2023

COMPUTER SCIENCE — HONOURS

Paper : CC-9

(Introduction to Algorithms and its Applications)

Full Marks : 50

The figures in the margin indicate full marks.

*Candidates are required to give their answers in their own words
as far as practicable.*

Answer *question no.* 1 and *any four* questions from the rest.

1. Answer *any five* questions : 2×5

    (a) State true or false with proper justification $f(n) + g(n)$ will be always in O $(\min(f(n), g(n)))$.

    (b) Define time complexity and space complexity of an algorithm.

    (c) Define Big Theta (Θ) notation. What does it signify when we represent it as $f(n) = \Theta(g(n))$?

    (d) Briefly explain the strategy used in divide and conquer technique.

    (e) Arrange the following computing times according to most preferable choice for a large value of n.
        (i) $O(2^n)$, (ii) $O(n)$, (iii) $O(\log n)$, (iv) $O(1)$, (v) $O(n \log n)$.

    (f) Differentiate between dynamic programming and the greedy method.

    (g) What happens if P does not equal to NP?

    (h) State the principle of optimality in dynamic programming.

2. (a) Differentiate depth first search and breadth first search for any graph G.

    (b) Write down the breadth first search algorithm for a graph G.

   (c) What is the time complexity of breadth first search algorithm? $3+5+2$

3. (a) Specify the objective of Dijkstra's algorithm.

    (b) How is the efficiency of Dijkstra's algorithm calculated?

    (c) Using Dijkstra's algorithm, find the length of the shortest path of the following graph from the vertex a to vertex t. $2+2+6$

(2)
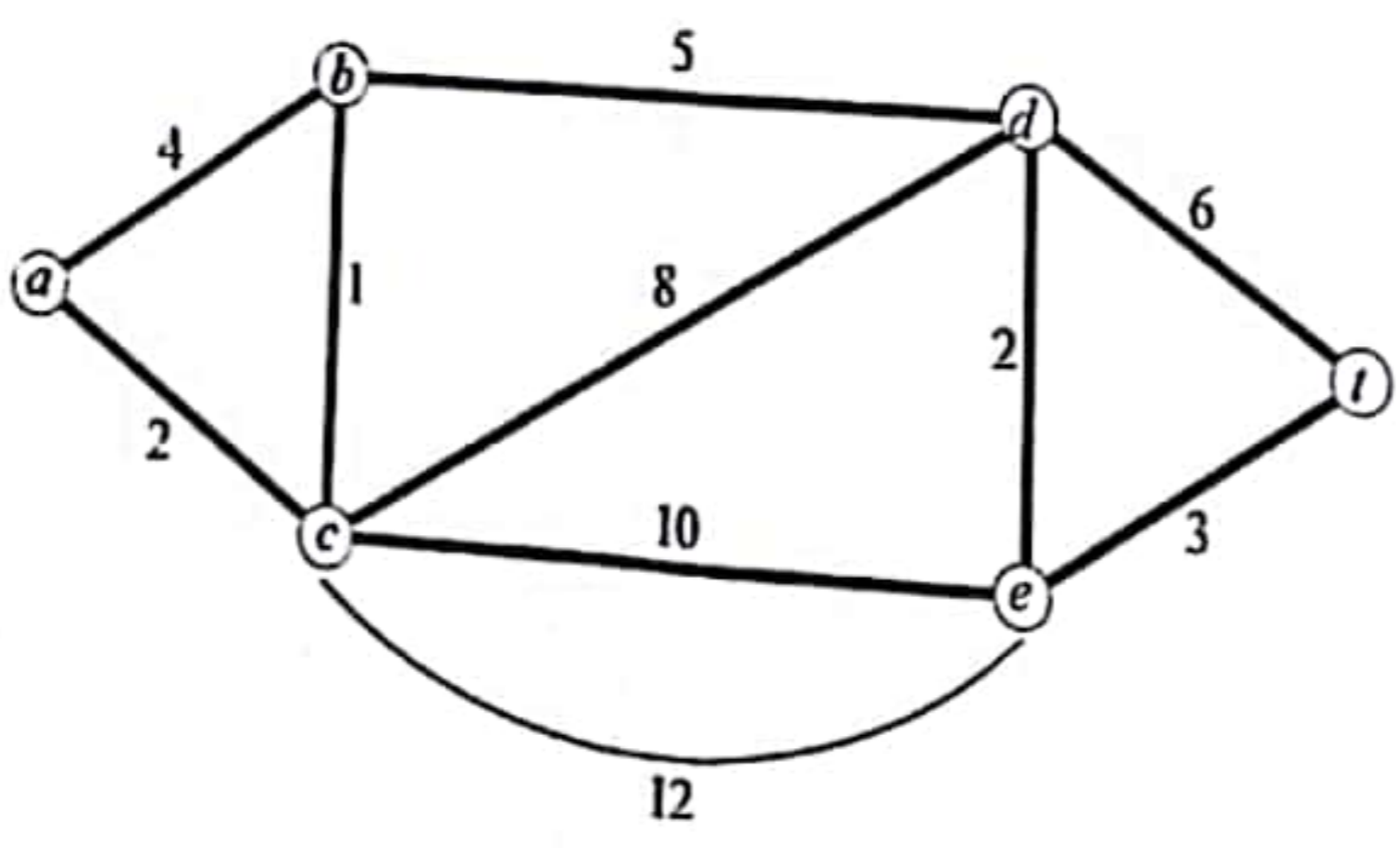
4. (a) What do you mean by minimum spanning tree of a connected graph?

(b) Use Kruskal's algorithm to find the minimum spanning tree of the following graph using Greedy approach. Show all the steps.
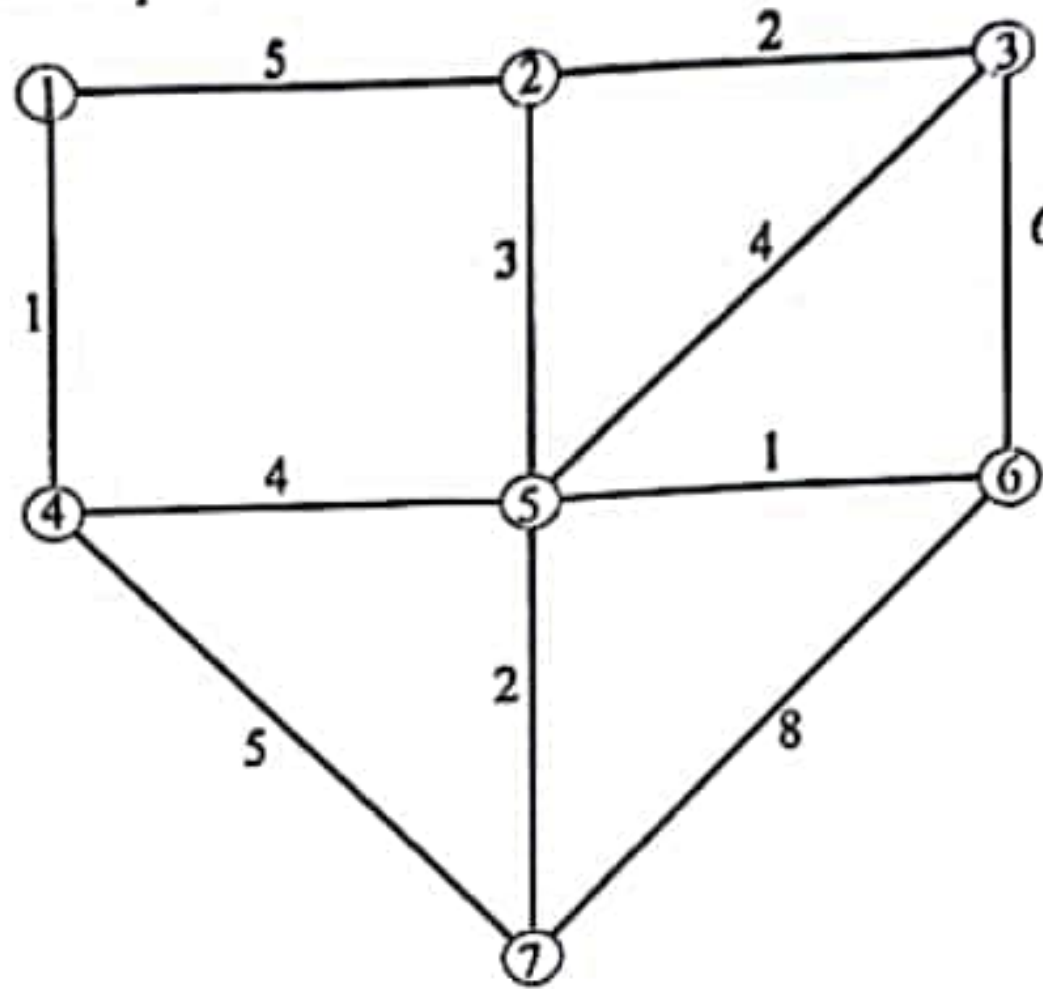
(c) Briefly, state the difference between Kruskal's algorithm and Prim's algorithm.   2+6+2

5. (a) What concept is imposed on 0–1 Knapsack and fractional Knapsack?

(b) Three objects having weights $w_1 = 4$, $w_2 = 5$ and $w_3 = 8$ units with profits $p_1 = 3$, $p_2 = 2$ and $p_3 = 5$ respectively are to be filled in a bag having a capacity of 10 units.

Frame the problem as 0–1 Knapsack problem and solve it using tabulation method.   3+7

6. (a) Which method can be used to solve the matrix chain multiplication problem? Discuss in brief.

(b) Show the steps to solve the following matrix chain multiplication problem :

$A_{30\times10}$ $B_{10\times5}$ $C_{5\times20}$ $D_{20\times25}$ $E_{25\times5}$.   (1+3)+6

7. (a) Briefly discuss about Travelling Salesman Problem (TSP).

(b) Solve the following Travelling Salesman Problem (TSP) using dynamic programming approach. There are four cities 1, 2, 3 and 4. Start from city 1 and visit all the cities. The cost matrix is given below :   4+6

$$
\begin{array}{c@{}c}
 & \begin{array}{cccc} 1 & 2 & 3 & 4 \end{array} \\
\begin{array}{c} 1 \\ 2 \\ 3 \\ 4 \end{array} &
\left(\begin{array}{cccc}
0 & 10 & 15 & 20 \\
5 & 0 & 9 & 10 \\
6 & 13 & 0 & 12 \\
8 & 8 & 9 & 0
\end{array}\right)
\end{array}
$$

8. (a) What do you understand by m-colourability problem?

(b) Describe the Floyd Warshall's algorithm with an example and analyze its efficiency.   3+7

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