Design and Analysis of Algorithm (M.Tech CS)

Back paper Exam (16th Dec 2025) Score: 100 Time: 3 Hrs 00 Mins

1. Suppose T satisfies $T(n) = T(n/2)+T(n/3)+O(n)$ for all $n \geq 1$. Find the asymptotic expression of $T(n)$ and prove it. [15]

2. Describe an algorithm that, given an array of n integers and another integer x, determines whether the array contains two elements that sum to exactly x. Your algorithm should take $O(n \log n)$ time in the worst case. [15]

3. Suppose in the quick sort the pivot element is chosen as the last element. Give an example of array of n integers (for all n) for which this choice of pivot requires $O(n^2)$ comparisons for running the quicksort. [15]

4. Describe how hash table works to store and searching an element. Explain the expected run time of searching an element. [15]

5. Write an algorithm to compute the number of components of a given graph. [15]

6. Given n elements, build a min-heap in $O(n)$ time. [15]

7. Let L be the language consisting of all trees. Show that it is an NP language. [10]