Course Code : CST 314 **GTHS/RS – 19 / 7185**

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 generate suitable bound : 5 (CO 1)

$$t_n = 2t_{n-1} - 2t_{n-2} \quad n \geq 2, \text{ subject to } t_0 = 0 \quad t_1 = 1$$

(b) Solve the following recurrence relation using recursion tree method. Also prove the provided bound is asymptotically tight. 5 (CO 1)

$$\mathbf{T(n) = 2T(n/2) + cn}$$

(c) Compute the asymptotic bound for the following recurrence relation using substitution method : 5 (CO 1)

$$\mathbf{T(n) = 2T(n/3) + \log(n)}$$

2. (a) Implement selection sort on the following array. Also, state the underlying algorithm along with the time and space complexity. 5 (CO 1)

12, 15, 65, 61, 10, 11, 53

(b) State and explain the necessity of amortized analysis. Illustrate the process with the help of binary counter. 5 (CO 1)

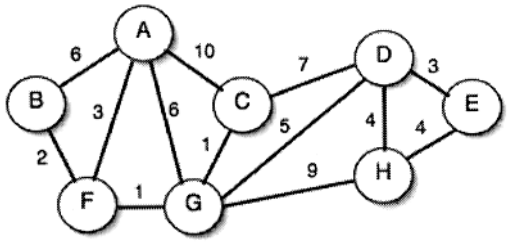
(c) State an algorithm for the construction of max heap. Implement this on the following set of elements : 5 (CO 1)

12, 13, 15, 45, 56, 48, 32, 65, 84

3. (a) Compute the minimum and maximum element in the following set of elements using DAC approach :

14, 25, 36, 47, 28, 93, 19, 26, 48, 12, 10 5 (CO 2)

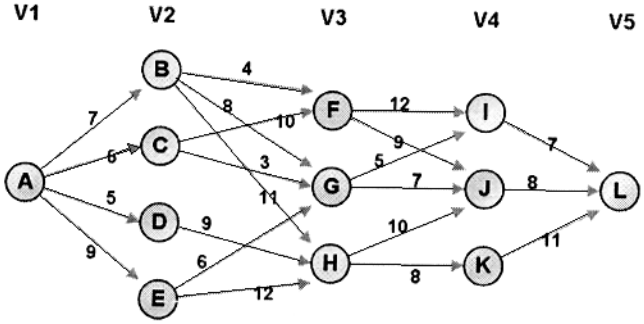
(b) Compute minimum cost spanning tree for the following connected graph using greedy approach. Also, write the time complexity of the underlying algorithm.



5 (CO 2, CO 3)

(c) State and explain the Prim's algorithm for computing the minimum cost spanning tree. Also, mention the time and space complexity. 5 (CO 2)

4. (a) Implement the multistage graph using dynamic programming approach on the following graph and compute the shortest path from source A to destination L :



5 (CO 2, CO 3, CO 5)

(b) Can negative edges be handled in Bellman Ford Shortest Path Algorithm? State the underlying algorithm. 5 (CO 2)

(c) State principle of optimality with proper example. How is it applied as a key characteristic in dynamic programming ? Explain with the help of longest common subsequence. 5 (CO 2, CO 3, CO 5)

5. (a) State an algorithm for the computation of all the articulation points in an undirected connected graph. 5 (CO 2, CO 3)

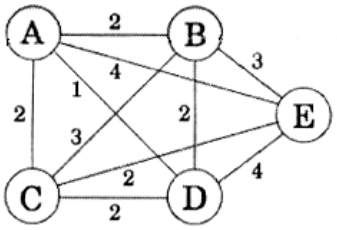
(b) How graph coloring problem can be solved using backtracking approach? Propose the formulation along with the backtracking efficiency. 5 (CO 2, CO 3, CO 5)

(c) Implement sum of subset on the following data using backtracking formulation:

$W = \{5, 10, 12, 13, 15, 18\}$, and $m = 30$ 5 (CO 2, CO 3, CO 5)

6. (a) Clearly define the polynomial reduction process. Define NP complete and NP hard problem with the help of polynomial reduction. Give an example. 5 (CO 4)

(b) Implement approximate Travelling salesman problem on the following connected graph. Also state the approximate algorithm.



5 (CO 4)

(c) Reduce satisfiability problem into an independent set problem. What conclusion can you draw using this reduction ? 5 (CO 4)