

**Course/ Batch:** BTech/ SCSET  
**Course Code:** CSET244  
**Semester:** Even  
**Session:** 2024-2025

**Course Type:** Core  
**Course Name:** Design and Analysis of Algorithms

### **Tutorial Assignment: Week 5**

#### **Tutorial title: Divide and Conquer**

#### **CO Mapping**

Question no	CO1	CO2	CO3
Q1	✓	✓	
Q2	✓	✓	
Q3	✓	✓	
Q4	✓	✓	
Q5	✓	✓	

**Q1.** You are given an array of  $n$  elements, and you notice that some of the elements are duplicates; that is, they appear more than once in the array. Design an algorithm to remove all duplicates from the array in time  $O(n \log n)$ . Justify that your algorithm runs in  $O(n \log n)$  time in the worst case.

**Q2.** Given an array of  $n$  elements, decide whether the array has an element that appears more than  $n/2$  times in the array, and if so, find the element. If there are more than such element, report any one. Design and analyze an algorithm that runs in  $O(n \log n)$  time in the worst case.

**Q3.** Suppose there is an integer multiplication algorithm A that takes  $8n^{1.5}$  single digit multiplications to multiply two  $n$ -digit numbers, whereas another multiplication algorithm B (can be the classical high school multiplication algorithm) takes  $n^2$  single digit multiplications. Find the crossover point for which algorithm A asymptotically beats algorithm B.

**Q4.** A list of  $n$  names, each of length  $n$ , need to be sorted into dictionary order using the merge-sort algorithm. What will be the worst case running time of this computation?

**Q5.** Consider sorting the following array  $A = \{15, 25, 35, 55, 85, 90\}$  in ascending order using deterministic Quicksort algorithm that uses the last element as the pivot. What will be the number of swaps performed during this Quicksort?