2023
B.E. (Computer Science and Engineering)
Fourth Semester
CS-401: Analysis and Design of Algorithms

Time allowed: 3 Hours   Max. Marks: 50

NOTE: Attempt five questions in all, including Question No. I which is compulsory and selecting two questions from each Section.

x-x-x

I. Write short answers of the following:
   a. Define algorithm. What are the criteria that an algorithm should follow?
   b. Define time complexity and space complexity.
   c. Prove that if $f_1(n)=O(g_1(n))$ and $f_2(n)=O(g_2(n))$, then $f_1(n) + f_2(n) = O(g_1(n) + g_2(n))$.
   d. What are the elements of Greedy strategy?
   e. Define spanning tree.   **(2 marks each)**

Section-A

II.
   a. What are asymptotic notations? Describe with the help of examples commonly used asymptotic notations.
   b. Solve the following recurrence relation exactly:
      $T(1) = 1$, and for all $n \geq 2$, $T(n) = T(\lfloor \frac{n}{2} \rfloor) + 1$.   **(5,5)**

III.
   a. What is control abstraction? With the help of control abstraction, describe in detail divide-and-conquer strategy of algorithm design.
   b. Write Pseudocode of an algorithm that makes use of divide-and-conquer strategy to find maximum and minimum from a list of elements. Determine the time complexity and space complexity of the algorithm. Express them using suitable asymptotic notations.   **(5,5)**

IV.
   a. Write Prim's algorithm to find minimum cost spanning tree.
   b. Using Prim's algorithm, find the minimum cost spanning tree for the following graph: **(5,5)**
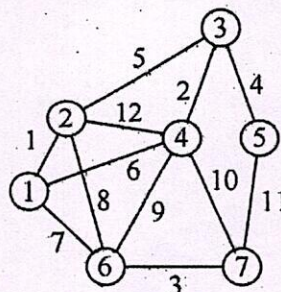

Section-B

V.
   a. Write an algorithm to solve sum of subsets problem. Using the described algorithm, solve the following problem instance: w={5, 7, 10, 12, 15, 18, 20} and m=35.
   b. Find an optimal parenthesization of a matrix-chain product whose sequence of dimensions is <5, 10, 3, 12, 5, 20, 8>.   **(5,5)**

VI.
   a. Describe n-Queens problem. Write a backtracking algorithm to solve this problem. Using this algorithm find a solution to 4-Queens problem.
   b. Write an algorithm to solve multi-stage graph problem. Solve multi-stage graph problem for the graph given below: **(5,5)**
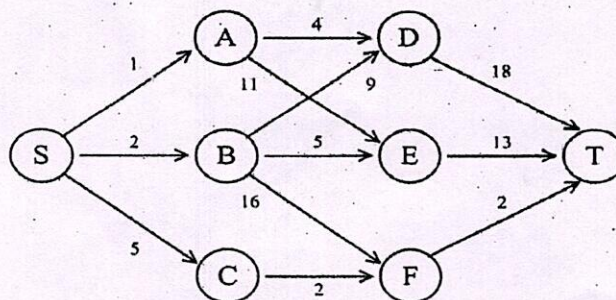
VII.
   a. What are NP-complete problems? State and describe in brief two NP-complete problems.
   b. Find longest common subsequence of the given sequences X=ABABBCAC, Y=ACBACCAC.   **(5,5)**

x-x-x