y_i) dominates (x_j, y_j) if both $x_i \geq x_j$ and $y_i \geq y_j$.

2. Answer exactly **ONE** of the following **TWO** questions:

Maximum Marks: 20

- (a) **[20 Marks] Painter's Partitioning.** Given a set of n jobs of requiring $A[n]$ time to be painted by k painters, where each painter can paint a contiguous set of jobs. Describe and analyze an algorithm to report the minimum time required to complete the jobs if all painters work in parallel.
- (b) **[10 Marks] Shortest k edge path.** Given a weighted graph G having n vertices, describe and analyze an algorithm to report any pairwise shortest path having exactly k ($>> n$) edges.

3. Answer exactly **ONE** of the following **THREE** questions:

Maximum Marks: 30

- (a) **[30 Marks] Closest Pair of points in 3D.** Given a set of n points in a 3D space, design and analyze a divide and conquer algorithm to compute the closest pair of points.
- (b) **[20 Marks] Unique sum subarrays.** Given an array of n positive numbers in $[0, m]$, design and analyze an algorithm to find the number of all unique sums of its contiguous subarrays.
- (c) **[10 Marks] Significant Inversions.** Given an array A having n numbers, a significant inversion is an ordered pair i, j where $i \leq j$ such that $A[i] \geq 2A[j]$. Design and analyze a divide and conquer algorithm to compute the number of significant inversions in A .

4. Answer exactly **ONE** of the following **THREE** questions:

Maximum Marks: 30

- (a) **[30 Marks] Stock exchange.** Given a commodity having stock prices S over n days, where the stock can be bought for $S[i]$ and sold for $S[j]$ if $i \leq j$. Design and analyze an algorithm to compute the maximum profit that can be made by performing k transactions (buy+sell).
- (b) **[20 Marks] Suffix, Prefix, Duplicates.** Given a set of strings S having sum of lengths of all the strings n , design and analyze an algorithm to remove all the duplicates and the strings that are proper prefixes or suffixes of another.
- (c) **[10 Marks] Number of palindrome subsequences.** Given a string S of length n , design and analyze an algorithm to compute the number of its subsequences which are palindromes.