



COMSATS University Islamabad
Department of Computer Science
Terminal Examination – Spring 2024

Class: (BS) CS

Course Code & Title: CSC307 Graph Theory

Time Allowed: 3 Hours

Instructors: Dr. Malik A. Kamran

Semester: 4th

Date: 03-06-2024

Max Marks: 50

Name: Abdullah

Registration # FA22-BCS-005

Instructions

- Use black or blue ball-pen only. Markers/lead pencils are not allowed.
- All questions are self-explanatory and require no further explanations during exam time.
- Attempt all questions.

Question 1

CLO-1

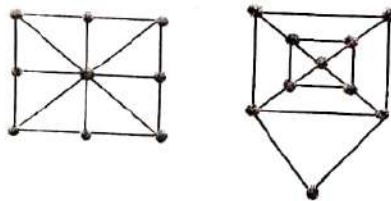
Marks [3+1+1+3+1+4+1+1]

CLO1: Illustrate the basic terminology of graph theory including properties and special cases for each type of graph, trees, and forest.

1. Find and draw the intersection graph of the sets $\{1, 2, 5, 6\}$, $\{1, 7, 9\}$, $\{2, 3, 7, 8\}$, $\{3, 5, 10\}$, $\{4, 6, 8\}$, $\{5, 6, 9, 10\}$.
2. A map has different countries, some of which share borders. The countries are colored with different colors.
 - (i) How can you model this situation using graph theory? Are the edges directed or multiple?
 - (ii) What is a natural question to ask regarding the coloring of the regions?
3. How many vertices a graph contains if it has 12 edges, 3 vertices of degree 2 and other vertices of degree 3.
4. Finding center is considered more useful in trees than in a graph, why? Compare eccentricity and induction methods of finding center in a tree of at least 7 nodes.
5. What is a spanning tree? Find number of spanning trees in K_5 .

Question 2**CLO-2****Marks [2+2+2+2+2]****CLO2: Interpret basic results related with Eulerian and Hamiltonian graphs.**

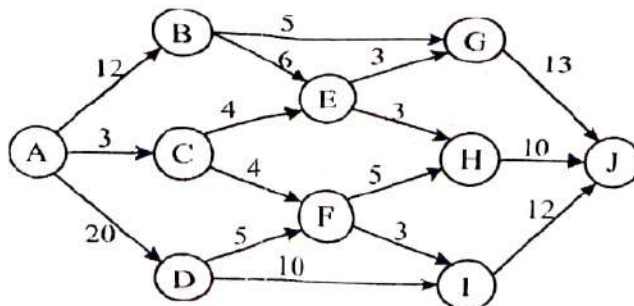
1. Describe sufficient criteria for finding Hamiltonian path/circuit with examples.
2. Degree of the vertices can indicate existence of Eulerian walk and Eulerian circuit. Prove with example graphs.
3. Find Hamiltonian and/or Eulerian path/circuit, if exists, in the following graphs.



4. Finding Hamiltonian circuit is more challenging than Eulerian, why?

Question 3**CLO-3****Marks [5+4+2+2]****CLO3: Apply network flow algorithms to solve graph connectivity problems.**

1. Calculate all possible changes in the number of components by removing a vertex or edge in the following types of graphs:
 - a. P_n
 - b. C_n
 - c. K_n
 - d. E_n
 - e. Disconnected graph
2. Capacity is shown on the following network. Find maximum flow in the following network using Ford-Fulkerson algorithm.

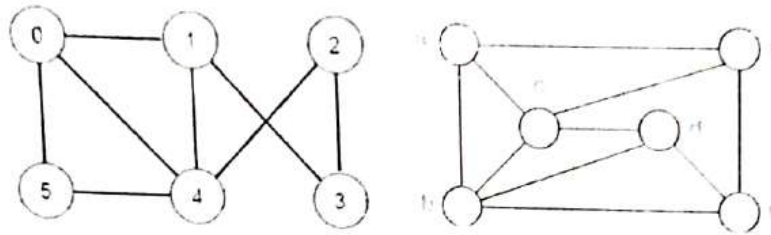


3. Find the types of graphs that exhibit 2-coloring as well as perfect matching?
4. Draw the following bipartite graph B and provide a real-life example for this graph:
 $B=(G, X, Y)$, $G=\{1,2,3,4,5\}$, $X=\{1,2,3\}$, $Y=\{4,5\}$

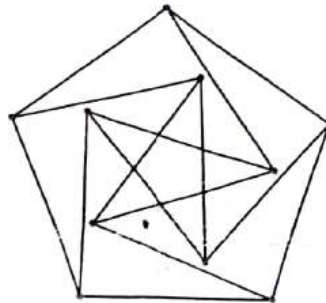
Question 4**CLO-4****Marks [2+3+3+2+2]**

CLO4: Solve a variety of real-world problems in computer science using appropriate forms of graphs.

1. Prove with example that each vertex cover is always a dominating set but not vice versa.
2. Show dominating set, max matching, and min vertex cover in the following graphs:



3. Determine the edge cover, edge coloring, and independence set in the following graph.



4. Draw a Latin square of 3x3 using its formula. Convert it to a doubly Stochastic matrix.
5. How many permutation matrices of size n exist?