Reg. No ..... Name 26P274

M. Sc. DEGREE END SEMESTER EXAMINATION - APRIL 2026

SEMESTER 2 - COMPUTER SCIENCE (ARTIFICIAL INTELLIGENCE)

COURSE : 24P2CAIT06 - GRAPH THEORY AND NETWORK ANALYSIS

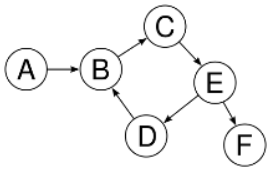
(For Regular 2025 Admission and Improvement/Supplementary 2024 Admission)

Time : 3 hours **Max. Weightage: 30**

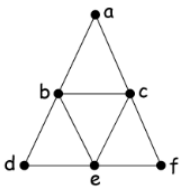
PART A

Answer any 8 questions **Weight: 1**

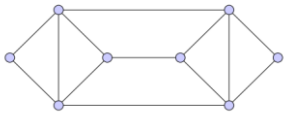
1. Construct the incidence matrix of the following graph: (U, CO1)



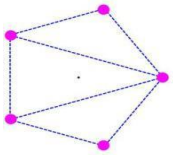
2. Draw the graph K_5 and determine the degree of each vertex. (U, CO1)
3. Differentiate between perfect and maximum matching in bipartite graphs with suitable examples. (An, CO2)
4. Determine whether the given graph contains an Euler circuit and justify your answer. (An, CO2)



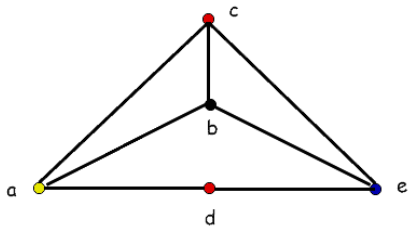
5. Deduce the chromatic polynomial for a complete graph with 6 vertices and explain the process. (An, CO3)
6. Determine the chromatic number of the following graph. (A, CO3)



7. Construct the dual of the given planar graph: (A, CO4)



8. Verify Euler's formula for the given planar graph. (A, CO4)



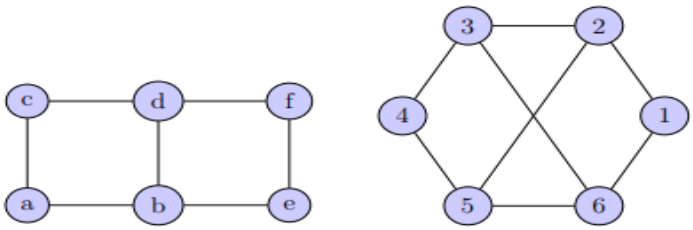
9. Distinguish between a directed path and a directed cycle with appropriate examples. (An, CO5)
10. Examine the concept of job sequencing problem in the context of directed graphs. (An, CO5)

(1 x 8 = 8)

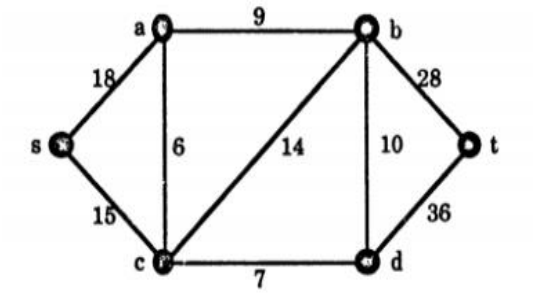
PART B

Answer any 6 questions. **Weights: 2**

11. Discuss isomorphism. Determine whether the following pair of graphs are isomorphic. (U, CO1)

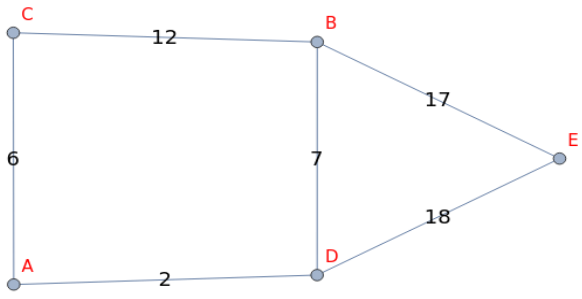


12. State Dijkstra's Algorithm. Apply the algorithm to the given weighted graph and find the shortest path and its length from vertex s to vertex t. (A, CO1)



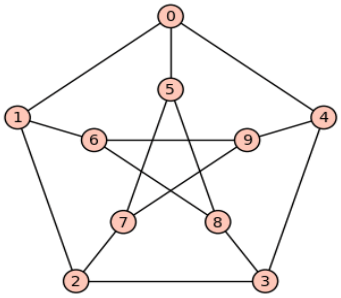
13. Examine the application of graph theory in constructing reliable communication networks. (An, CO2)

14. A postal worker must deliver mail in a neighbourhood represented by the following graph. Illustrate an optimal delivery route such that the distance travelled can be minimized. (Start from any vertex.) (An, CO2)

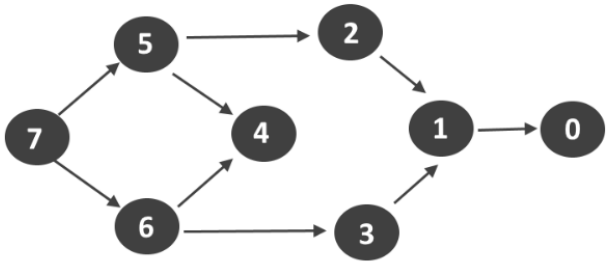


15. Draw the graphs C_7, C_8, K_5 and $K_{3,3}$. Apply proper vertex coloring and determine their chromatic numbers. (A, CO3)

16. Explain the algorithm for planarity detection. Using planarity detection algorithm determine whether the given graph is planar or not. (A, CO4)



17. Illustrate topological sorting on the given directed graph: (An, CO5)



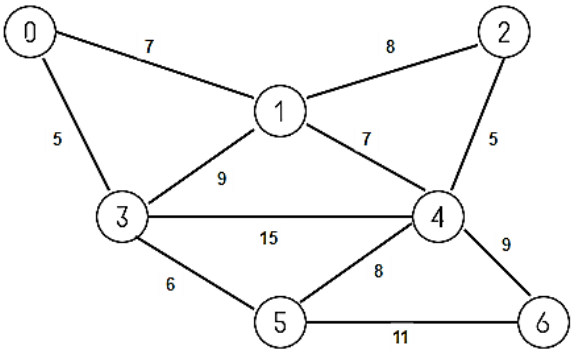
18. Relate the steps involved in designing an efficient computer drum to directed graph concepts. (An, CO5)

(2 x 6 = 12)

Part C

Answer any 2 questions. **Weights: 5**

19. A company plans to build a railway network connecting 7 cities. The given graph shows the cost (in millions) of building a railway line between pairs of cities. Using an appropriate algorithm, trace a minimum-cost railway network. (U, CO1)

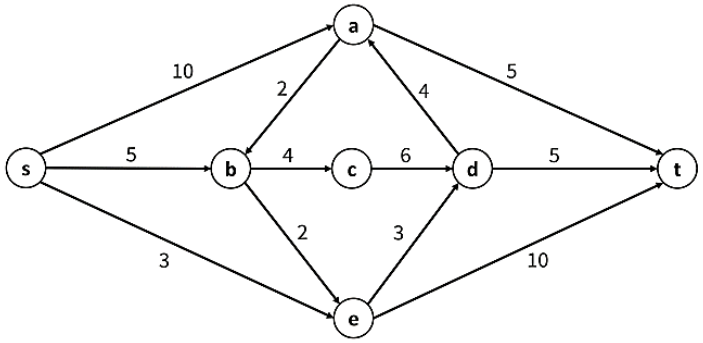


20. There are four jobs A, B, C and D that need to be assigned to four machines I, II, III and IV. The processing cost for each job machine combination is given in the matrix below. Determine the optimal job allocation that minimizes the overall processing cost. (A, CO2)

		machines			
		I	II	III	IV
jobs	*A*	10	12	19	11
	B	5	10	7	8
	C	12	14	13	11
	D	8	15	11	9

21. Suppose we have 5 tasks (T1, T2, T3, T4, T5) that need to access shared data. The following pairs of tasks cannot run simultaneously due to shared resources: ***(T1, T2), (T1, T3), (T2, T4), (T3, T4), (T3, T5)***. Construct a conflict graph and determine the minimum number of memory blocks required to avoid data overlap. (A, CO3)

22. Using Ford-Fulkerson, find the maximum s − t flow in the graph G below, the corresponding residual graph, and list out the corresponding minimum cut. (A, CO5)



(5 x 2 = 10)

OBE: Questions to Course Outcome Mapping

CO	Course Outcome Description	CL	Questions	Total Wt.
CO1	Understand the fundamental concepts of graphs, subgraphs, and trees, and their applications in shortest path and network connectivity problems.	U	1,2,11,12,19	11
CO2	Analyze connectivity properties, matching, Eulerian and Hamiltonian graphs, and their role in solving optimization problems.	An	3,4,13,14,20	11
CO3	Determine independent sets, cliques, and chromatic numbers in graphs.	A	5,6,15,21	9
CO4	Interpret the properties of planar graphs using Euler's formula and Kuratowski's theorem.	A	7,8,16	4
CO5	Design efficient solutions for applications involving directed graphs and networks.	An	9,10,17,18,22	11

Cognitive Level (CL): Cr - CREATE; E - EVALUATE; An - ANALYZE; A - APPLY; U - UNDERSTAND; R - REMEMBER;