Hall Ticket No | | | | | | | | | | Question Paper Code: ACSC22

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal-500043, Hyderabad

B.Tech V SEMESTER END EXAMINATIONS (REGULAR/ SUPPLEMENTARY) - FEBRUARY 2024

Regulation: UG20

COMPETITIVE PROGRAMMING USING GRAPH ALGORITHMS

Time: 3 Hours **(CSE | CSE (AI&ML) | CSE (DS) | CSE (CS) | CSIT | IT)** **Max Marks: 70**

Answer ALL questions in Module I and II
Answer ONE out of two questions in Modules III, IV and V
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

MODULE – I

1. (a) Elaborate the adjacency matrix in a graph. Explain how is it used to represent graph connectivity? [BL: Understand| CO: 1|Marks: 7]

   (b) Mention the basic conditions to be satisfied for two graphs to be isomorphic. Are the two graphs shown in Figure 1 are isomorphic? Justify with valid reasons [BL: Apply| CO: 1|Marks: 7]

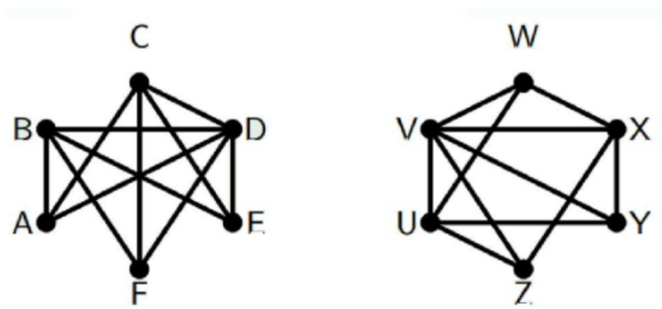

Figure 1

MODULE – II

2. (a) Outline the concept of cuts in graphs, including cut vertices and cut edges, with examples. [BL: Understand| CO: 2|Marks: 7]

   (b) Consider a weighted directed graph G with 4 vertices and the following adjacency matrix representing the graph: A= $\begin{bmatrix} 0 & 3 & \infty & 5 \\ \infty & 0 & 1 & \infty \\ \infty & \infty & 0 & 2 \\ \infty & \infty & \infty & 0 \end{bmatrix}$ Use the Floyd-Warshall algorithm to find the shortest paths between all pairs of vertices in the graph G. [BL: Apply| CO: 2|Marks: 7]

MODULE – III

3. (a) Compare and contrast Eulerian paths/cycles with Hamiltonian paths/cycles. [BL: Understand| CO: 3|Marks: 7]

(b) A traveling salesperson needs to visit 5 cities (A, B, C, D, E) and return to the starting city. The distances between the cities are given as follows:

A to B: 10 units

A to C: 15 units

A to D: 20 units

A to E: 25 units

B to C: 35 units

B to D: 30 units

B to E: 20 units

C to D: 25 units

C to E: 30 units

D to E: 15 units

Find the shortest possible route that visits each city exactly once and returns to the starting city using the nearest neighbor algorithm. [BL: Apply| CO: 3|Marks: 7]

4. (a) Explain how does the railway network connector problem apply to real-world scenarios. [BL: Understand| CO: 4|Marks: 7]

(b) Consider a connected undirected graph G with 6 vertices and the following set of edges:

E=(1,2),(1,3),(2,3),(2,4),(3,4),(3,5),(4,5),(4,6),(5,6)

Use Kruskal's algorithm to find the minimum spanning tree (MST) of the graph G. [BL: Apply| CO: 4|Marks: 7]

MODULE – IV

5. (a) Summarize about directed paths, tournaments, and cycles in directed graphs, emphasizing their characteristics. [BL: Understand| CO: 5|Marks: 7]

(b) Given a set of directed graphs, identify DAGs and propose algorithms for topological sorting to solve real-world problems like sentence ordering. [BL: Apply| CO: 5|Marks: 7].

6. (a) Describe in detail about connectivity and strongly connected digraphs. Distinguish between cyclic and acyclic graphs [BL: Understand| CO: 5|Marks: 7]

(b) Build a connected graph G and find two spanning trees T_1 and T_2 of G such that the distance (T_1, T_2)= 3. Find the branch set, chord set, rank and nullity of T_1. [BL: Apply| CO: 5|Marks: 7]

MODULE – V

7. (a) Discuss Euler's formula and Tutte's conjecture in the context of planar embeddings of trees and graphs. [BL: Understand| CO: 6|Marks: 7]

(b) Explore and present real-world applications of Kuratowski's Theorem, delving into how its principles can be employed to solve practical non-planarity challenges in different contexts. [BL: Apply| CO: 6|Marks: 7]

8. (a) Elaborate the detection of planarity in graphs, distinguishing between combinational and geometric graphs. [BL: Understand| CO: 6|Marks: 7]

(b) Analyze and justify why K_5 and $K_{3,3}$ cannot be drawn in a plane without edge crossings. [BL: Apply| CO: 6|Marks: 7]

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