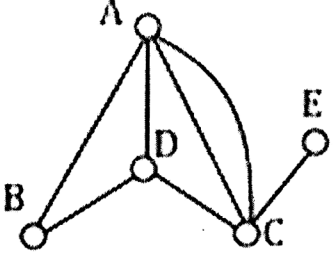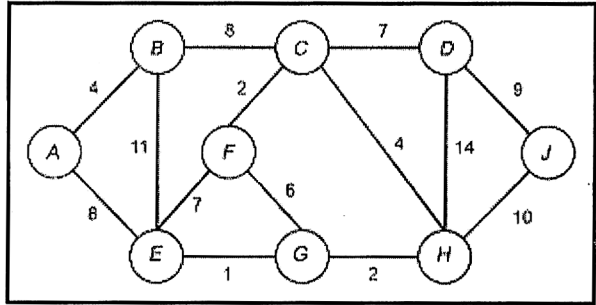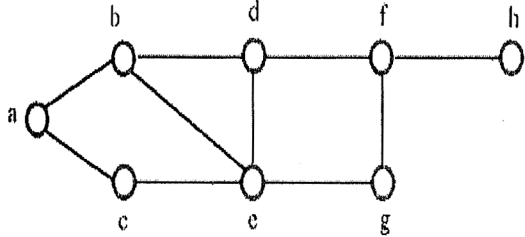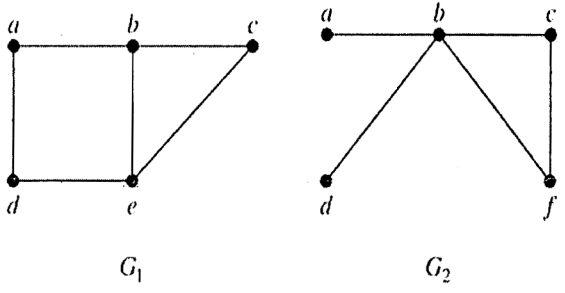**Bachelor Of Engineering In Information Technology**
2nd Year 2nd Semester, Semester Examination, 2023
Subject Name –Graph Theory & Combinatorics (IT/PC/B/T/224)

Full Marks=100

CO1 [10]	**Q1.** (i) Find the adjacency matrix of the graph given below. Find out the number of paths of length 2 from one vertex to others. (ii) Find out the maximum and minimum number of edges in a 3-component graph having 10 vertices. [5+5=10]
CO2 [20]	**Q2.** (i) Does a Hamiltonian path or circuit exist on the graph below (Figure: 1)? Justify it. (ii) Prove with a suitable example "Every tree has either one or two centers". (iii) Using Prim's algorithm find the minimal spanning tree of the graph given below (Figure: 2). Figure: 1 Figure: 2 [6+6+8=20]
CO3 [20]	**Q3.** (i) Does a cut point and cut edges exist of the graph given below (Figure: 3)? If yes then mention them. (ii) Find the union of the two graphs G_1 and G_2 given below (Figure: 4). (iii) Justify this using a suitable example "The vertex connectivity of any graph G can never exceed the edge connectivity of G". Figure: 3 Figure: 4 [7+7+6=20]
CO4 [20]	**Q4.** (i) "A graph is 2-colorable if it is bipartite and every cycle has an even length." Justify this with a suitable example. (ii) If a graph has 100 vertices and 300 edges, can it be planer? (iii) Find the chromatic number of the graph given below (Figure: 5). (Mention all steps properly)

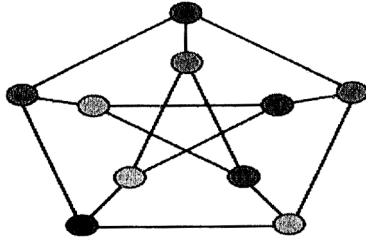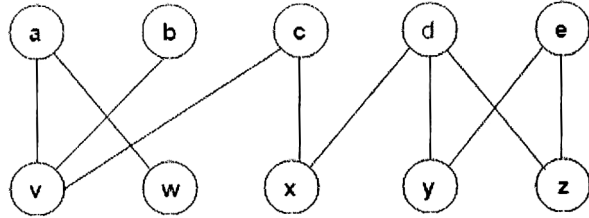|	
	(iv) Find out how many vertices can be matched using maximum matching in the bipartite graph algorithm of the following graph given below (Figure: 6)? Can we call it perfect matching? Justify this. Figure: 5 Figure: 6 [6+3+4+(4+3)=20]
CO5 [20]	**Q5.** (i) How many cards must be selected from a standard deck of 52 cards to guarantee that at least three **hearts** are selected?? (ii) How many ways are there for **eight men** and **five women** to stand in a line so that **no two women** stand next to each other? (iii) Suppose a club has 25 members. How many ways are there to choose a **president, vice-president, secretary,** and **treasurer** of the club, where no person can hold more than one office? [6+7+7=20]
CO6 [10]	**Q6.(i)** Find the generating functions of the following sequences given below in closed form . $$0, 1, -\frac{1}{2}, \frac{1}{3}, -\frac{1}{4}, \ldots$$ (ii) Using generating functions, find a_n in terms of n for the case given below: $$a_0 = 1, \ a_1 = 2 \text{ and } a_{n+2} = 5a_{n+1} - 4a_n \text{ for } n \geq 0$$ [5+5=10]

CO1: Explain and **discuss** the concept of different types of Graphs with fundamental properties and **express** different types of matrix representation. (K2)

CO2: Illustrate different types of trees such as (i) rooted tree (ii) spanning tree etc, and **explain** their properties. (K3)

CO3: Apply operations like Union, Deletion, and decomposition of graphs and **illustrate** Cut vertex and Cut edge and their properties. (K3)

CO4: Illustrate planar graph and their properties and Graph Coloring and Matching. (K3)

CO5: Apply and **evaluate** basic counting rules, pigeon-hole principle and principle of inclusion-exclusion. (K3)

CO6: Apply and **Solve** problems using Generating Function and Recurrence Relations. (K3)