25P2070

Reg. No …… Name ……

M. Sc. DEGREE END SEMESTER EXAMINATION - APRIL 2025

SEMESTER 2 - COMPUTER SCIENCE (ARTIFICIAL INTELLIGENCE)

COURSE: 24P2CAIT10: GRAPH THEORY AND NETWORK ANALYSIS

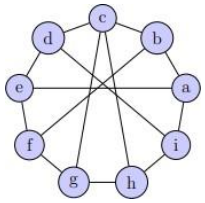
(For Regular 2024 Admission)

Time: Three Hours Max. Weightage: 30

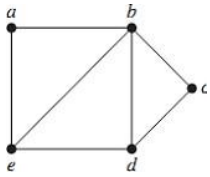
PART A **Weight:1**

Answer any 8 Questions

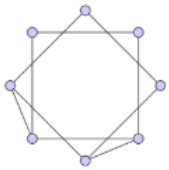
1. Find the degree of each vertex in the following graph: (U, CO1)



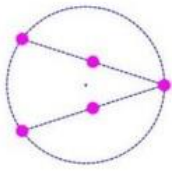
2. Define : (i) Simple graph (ii) Finite and infinite graph (iii) Isolated vertex (iv) Subgraph (U, CO1)
3. Determine whether the following graph has a Hamiltonian circuit. If it has, trace the circuit. (An, CO2)



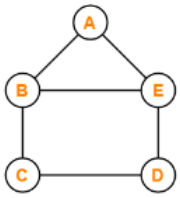
4. Contrast vertex cover and edge cover with appropriate illustrations. (An, CO2)
5. Differentiate between an independent set and a clique. (A, CO3)
6. Determine the vertex chromatic number for the following graph. (A, CO3)



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



8. Verify Euler's formula for the planar graph given below:



9. Outline the Max-Flow Min-Cut Theorem with a suitable example. (An, CO5)

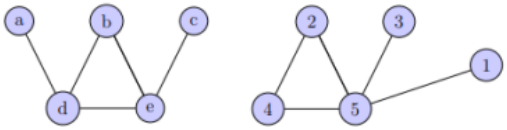
10. Illustrate the process of ranking participants in a tournament using the concept of directed graphs. (An, CO5)

(1x8=8)

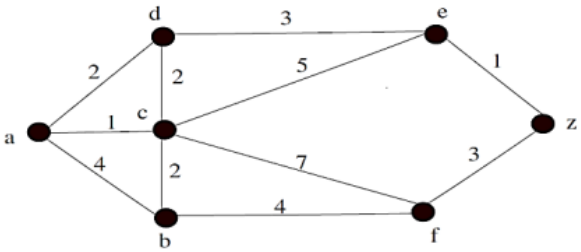
PART B

Answer any 6 questions **Weights: 2**

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



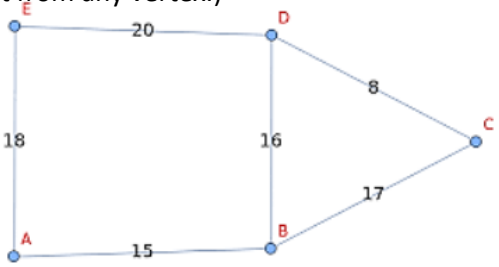
12. State Dijkstra's Algorithm. Apply this algorithm to the given weighted graph and find the shortest path and its length from vertex a to vertex z. (U, CO1)



13. A salesman must visit four cities: A, B, C, D. The distance between the cities are given below. The salesman starts at city A, visits each city exactly once and returns to A. Deduce the shortest possible route that satisfies this condition. (An, CO2)

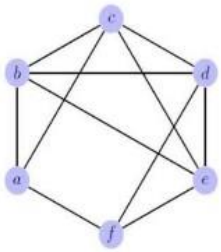
From → To	A	B	C	D
A	0	7	13	17
B	7	0	20	10
C	13	20	0	5
D	17	10	5	0

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



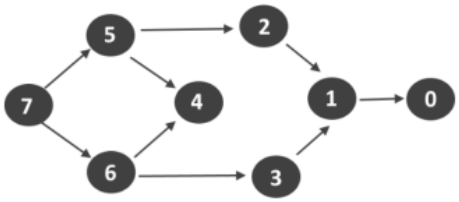
15. Draw the graphs C7, C8, K5 and K 3,3. Apply proper vertex coloring and determine their chromatic numbers. (A, CO3)

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



17. Relate the job sequencing problem in the context of directed graphs to real world scenarios. (An, CO5)

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

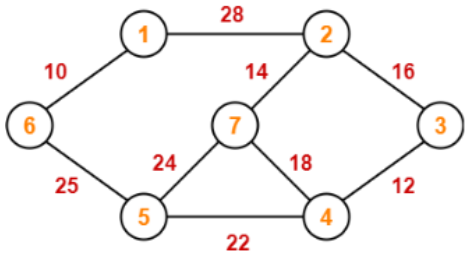


(2 x 6 = 12)

PART C

Answer any 2 questions **Weights:5**

19. A company plans to build a railway network connecting 7 cities. The following 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)

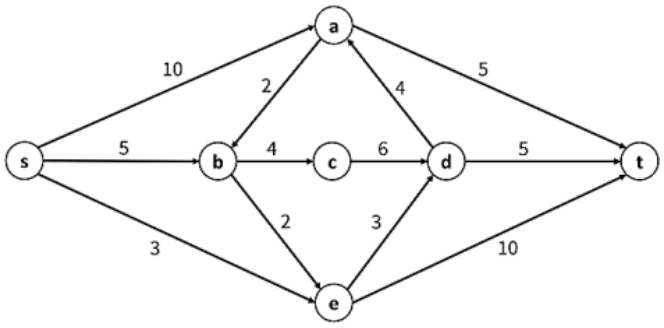


20. The ABC company has a taxi waiting at each of four cab stands. Four customers have requested service. The distance in miles from the waiting taxis to the customer is given in the matrix below. Find the optimal assignment of taxis to customers so as to minimize the total driving distances. (A, CO2)

Cab Sites	Customer (Dist in miles)			
	A	B	C	D
Stand 1	40	50	60	65
Stand 2	30	38	46	48
Stand 3	25	33	41	43
Stand 4	39	45	51	59

21. A computer system needs to store several files on a disk. Some files overlap in their access times, meaning they cannot be stored in the same memory block because they might be accessed simultaneously. Given the following overlap graph, construct the conflict graph, find its chromatic number and determine the minimum number of memory blocks needed so that no two overlapping files share the same block. Vertices: F1, F2, F3, F4, F5 Edges: (F1, F2), (F1, F3), (F2, F4), (F3, F4), (F3, F5) (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	Discuss 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;