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Pages: 3

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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S4 (S, FE) / S2 (PT) (S,FE) Examination December 2024 (2019 Scheme)

Course Code: MAT 206

Course Name: GRAPH THEORY

Max. Marks: 100 Duration: 3 Hours

PART A

(Answer all questions; each question carries 3 marks) Marks

1 Draw a simple graph each of two, three and five vertices. 3

2 Define walk, path and circuit in a graph. 3

3 Define Hamiltonian circuit and Hamiltonian path. Draw a graph that has a Hamiltonian path, but does not have a Hamiltonian circuit. 3

4 Define Complete symmetric digraphs and complete asymmetric digraphs with example for each.

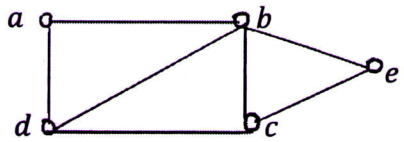
5 Prove that any connected graph with n vertices and (n-1) edges is a tree. 3

6 Define spanning tree. Give an example. 3

7 What is a fundamental cut-set ? Illustrate with an example 3

8 Distinguish between separable and non-separable graphs. 3

9 Define adjacency matrix. Write the adjacency matrix of the given graph.



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10 Define chromatic number of a graph with an example. 3

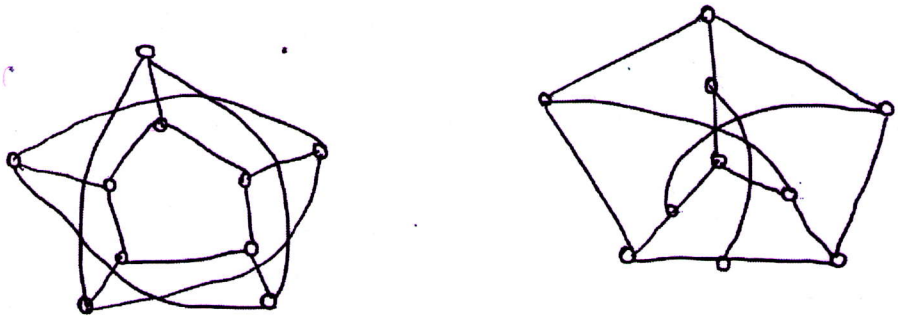
PART B

(Answer one full question from each module, each question carries 14 marks)

Module -1

11 a) Prove that the number of vertices of odd degree in a graph is always even. 7

b) Determine whether the following graphs are isomorphic. Justify your answer. 7



12 a) Prove that for any simple graph with at least two vertices has two vertices of same degree. 7

b) Prove that a graph G is disconnected if and only if its vertex set V can be partitioned into two non-empty disjoint subsets V_1 and V_2 such that there exists no edge in G whose one end vertex is in subset V_1 and other in subset V_2. 7

Module -2

13 a) Show that in a complete graph with n vertices there are $\frac{n-1}{2}$ edge disjoint Hamiltonian circuits if n is an odd number ≥ 3. 7

b) Draw equivalence graph for the binary relation " is congruent to modulo 3" defined on $\{10,11,12,\ldots 20\}$ 7

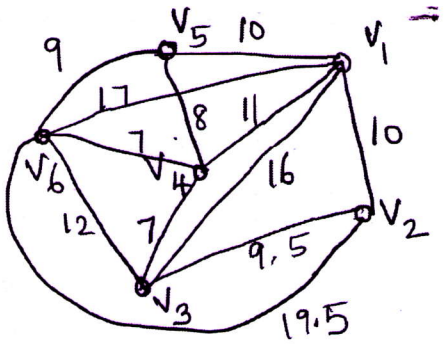
14 a) Explain the operations union, intersection and ring sum on graph with an example 7

b) Distinguish between strongly connected and weakly connected digraphs with examples 7

Module -3

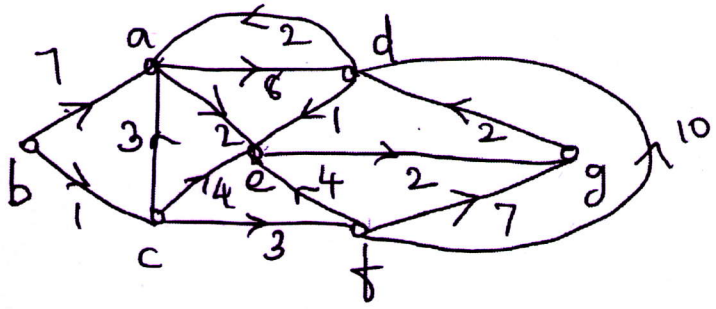
15 a) Prove that the height of a binary tree with n vertices is $\frac{n-1}{2}$ 7

b) Using Kruskal's algorithm to find the minimal spanning tree for the graph given below. What is the weight of this tree? 7



16 a) Prove that a graph with n vertices, (n-1) edges and no circuits is connected. 7

b) Use Dijkstra's algorithm to find the shortest path between the vertices a and g 7



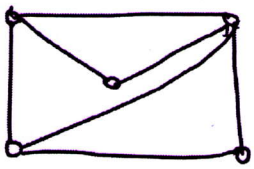
Module -4

17 a) Prove that every circuit has an even number of edges in common with any cut-set 7

b) Prove that the complete graph on five vertices is non-planar 7

18 a) Prove that with respect to a given spanning tree, a branch that determines a fundamental cut-set S is contained in every fundamental circuit associated with the chord in S, and in no others. 7

b) Draw the geometric dual of the graph below. 7

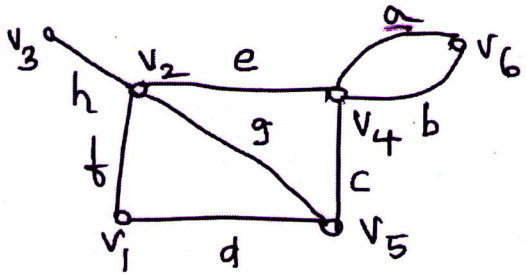


Module -5

19 a) Prove that the rank of an incidence matrix of a connected graph with n vertices is (n-1) 7

b) Prove that an n vertex graph is a tree if and only if its chromatic polynomial is $\lambda(\lambda-1)^{n-1}$ 7

20 a) Write the circuit matrix and path matrix between v_3 and v_4 for the following graph. 7



b) Define matching and covering in a graph. Give a detailed example for these. 7

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