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Reg No.:_______________ Name:_______________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S3 (Challenge Courses) Examination November 2025

Course Code: GAMAT401

Course Name: MATHEMATICS FOR INFORMATION SCIENCE - 4

Max. Marks: 60 Duration: 2 hours 30 minutes

PART A

(Answer all questions. Each question carries 3 marks)

		CO	Marks
1	Define complete graph and null graph with examples.	CO1	(3)
2	Prove that no simple graph has all its vertex degrees distinct.	CO1	(3)
3	State Dirac's theorem for Hamiltonian graphs. Why is it not a necessary condition for a simple graph to have a Hamiltonian circuit?	CO2	(3)
4	Define complete symmetric graph. Find the number of edges in a complete asymmetric graph and complete symmetric graph with 25 vertices.	CO2	(3)
5	A tree has five vertices of degree 2, three vertices of degree 3 and four vertices of degree 4. How many vertices of degree 1 does it have?	CO3	(3)
6	Find the minimum and maximum height of a binary tree with 255 vertices. Also, find the number of pendant vertices in the binary tree.	CO3	(3)
7	Write any three properties common to the two graphs of Kuratowski.	CO4	(3)
8	A connected planar graph has nine vertices having degrees 2, 2, 3, 3, 4, 4, 5, 5, and 6. (i) How many edges does the graph have? (ii) How many faces does it have?	CO4	(3)

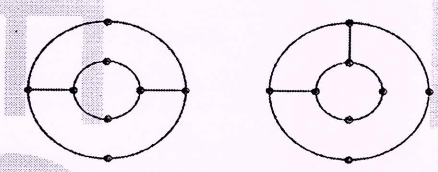
PART B

(Answer any one full question from each module, each question carries 9 marks)

Module -1

9 a) Draw a simple disconnected graph with 10 vertices, 4 components and maximum number of edges. CO1 (3)

b) Define isomorphism of graphs. Are the two graphs given below isomorphic? Why? CO1 (3)



c) State Konigsberg bridge problem? Is there any solution to the problem? Justify your answer. CO1 (3)

10 a) Does there exist a 5-regular graph with 9 vertices? Why? CO1 (3)

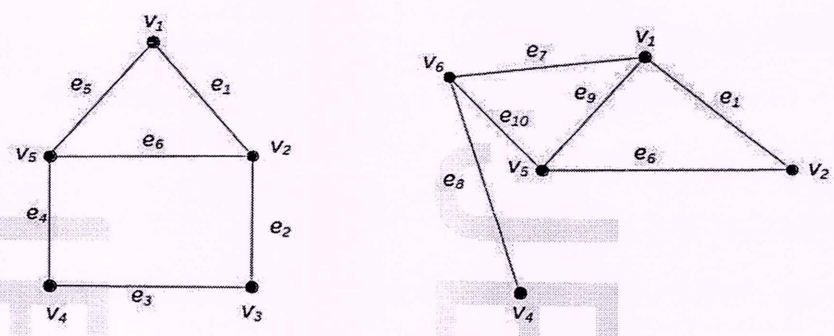
b) Prove that if a graph (connected or disconnected) has exactly two vertices of odd degree, then there must be a path joining these two vertices. CO1 (3)

c) Define edge-disjoint subgraphs and vertex-disjoint subgraphs of a graph, with examples. CO1 (3)

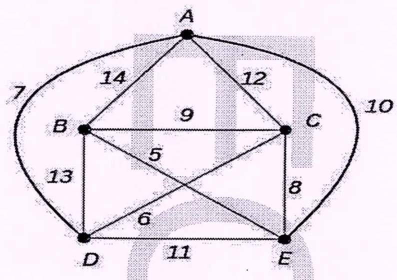
Module -2

11 a) Prove that a connected graph is an Euler graph if and only if it can be decomposed into circuits. CO2 (4)

b) Find the union, intersection and ring sum of two given graphs. CO2 (5)

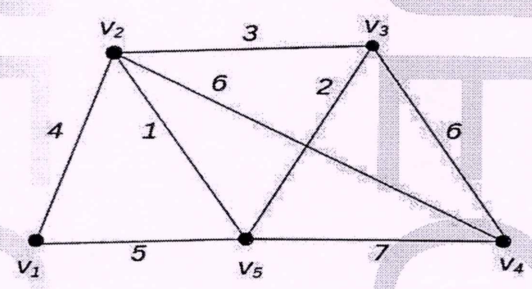


12	a)	In a complete graph of n vertices, prove that there are $\frac{n-1}{2}$ edge-disjoint Hamiltonian circuits, if n is an odd number ≥ 3.	CO2	(4)
	b)	State the Travelling Salesman Problem. Print a Travelling Salesman tour on the graph given below, starting from the node E.	CO2	(5)



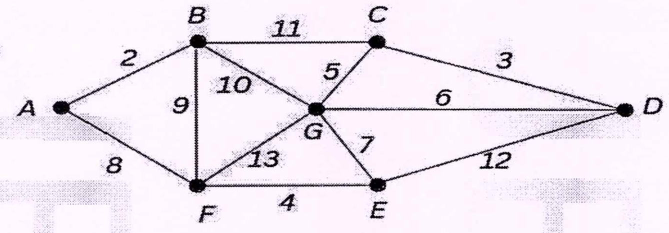
Module -3

13	a)	Prove that a graph is a tree if and only if it is minimally connected.	CO3	(4)
	b)	Using Prim's algorithm to find a minimum spanning tree for the given weighted graph.	CO3	(5)



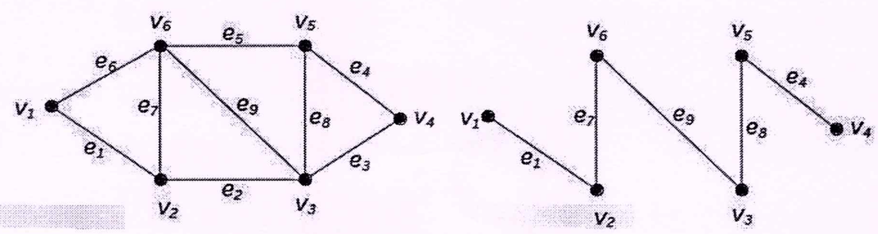
14	a)	Prove that the distance between the vertices of a connected graph is a metric.	CO3	(4)

b) Apply Dijkstra's algorithm to find the shortest path between node A and node D in the graph below. CO3 (5)



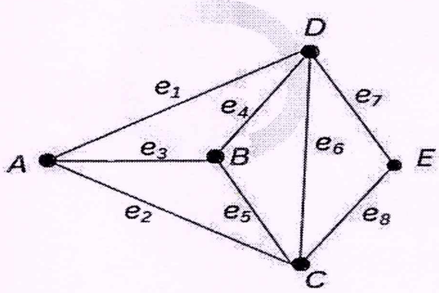
Module -4

15 a) Define fundamental cutset and fundamental circuit of a graph. Write any two fundamental cutsets and any two fundamental circuits of the graph shown below, with respect to the given spanning tree. CO4 (5)



b) Prove that the rank of the incidence matrix of a graph with n vertices is $n-1$. CO4 (4)

16 a) Find the incidence matrix and adjacency matrix of the following graph. CO4 (5)



b) Prove that every cut-set in a connected graph G must contain at least one branch of every spanning tree of G. CO4 (4)

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