

Indian Institute of Engineering Science and Technology, Shibpur
B.Tech. - M.Tech. Dual Degree 5th Semester Examinations, December, 2021
Graph Algorithms (CS 3104)

Full Marks: 70

Time: 90 minutes

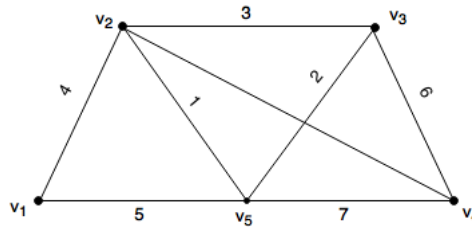
*Answer Question No. 1 and any four from the remaining.
Do all parts of a question together. Do not mix up answers to parts of different questions in the answer script.*

1. Define the following terms.

- (a) Hamiltonian Path.
- (b) Graph Density.

[3 + 3 = 6]

2. (a) Using Prim's algorithm, find a minimal spanning tree for the weighted graph shown below.



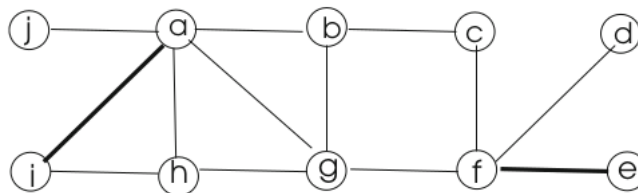
- (b) Prove that the chromatic number of a graph will not exceed by more than one the maximum degree of the vertices in a graph.

[7 + 9 = 16]

3. (a) Define vertex colouring of a graph G and show that every planar graph is 5-vertex colourable.
(b) Given a directed graph $G = (V, E)$. Describe a fast algorithm to compute the connected components in a graph G .

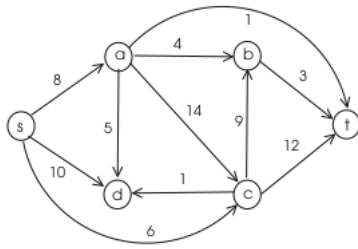
[7 + 9 = 16]

4. (a) Prove that in a bipartite graph, the number of edges in a maximum matching is equal to the number of vertices in a minimum covering.
(b) Consider the graph shown below with initial matching shown in bold, find augmenting paths iteratively to obtain a maximum matching for this graph.



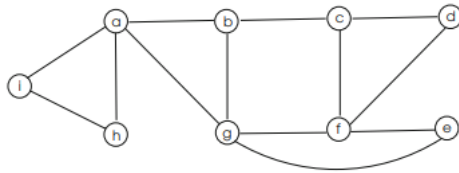
[7 + 9 = 16]

5. (a) Find the maximum flow in the network shown below using the Ford–Fulkerson algorithm by showing all iterations of the algorithm.

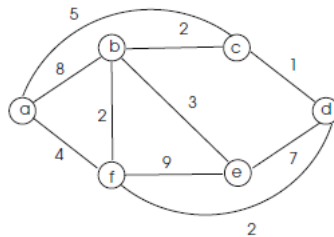


[16]

6. (a) Find the clustering coefficient for each vertex in the graph shown below and also work out the average clustering coefficient.



- (b) Compute the vertex betweenness values for each vertex for the graph as shown below. Find two influential nodes in this graph using these measures.



[8 + 8 = 16]