Comilla University

Department of Computer Science and Engineering

2nd Year 1st Semester Final Examination-2020

Session: 2018-19

Course Code: CSE- 2101 Course Title: Algorithm Analysis and Design

Full Marks: 60 Time: 03 Hours

N.B. 1) The figures in the right margin indicate full marks.

2) Answer any **five (05)** of the following questions:

01. a. Why do you need an algorithm to solve a problem? What are the major characteristics of it? 03

b. Interpret the following complexity notations with necessary examples: 02

I. $O(1)$

II. $O(logn)$

c. Show that, the worst-case running time of Insertion Sort algorithm is a quadratic function of n where n represents the input size. 04

d. Define time and space complexity. What is the general approach to calculate space complexity? 03

02. a. What is a recurrence relation? Draw a recursion tree for the following recurrence and express the complexity in terms of asymptotic notation: 03

$$T(n) = \begin{cases} \theta(1) & if\ n = 1 \\ 2T\left(\frac{n}{2}\right) + c(n) & if\ n > 1 \end{cases}$$

b. Draw a recursion tree for the following recurrence and find the height of the resultant tree: 03

$$T(n) = T\left(\frac{n}{3}\right) + T\left(\frac{2n}{3}\right) + cn$$

c. State Master theorem for solving recurrences. Solve the following recurrences using Master theorem and find their corresponding asymptotic notation: 04

I. $T(n) = 4T\left(\frac{n}{2}\right) + n$

II. $T(n) = 2T\left(\frac{n}{2}\right) + \frac{n^3}{logn}$

d. How does divide and conquer approach solve a problem? 02

03. a. Illustrate the Binary Search Algorithm — 04

b. Consider the following expression and solve by applying divide-and-conquer method in which a–2 and b–2 — 03

$$T(n) = \begin{cases} T(1) & if\ n = 1 \\ aT\left(\frac{n}{b}\right) + f(n) & if\ n > 1 \end{cases}$$

c. Apply quick sort algorithm to the following: — 05

A, L, G, O, R, I, T, H, M, D, E, S, I, G, N

04. a. Illustrate the operation of HEAPSORT on the following array: — 03

$A = \{16, 13, 21, 2, 7, 11, 23, 8, 27\}$ 71, 27, 23, 16, 13, 87, 2

b. Find an optimal parenthesization of a matrix chain product whose sequence of dimension is {5, 10, 3, 12, 5, 50, 6} using DP approach. — 05

c Define the optimal substructure for 0/1 knapsack problem. Consider a knapsack with a maximum capacity of 50 kg. Apply 0/1 knapsack on the following instances and produce the solution vector along with the maximum profit: $w[\ ] = \{10, 20, 30\}$ and $p[\ ] = \{60, 100, 120\}$ where w[] and p[] represent the corresponding weights and profits of the items. — 04

05. a. Make a comparison between the two methods of algorithm design Divide and Conquer and Greedy — 05

b. Define minimum-cost spanning trees with figure. — 02

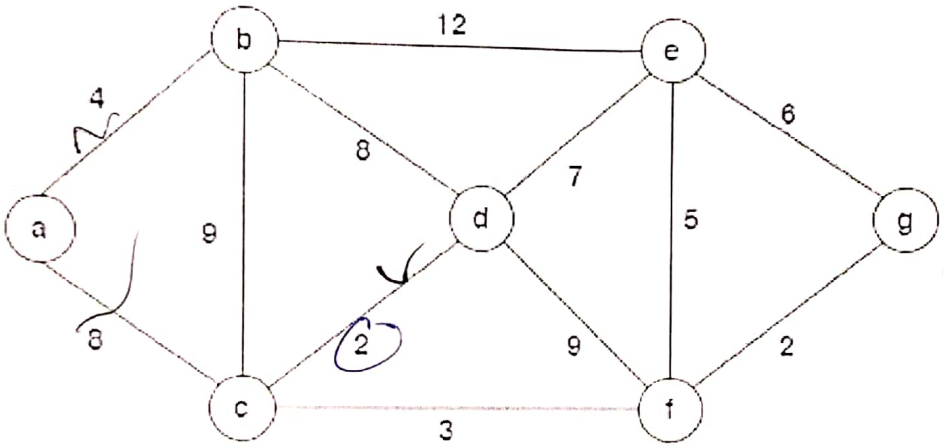
c. A thief enters a house for robbing it. He can carry a maximal weight of 60kg into his bag. There are 5 items in the house with the following weights and values. What items should thief take if he can even take the fraction of any item with him? — 05

Item	Weight	Value
1	5	30
2	10	40
3	15	45
4	22	77
5	25	90

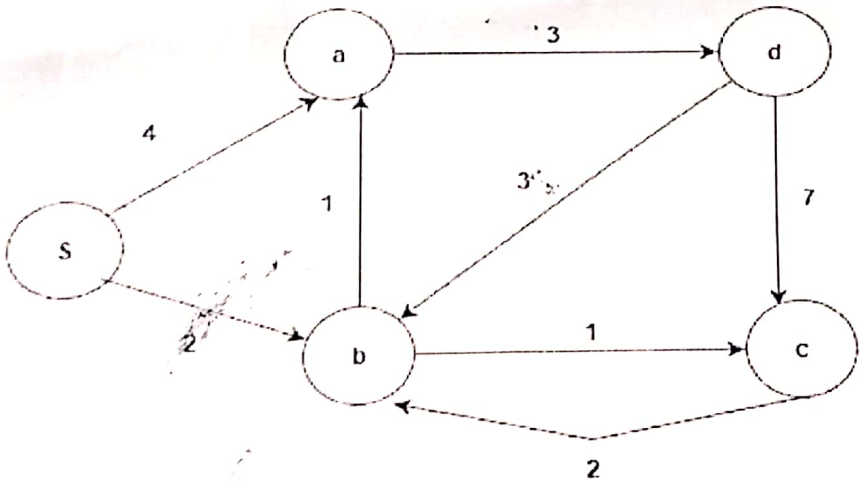
06. a. "A spanning tree is minimally connected and maximally acyclic." Illustrate the meaning of this statement. **03**

b. List the steps of Kruskal's algorithm required to find the minimum spanning tree of a graph. **04**

c. Apply Prim's algorithm on the following graph and find the minimum spanning tree of the graph: **05**

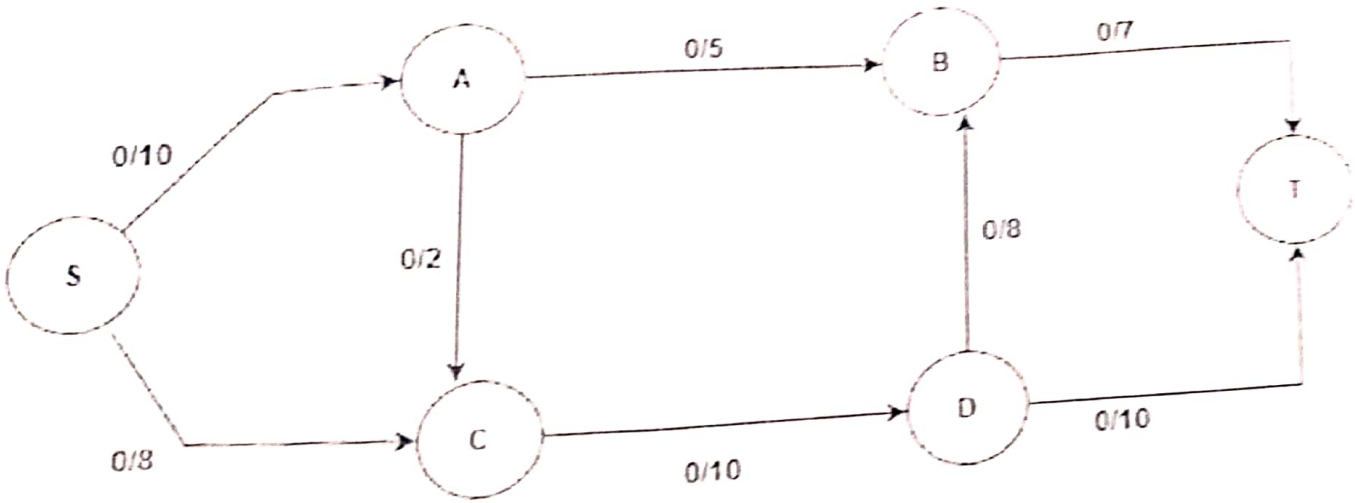


07. a. Define negative weight cycle. Consider the following graph and 'S' as the source vertex. Apply Bellman-Ford algorithm to find the shortest paths and their weights: **04**



b. What is a residual network? What are the necessary conditions of a flow network? **03**

c. What is an augmenting path? Determine the maximum flow from S to T of the following network using Ford-Fulkerson algorithm: **05**



08. a. Define Stack and Queue. Briefly explain the operation of stack with algorithm. 2+5=7

b. A Magic Square is an **n×n** matrix of the integers 1 to n^2 such that the sum of every row, column and diagonal is the same. Applying the magic square algorithm solve this problem for the case of n=7. 05