

End Semester Examination (Monsoon 2022-2023)
Department of Computer Science & Engineering, IIT (ISM), Dhanbad

Discipline: M.Tech. (CSE) & Research Scholar

Subject: Algorithmic Graph Theory (CSC503)

Time: 3 hours, **Marks:** 100

Instruction: Answer all questions

Q. No		Marks
1.a	Why running time measurement is important to study? Mention some of the factors affecting the running time of a program.	(2+3)
b.	Deduce the Satisfiability problem in Clique decision problem or vice versa.	5
2.a	Prove that every graph G with maximum degree r is an induced subgraph of an r -regular graph.	4
b.	Write the O , Ω and θ notation for the function a) $n^2 \log n + n$ and b) $n!$.	(3+3)
3.a	Calculate the maximum flow for the following graph from source to sink node.	5
b.	Illustrate Kruskal's algorithm with a suitable example describing all steps to find the minimal spanning tree.	5
4.a	Given a graph and a source vertex in the graph, find the shortest paths from the source vertex (A) to all other vertices in the above graph using Dijkstra's shortest Path Algorithm.	5
b.	Illustrate the situation when Dijkstra's Algorithm may fail to find the shortest path but Bellman-Ford Algorithm may succeed. And also mention the situation when Bellman-Ford Algorithm may fail (illustrate with an example).	5

5.a	Find the all pairs shortest paths among all vertices for the graph (of Q. No. 4) using Floyd-Warshall Algorithm (showing all intermediate steps).	5
b.	Describe Floyd-Warshall Algorithm to find the shortest paths among all vertices.	5
6.a	Prove that Peterson Graph is non-planar using Kuratowski's Theorem.	4
b.	Prove that Peterson Graph is non-planar using Wagner's Theorem.	4
c.	Prove that every planar graph has a dual. ✓	2
7.a	For a planar graph G with n number of vertices and e number of edges with r regions, prove by method of induction that $n - e + r = 2$.	5
b.	The in-order and pre-order tree traversal of a given tree T is given by: In-order: D B H E I A F C J G K Pre-order: A B D E H I C F G J K Find the Prufer Sequence S of T (mentioning all steps).	5
8.a	If a graph G is maximal planar graph with n vertices ($n \geq 3$) and m edges then show that $m = 3n - 6$.	4
b.	Describe a method for finding a minimum connected dominating set and also, illustrate the same with suitable example.	3 + 3
9.a	The Prufer sequence of a tree T is given by: Prufer sequence: 1 7 6 6 1 Construct the tree T showing all steps for the same.	(2+3)
b.	Illustrate Prim's algorithm with an example.	5
10.a	Write algorithm for DFS & BFS.	5
b.	Trace DFS and BFS algorithm for the following graph.	5

