4ᵗʰ Semester Regular / Back Examination: 2022-23
SUBJECT: Design and Analysis of Algorithm
CST,CSEAI,CSE,CSEAIME,ELECTRICAL & C.E,ELECTRONICS & C.E, CSIT,IT
Time : 3 Hours
Max Marks : 100
Q.Code : M603
Answer Question No.1 (Part-1) which is compulsory, any eight from Part-II and any two from Part-III.
The figures in the right hand margin indicate marks.

Part-I

Q1   **Answer the following questions:**   **(2 x 10)**
a)   Write any four properties of an algorithm.
b)   How the Backtracking of algorithm differs from that of branch and bound algorithm?
c)   State the principle of optimality. Find two problems for which the principle does not hold.
d)   Define Dis-joint set. Write the operation supported by the dis-joint set.
e)   Differentiate between Deterministic and nondeterministic algorithm.
f)   Differentiate between Dynamic Programming and Greedy method.
g)   What is the time required for finding the shortest path in a graph with n-vertices and e- edges?
h)   Define max clique problem versus clique decision problem.
i)   Show that given a maximum flow in a network with edge, a maximum cut of N can be computed in O(m) times.
j)   Define polynomial time reducibility.

Part-II

Q2   **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)**   **(6 × 8)**
a)   State the fractional Knapsack problem? Find an optimal solution to the Knapsack instance n= 3, m = 20, (P1, P2, P3) = (25, 24, 15) and (W1, W2, W3) = (18, 15, 10)
b)   Analyze the situations where quick sort performs the best and worst. Find the best and worst case time complexity of quick sort.
c)   Explain the greedy algorithm to solve the following Activity Selection Problem.

Job	1	2	3	4	5	6
Start time	1	3	0	5	3	7
Finish Time	4	5	6	7	9	9

d)   Construct a min-heap using heapify procedure with the following elements and demonstrate each step:

4, 5, 18, 13, 16, 35, 8, 26, 45.

e)   What is single source shortest path problem? How it is different from all pair shortest path problem?

f) Suppose that all characters in the pattern p are different. Show how to accelerate NAÏVE-STRING-MATCHING to run in time $O(n)$ on an n-character text T.

g) Define Big-Oh and Big-omega notation. Find Big-Oh for the function $f(n)=4n^2+2n+7$

h) Derive time complexity of job sequencing with deadlines. Explain the most suitable technique to solve this problem.

i) The directed Hamiltonian cycle is NP-complete. Prove that the undirected Hamiltonian cycle is reducible to the directed Hamiltonian cycle

j) Solve the following recurrence relation:
$$T(n) = 2T(n/2) +n^3$$
$$T(n) = 16T(n/4) +n$$

k) Give the control Abstraction for divide-and-conquer. Use divide and conquer paradigm to devise recurrence relation for analysis of quick sort. use the same to find best case analysis for quick sort

l) Construct a Huffman tree for the following data obtain its Huffman code

Character	A	B	c	d	e	f
No. of Occurrences	2	3	3	4	6	10

Part-III
Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 a) Describe and justify Kruskal's algorithm for finding the minimum spanning tree of an undirected graph.

b) Let the dimensions of matrices A,B,C,D respectively be 10X5, 5X15, 15X8, 8X20 generate matrix product chains that produces minimum number of matrix multiplications using dynamic programming.

Q4 a) Explain the algorithm for finding length of LCS. Determine LCS of "ROURKELA" and "IOUEA".

b) Find out the shortest path from following graph G using Bellman Ford algorithm taking source vertex S. What its time complexity? **(8)**

G
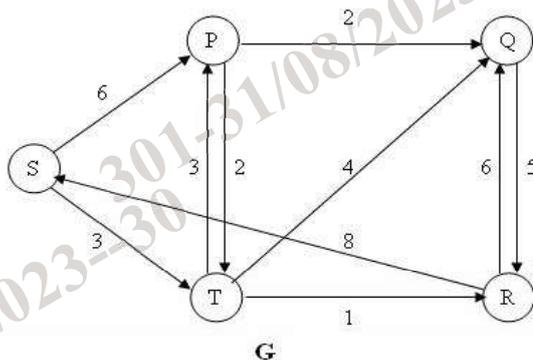
Q5 a) Explain the 2-approximation algorithm with proof for solving the Travelling Salesman Problem. **(8)**

b) Discuss the concept of pattern matching algorithm? Write the Rabin-karp algorithm for the string matching. Suppose T = "kalhonaho", P = "hona", then Find the position where Pattern matching occurs. **(8)**

Q6 a) Discuss the relation between P, NP, NP-complete and NP-Hard problem with suitable example. **(8)**

b) Discuss the 4 – queen's problem. Draw the portion of the state space tree for n = 4 queens using backtracking algorithm. **(8)**