Mahindra University Hyderabad
École Centrale School of Engineering
Minor – I

Program: B.Tech.   **Branch: Computation & Mathematics**   **Year: Second**   **Semester: Fall**
Subject: Graph Algorithms (MA 2105)

Date: 22/09/2022   Start Time: 08:25 AM
Time Duration: 1.5 Hours   Max. Marks: 20

Instructions:
1) Start each answer on a new page and number your answers clearly. Answer all parts of the same question together and in sequence.
2) Explanation of every step is highly desirable.

Q 01: Select the correct choice for the following questions with proper explanation. The right choice without valid justification will not be considered.   [01 × 08]

A) A connected undirected graph containing n vertices and $n - 1$ edges:

   a) Cannot have cycles   b) Must contain at least one cycle

   c) Can contain at most two cycles   d) Must contain at least two cycles

B) Let $G = K_n$ where $n \geq 5$. Then the number of edges of any induced sub-graph of G with five vertices will be:

   a) 10   b) 5   c) 6   d) 8   e) None of these

C) Let D be a simple graph on ten vertices such that there is a vertex of degree 1, a vertex of degree 2, a vertex of degree 3, a vertex of degree 4, a vertex of degree 5, a vertex of degree 6, a vertex of degree 7, a vertex of degree 8, and a vertex of degree 9. What can be the degree of the last vertex?

   a) 4   b) 0   c) 2   d) 5   e) None of these

D) What is the maximum number of possible non-zero values in an adjacency matrix of a simple graph with n vertices?

   a) $n(n-1)/2$ b) $n(n+1)/2$ c) $n(n-1)$ d) $n(n+1)$

E) What is the maximum number of edges in a bipartite graph having ten vertices?

   a) 24   b) 21   c) 25   d) 16

F) Which of the following statements for a simple graph is correct?

   a) Every path is a trail   b) Every trail is a path and every path is a trail

   c) Every trail is a path   d) Path and trail have no relation

G) Let $G(V,E)$ be a simple graph with $|V| = n$ and $|E| = m$. Then the number of edges in the complement of G, i.e., $|E(G')|$ is:

a) $(n^2 - n - 2m)/2$

b) $(n^2 + n + 2m)/2$

c) $(n^2 - n + 2m)/2$

d) None of these

H) A graph with n vertices will have a parallel edge or self-loop if the total number of edges is:

a) Greater than $(n-1)$

b) Less than $n(n-1)$

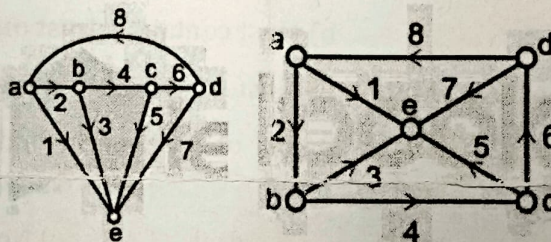c) Greater than $n(n-1)/2$

d) Less than $n^2/2$

Q 02: Each of the following questions consists of three marks.   [03 × 02]

A) There are 25 telephones in the office of Mahindra University. Is it possible to connect them with wires to connect each phone with exactly seven others?

B) Check whether the following graphs are isomorphic or not. In either case, justify your answer.

Q 03: Define the subgraph of a graph G by considering a suitable example. Consider the graph illustrated below.   [02 + 02 + 02]
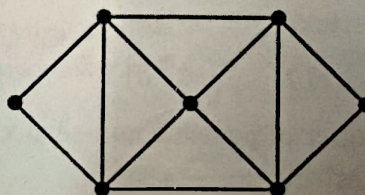
A) Find and draw a subgraph with the smallest number of edges that are still connected and contain all the vertices.

B) Find and draw a subgraph with the largest number of edges that don't contain any cycles.

C) What is your observation regarding the number of edges obtained in the above problems? Explain, in detail, the relation between the outcome of these problems. Also, explain the term which is occurring while describing them.