Hall Ticket No | | | | | | | | | | Course Code: ACSD05

# INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)

**B.Tech II SEMESTER CIE - I EXAMINATIONS MAY - 2024**

**Regulation: BT23**

## ESSENTIALS FOR PROBLEM SOLVING

**(CSE | CSE (AI & ML) | CSE (DS) | CSE (CS) | CSIT | IT | ECE | EEE)**

**Time: 2 Hours** **Max Marks: 20**

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**Answer any FOUR questions**

**All parts of the question must be answered in one place only**

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1. (a) Draw the following graphs:
   i) Null graph $N_5$
   ii) Complete graph $K_6$
   iii) Complete bipartite graph $K_{7,4}$
   iv) Union of $K_{1,3}$ and $W_4$ [BL: Apply| CO: 1|Marks: 2]

   (b) The following five items refer to the graph G defined as follows. The set of vertices is V = {0, 1, 2, 3, 4, 5, 6, 7, 8}, and two vertices u and v are adjacent if $|u-v| \in \{1, 4, 5, 8\}$. Determine the order and the size of the following subgraphs of G:
   i) The subgraph induced by even vertices.
   ii) The subgraph induced by odd vertices.
   iii) The subgraph induced by the set {0, 1, 2, 3, 4}.
   iv) A spanning subgraph with as many edges as possible but without cycles.
   [BL: Apply| CO: 1|Marks: 3]

2. (a) Summarize digraph. Let G5 be a digraph where V (G5) = a, b, c, d and A(G5) = {ab, ba, cc, dc, db, da}. Draw the digraph for G5 [BL: Apply| CO: 1|Marks: 2]

   (b) suppose that in a group of 5 people: A, B, C, D, and E, the following pairs of people are acquainted with each other. a) A and C b) A and D c) B and C d) C and D e) C and E
   i) Draw a graph G to represent this situation.
   ii) List the vertex set, and the edge set, using set notation.
   In other words, show sets V and E for the vertices and edges, respectively, in G = {V, E}. c) Draw an adjacency matrix for G. [BL: Apply| CO: 1|Marks: 3]

3. (a) Explain how matrices can be used to represent and analyze walks in graphs. Discuss the adjacency matrix and its properties? [BL: Understand| CO: 2|Marks: 2]

   (b) Consider the following graph as shown in Figure 1

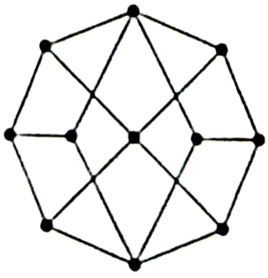

Figure 1

i) Find a Hamilton path. Can your path be extended to a Hamilton cycle?

ii) Is the graph bipartite? If so, how many vertices are in each "part"?

iii) Use your answer to part (b) to prove that the graph has no Hamilton cycle.

iv) Suppose you have a bipartite graph G in which one part has at least two more vertices than the other. Prove that G does not have a Hamilton path.

[BL: Apply| CO: 2|Marks: 3]

4. (a) Illustrate the following methods to tour a graph:

i) Eulerian Tours

ii) Hamiltonian Paths / Cycles

iii) Dijkstra's Algorithm [BL: Understand| CO: 2|Marks: 2]

(b) AA salesman needs to visit 5 cities (A, B, C, D, E) exactly once and return to the starting city. The distances between the cities are as follows:

A to B: 10 units
A to C: 15 units
A to D: 20 units
A to E: 25 units
B to C: 35 units
B to D: 30 units
B to E: 35 units
C to D: 40 units
C to E: 45 units
D to E: 50 units

Using the brute-force approach, find the shortest possible route for the salesman to visit all cities and return to the starting city. Show the step-by-step process including all permutations and calculations of total distances. [BL: Apply| CO: 2|Marks: 3]

5. (a) What is the smallest number of colors that can be used to color the vertices of a cube so that no two adjacent vertices are colored identically? [BL: Understand| CO: 3|Marks: 2]

(b) A tree is a connected graph with no cycles as shown in Figure 2

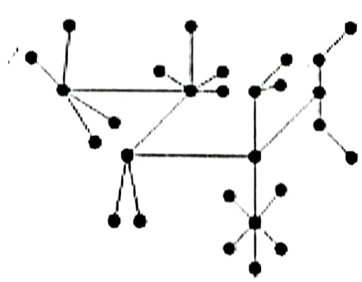

Figure 2

i) Describe a procedure to color for the tree given in Figure 2.

ii) The chromatic number of $C_n$ is two when $n$ is even. What goes wrong when $n$ is odd?

iii) Prove that your procedure from part (a) always works for any tree.

iv) Now, prove using induction that every tree has chromatic number 2.

[BL: Apply| CO: 3|Marks: 3]

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