UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
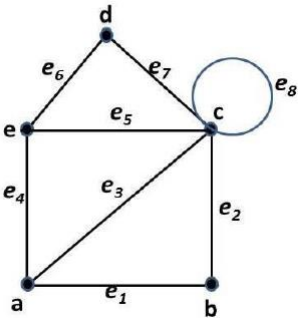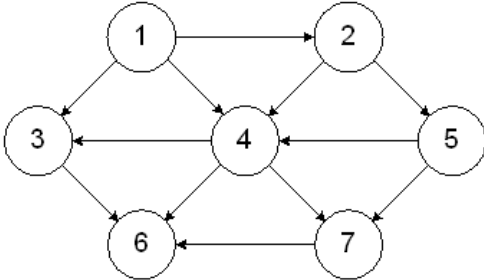**End Semester Examination, May 2023**
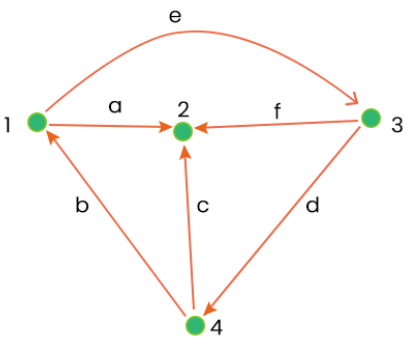
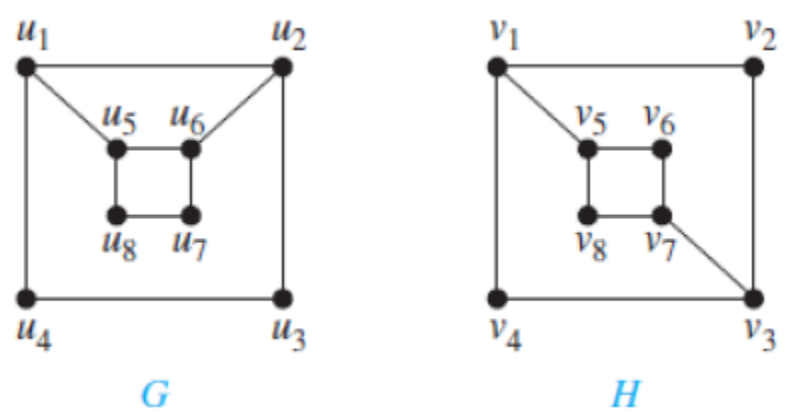Course: Graph Theory   Semester: IV
Program: B.Sc (Hons.) Mathematics & Int B.Sc-M.Sc Mathematics   Time: 03 hrs.
Course Code: MATH 2025K   Max. Marks: 100

Instructions: All questions are compulsory

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	Consider the following graph and give at least one example of each of the following, if possible. (a) A path from a to d. (b) A path from a to d that include all the edges. (c) A path from a to d that include all the vertices. (d) A circuit	4	CO1
Q 2	Briefly explain the concept of degree in a directed graph and find the in-degree and out-degree of the following directed graph.	4	CO1
Q 3	Determine the number of vertices for the following graphs. (a) If graph G is Regular graph with 15 edges. (b) If graph G has 10 edges with 2 vertices of degree 4 and all others of degree 3.	4	CO1
Q 4	Draw the following graphs (a) Cycle C_4 (b) Wheel W_5	4	CO1

	(c) Complete Bipartite graph $K_{3,4}$ (d) Complete graph K_6		
Q 5	In an undirected graph, prove that the number of odd degree vertices is even.	**4**	**CO3**

SECTION B
(4Qx10M= 40 Marks)

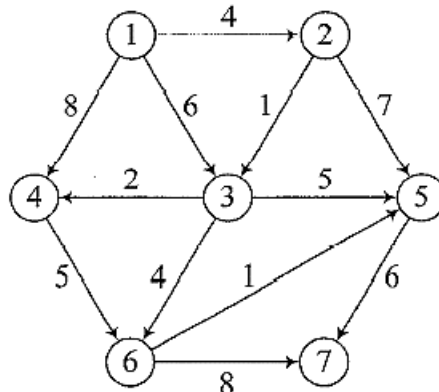|			
Q 6	(a) Draw the graph whose adjacency matrix is $A = \begin{pmatrix} 0 & 1 & 2 & 3 \\ 1 & 0 & 3 & 2 \\ 2 & 3 & 0 & 1 \\ 3 & 2 & 1 & 0 \end{pmatrix}$. (b) Find the incidence matrix of the following graph 	**10**	**CO1**
Q 7	Define Hamiltonian and Euler's graphs with relevant examples. Also, draw a connected graph with at least four vertices which is neither Eulerian nor Hamiltonian.	**10**	**CO2**
Q 8	Explain graph isomorphism and check whether the following graphs G and H are isomorphic or not. 	**10**	**CO1**
Q 9	Using Kruskal's algorithm, find the minimal spanning tree of the following graph.	**10**	**CO3**
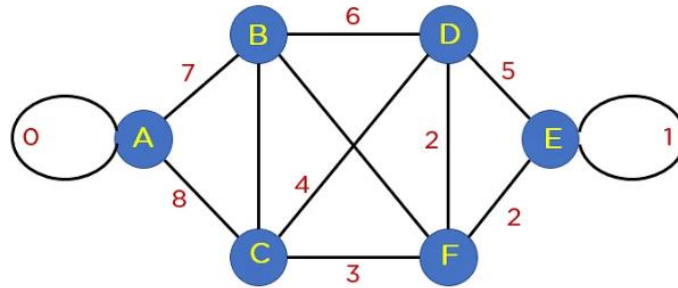
OR

Using Welch-Powell algorithm, determine the chromatic number of the following graph.
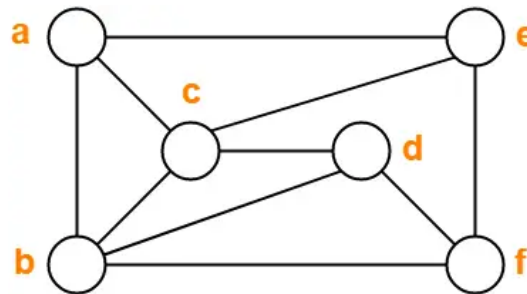
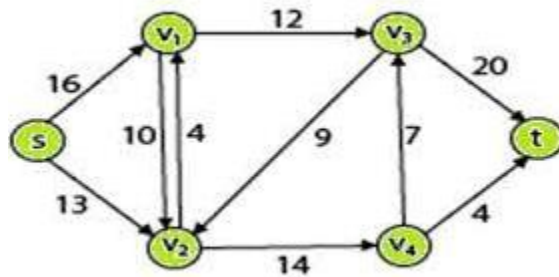| SECTION-C		
(2Qx20M=40 Marks)		
Q 10	Use Dijkstra's algorithm to find the shortest distance from vertex 1 to vertex 7 from the following network diagram. 	20	CO3
Q 11	Apply Ford-Fulkerson algorithm to find the maximum flow for the following network diagram	20	CO3

OR

(a) Using Floyd-Warshall algorithm, find the shortest distance between every pair of vertices from the following graph.
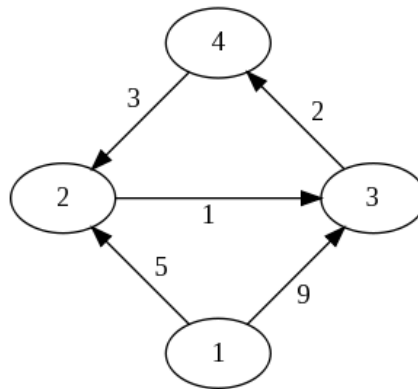
(b) Define Spanning tree and find the minimal spanning tree of the following graph using Prim's algorithm.