Course Code : CST 314 **EVFU/MW – 18 / 6055**

Fifth Semester B. E. (Computer Science and Engineering) Examination

DESIGN AND ANALYSIS OF ALGORITHMS

Time : 3 Hours] [Max. Marks : 60

Instructions to Candidates :—

(1) All questions carry equal marks.
(2) Solve any **Two** sub – questions from each question.
(3) Mention comments properly before writing the algorithms.

1. (a) Solve the following non homogeneous recurrence and provide the suitable asymptotic bound.

$$t_n = \begin{cases} 1 & \text{if } (n = 0) \\ 4t_{n-1} - 2^n & \text{otherwise} \end{cases}$$

Also, comment on the provided bound. 5 (CO 1)

(b) Solve the following recurrence using substitution method and generate suitable upper bound :

$T(n) = 2T(n/2) + cn^3 \quad n \geq 2, T(1) = 1$ 5 (CO 1)

(c) An inversion in an array A is a pair i, j such that $i < j$ and $A[i] > A[j]$. Design and analyze an algorithm to count the number of inversions in an array consisting of n elements. 5 (CO 1)

2. (a) Insert, delete and multiple deletions can be performed on a queue. Compute the amortized cost for these operations using accounting method. Also compare these costs with worst case time complexity. 5 (CO 1)

(b) Provide the suitable upper bound, lower bound and exact bound for the following :—

(1) $f(n) = 6n^2 + n(\log n) + 87$ (2) $f(n) = 3^n + 2^n$

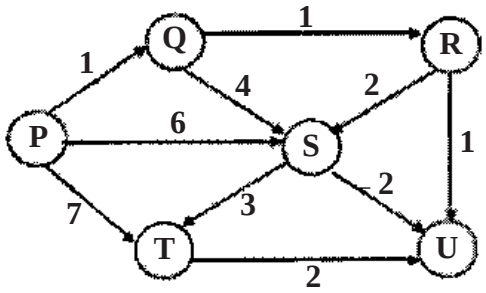
Compute the constants for proving the provided bounds. 5 (CO 1)

(c) Implement the 8 – bit sorting network for the following input sequence :—

8 , 7 , 9 , 2 , 3 , 5 , 4 , 1

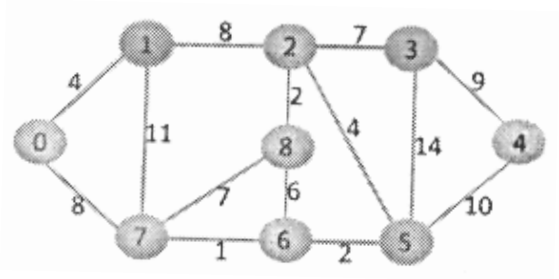
Also, state the number of merger and bitonic sorter required in the sorting network. 5 (CO 1)

3. (a) Implement single source shortest path algorithm for computing all shortest paths source vertex P. Use greedy approach for computing shortest paths.



5 (CO 2 , 3 , 5)

(b) What are the philosophical differences between Krusakal's and reverse delete algorithm ? Compute minimum cost spanning tree by applying reverse delete algorithm on the following connected graph :—



5 (CO 2 , 3 , 5)

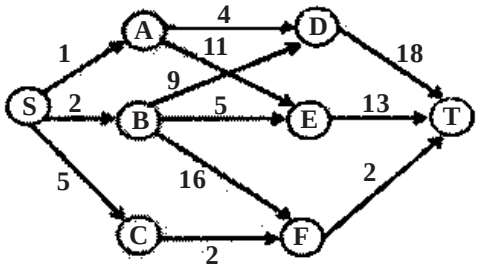
(c) Propose a DAC formulation for computing the closest pair of points in a given set of n points. Also, derive the time complexity of the algorithm. 5 (CO 2 , 5)

4. (a) Construct an optimal binary search tree for the following set of probabilities :—

i	0	1	2	3	4
p_i		0.1	0.1	0.2	0.3
q_i	0.05	0.05	0	0.05	0.15

5 (CO 2 , 5)

(b) Compute the shortest path from source to destination in the following multistage graph :—



Use dynamic programming for computing the shortest path.

5 (CO 2 , 3 , 5)

(c) Propose a maximum sum rectangle algorithm using dynamic programming approach. Apply the algorithm on the following matrix for computing the maximum sum rectangle :—

1	2	– 1	4
– 8	– 3	4	2
3	8	10	– 8
– 4	– 1	1	7

5 (CO 2 , 5)

5. (a) Propose a backtracking formulation for pattern matching in a given string. Your formulation should not use regular expression. Also, give an example. 5 (CO 2 , 5)

(b) Propose backtraking formulation for the implementation of n – queen problem. Also, specify the implicit and explicit constraints of this problem.

5 (CO 2 , 3 , 5)

(c) Draw the state space tree for the sum of subset problem using backtracking formulation for the data shown below :—

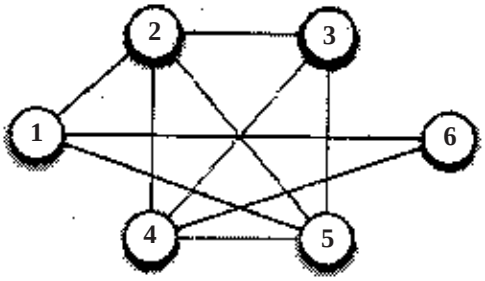
n = 5 , m = 30 , and w = { 5 , 10 , 12 , 13 , 15 }

Comment on the efficiency of this algorithm. 5 (CO 2 , 5)

6. (a) What do you mean by NP – completeness ? Prove that 3 – satisfiability is an NP – complete problem. 5 (CO 4)

(b) Show that a decision algorithm for TSP can be developed using an optimization problem for the TSP. Explain with proper example. 5 (CO 4)

(c) Compute the approximate vertex cover for the graph shown below :—



Also, state the algorithm for approximate vertex cover problem. 5 (CO 4)