Seat No: _____ Enrollment No: _____

PARUL UNIVERSITY

FACULTY OF ENGINEERING & TECHNOLOGY

B.Tech. Winter 2022 - 23 Examination

Semester: 5 **Date: 10/10/2022**
Subject Code: 203105301 **Time: 10:30 am to 01:00 pm**
Subject Name: Design and Analysis of Algorithms **Total Marks: 60**

Instructions:
1. All questions are compulsory.
2. Figures to the right indicate full marks.
3. Make suitable assumptions wherever necessary.
4. Start new question on new page.

Q.1 Objective Type Questions - (All are compulsory) (Each of one mark) **(15)**

1. What is the time complexity of the following function?

```
void myfunction()
{
        int a,b;
        for ( a=1; a<=n; a++)
            for ( b=1; b <= log(a); b++)
                printf("Hello");
}
```

(a) O(n) (c) O(n log n)
(b) $O(n^2)$ (d) O(1)

2. The recurrence relation that arises in relation with the complexity of binary search is:
(a) T(n) = T(n/2) + n (c) T(n) = 2T(n/2) + n
(b) T(n) = T(n/2) + k (d) T(n) = 2T(n/2) + k
3. If the array A contains the items 10, 4, 7,23,67,12 and 5 in that order, what will be the resultant array A after the third pass of the insertion sort?
(a) 67,12,10,5,4,7,23 (c) 4,7,10,23,67,12,5
(b) 4,5,7,67,10,12,23 (d) 4,10,7,23,67,12
4. Which of the following problem is NP-hard?
(a) Graph coloring Problem. (c) Quick sort
(b) Merge Sort (d) Shortest Path Problem
5. Let G be a connected undirected graph of 100 vertices and 300 edges. The weight of a minimum spanning tree of G is 500. When the weight of each edge of G is increased by 5, then what will be the new weight of a minimum spanning tree?
(a) 895 (c) 990
(b) 950 (d) 995
6. Consider the following three functions: $f_1=10^n$ $f_2=n^{\log n}$ $f_3=n^n$
Which one of the following options arranges the functions in the increasing order of asymptotic growth rate?
(a) f_3, f_2, f_1 (c) f_2,f_1,f_3
(b) f_1,f_2,f_3 (d) f_2,f_3,f_1
7. Measuring the performance of an algorithm in relation with the input size n is known as _____
8. Consider a simple undirected graph of 10 vertices. If the graph is disconnected, then the maximum number of edges it can have is _____ .
9. Fractional knapsack algorithm uses _____ algorithm design technique.
10. Define: Time Complexity.
11. Compute Time Complexity using Master's theorem: $T(n) = 64T(n/4) + n^7$
12. What is Principle of Optimality?
13. Mention Time Complexity of Kruskal's algorithm.
14. Write Recurrence relation of Strassen's matrix multiplication.
15. State True/False: $f(n) = O(g(n))$ implies $2^{f(n)} = O(2^{g(n)})$

Q.2 Answer the following questions. (Attempt any three) **(15)**

A) Give asymptotic upper and lower bounds for T(n) in each of the following recurrence. Assume that T(n) is constant for n<=1.
T(n) = 2T(n/2) + nlog n
B) Differentiate Greedy Technique and Dynamic Programming.

C) Write algorithm for Depth First Graph traversal of graph.

D) Write a brief note on the classes – P, NP, NPC and NPH with example.

Q.3 A) A message consisting of the characters given in the table below has to be transmitted over a network in a secured manner. **(07)**

Character	A	B	C	@
Probability	0.4	0.2	0.3	0.1

(i) Construct Huffman tree for the given characters. (Branch label left (0) Right(1))

(ii) Device Huffman codes for given characters.

(iii) Encode text CABA@CABAC using Huffman codes.

(iv) Decode the text whose encoding is 100101

B) Generate optimal substructure for Matrix Chain Multiplication using Dynamic Programming. Find out Minimum number of multiplications required for multiplying: A[5x1] B[1x4] C[4x1] D[1x3]. Write optimal parenthesizing of matrices. **(08)**

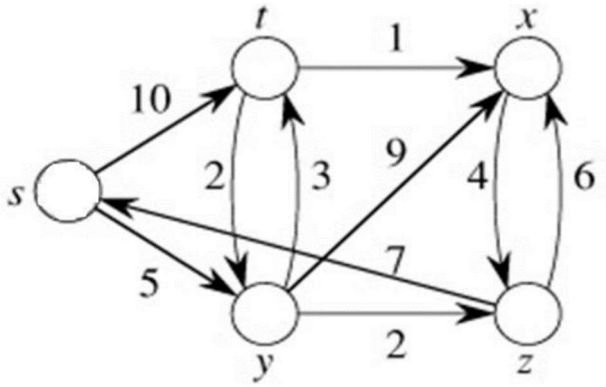
OR

B) Derive the optimal substructure that can be used to solve the Longest Common Subsequence problem using dynamic programming. Find the longest common subsequence for the given two sequences of characters: X = (1,0,0,1,0,1,1,0,1,1,0,1); Y = (0,1,1,0). **(08)**

Q.4 A) Define Backtracking technique. State Queen's problem and draw the state space tree of solving the 4 queen's problem using backtracking. **(07)**

OR

A) Find out the order in which nodes get included into the set of vertices of finalized shortest path distances, using Dijkstra's single source shortest-path algorithm on the following edge weighted directed graph with vertex S as the source. **(07)**



B) Write an algorithm to sort 'n' numbers using Quick sort. Trace the algorithm to sort the following elements in the ascending order: 54, 26, 93, 17, 77, 31, 44, 55, 20. **(08)**