Strathmore
UNIVERSITY

STRATHMORE INSTITUTE OF MATHEMATICAL SCIENCES (SIMS)
MASTER OF SCIENCE IN DATA SCIENCE AND ANALYTICS
CAT 2
DSA 8205: OPTIMIZATION FOR DATA SCIENCE

DATE: 27th January, 2025 **TIME**: 1 Hour (6pm-7pm)

INSTRUCTIONS

1. Answer **ALL** the **QUESTION**.
2. You may use a **SIMPLE CALCULATOR**. No **MOBILE PHONES** in the exams room.

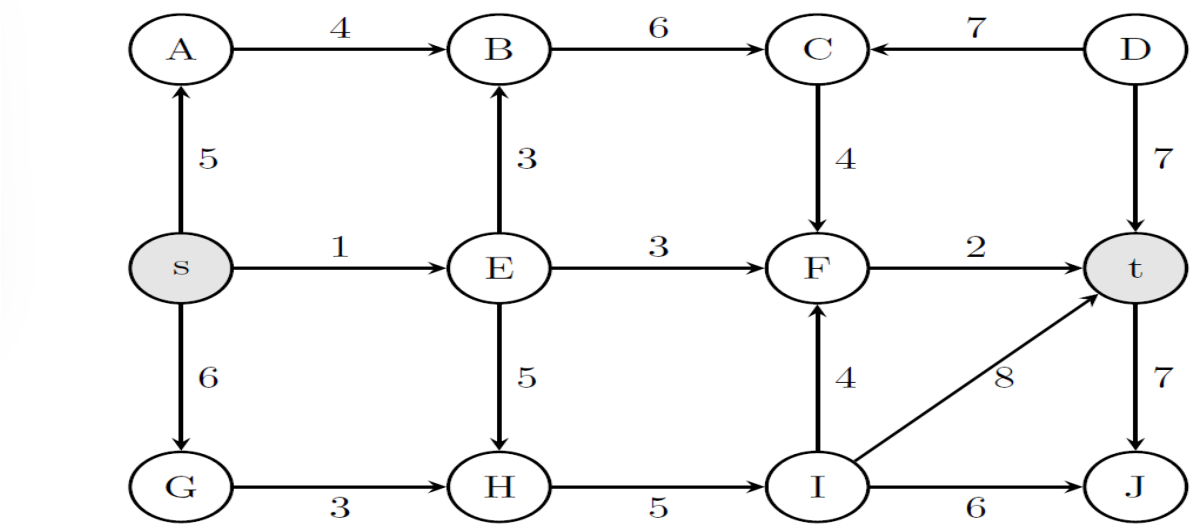
Question One (10 Marks)

(i) State the Ford-Fulkerson theorem for network flows. Explain how the network flow algorithm may be used to prove it for integer capacities. Indicate what problem you may encounter if you allowed non-integer flows and capacities, and what theorem in analysis makes the Ford-Fulkerson theorem still valid. (5 marks)

(ii) Explain how the question of finding a maximum size matching and a minimum size edge cover in a bipartite graph may be translated into the question of finding a maximum flow and a minimum cut in a network flow. Prove that the maximum size of a matching is the same as the minimum size of a cover in a bipartite graph. (5 marks)

Question Two (10 Marks)

(i) Consider the network N below with capacities on the edges.



Give a maximum ow from s to t in the network N (write the ow for each edge along the edges on the graph below), give the value of the ow, and give a minimum $s-t$ cut (give the partition of the vertices). (5 marks)

(ii) Use Edmonds-Karp's algorithm to compute a maximum ow in the network N. For each augmenting path write the nodes on the path and the value you augment the path with in a table. (5 marks)

END