National Institute of Technology Kurukshetra
Department of Computer Engineering
Competitive Programming and Efficient Coding
(ITPE 212)
End Semester Examination

Time: 3 Hour   Maximum Marks: 50

- All questions are compulsory and assume missing data, if any.

1.a) Given a string s and a pattern p, return the count of anagrams of the pattern found in the string. Two strings are anagrams if they have the same frequency of characters. Write modules for brute force approach and approach with O(n) time and constant space complexity.   6

1.b) Given a sorted array of n integers with duplicates. Find the count of occurrences of a given number.   4

2.a) You are given an array of temperatures T, where T[i] represents the temperature on the i-th day. Return an array answer such that answer[i] is the number of days you have to wait after the i-th day to get a warmer temperature. If there is no future day for which this is possible, put 0 instead. Do this with O(n) time complexity.   5

2.b) Implement merge sort to sort a singly linked list. Also, explain why merge sort is generally preferred over quick sort for sorting linked lists.   5

3.a) Implement two approaches to clone a singly linked list where each node has both next and random pointers — one with O(n²) time complexity and another optimized version with O(n) time complexity.   6

3.b) Design an algorithm to find the minimum number of edges to make an undirected graph connected.   4

4.a) Describe two methods for implementing disjoint set data structures, including the key operations, and discuss the time complexity of each approach.   6

4.b) Design and implement an efficient algorithm to compute a^b mod m, first with time complexity O(b), and then with an optimized approach achieving O(log b) time.   4

5.a) Given n dice, each having m faces numbered from 1 to m, determine the number of possible ways to achieve a total sum of X when all dice are rolled. Explain both the memoized (top-down) and bottom-up dynamic programming approaches with a suitable example. Also, analyze and compare their time complexities.   8

5.b) Write the differences between greedy and dynamic programming approaches?   2