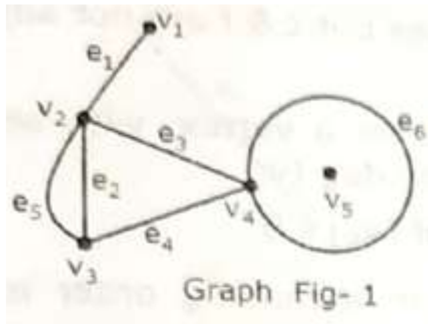
1. **Graph:** A diagram consisting of a finite number of dots or points together with lines(not necessarily strait lines) joining certain pairs of these dots is called graph.



2. **Vertex :** The dots used in a graph are called vertices and are denoted by v_1 and v_2 , etc.

3. **Edge :** The lines (not necessarily straight line) joining certain pair of the dots in a graph are called edges, and are denoted by $e_1, e_2, ...\ or\ a, b...\ etc.$

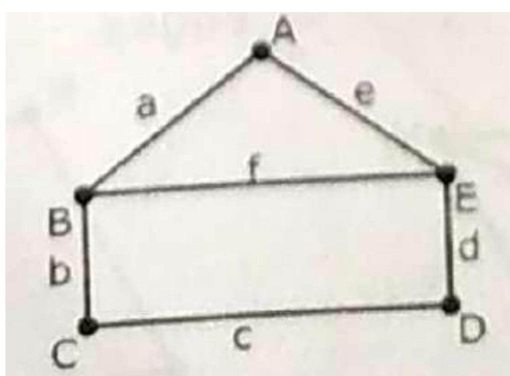
4. **Vertex-Set:** The set of all vertices is called the vertex set of the graph. It is denoted by V. $V = \{v_1, v_2, v_3, v_4, v_5\}$.

5. **Edge- Set:** The set of all edges is called the edge set of the graph. It is denoted by E. $E = \{e_1, e_2, e_3, e_4, e_5, e_6\}$.

6. **Loop :** A edge whose end vertices are same is called a self-loop or loop.

7. **Parallel or Multiple Edges:** There may exist that more than one edge associated with a given pair of vertices. Such edges are called parallel edges. In Fig-1 $e_2\ and\ e_5$ are parallel edges.

8. **Simple Graph:** A Graph having no parallel edges and no self loop is called Simple Graph.



9. **Adjacent Vertices:** Two vertices are said to be adjacent if they are end vertices of the same edge. In Fig-2 C and D are adjacent vertices.

10. Adjacent Edges: Two non parallel edges are said to be adjacent if they are incident to common vertex, . In Fig-2 c and d are adjacent edges

11. **Degree of Vertex:** The number of edges incident to a vertex, with self loop counted twice, is called degree of vertex. It is denoted by $\deg(v)$

12. **Degree Sequence:** Degree of vertices is written in ascending order is called degree sequence of graph.

13. **Regular Graph:** A graph in which all vertices are of equal degree is called regular graph.

14. **Isolated vertex:** A vertex of degree of zero is called Isolated vertex.

15. **Pendent vertex or End vertex and Pendent Edge:** A vertex whose degree is 1 called pendent vertex and an edge incident to pendent vertex is called pendent edge.

16. **Null graph:** A graph having no edge is called a null Graph.

17. **Complete graph:** A simple graph is called complete graph if each pair of distinct vertices is joined by an edge.

*o Incidence Matrix: (M)

the edges are labelled $\{1, 2, --, m\}$, "Incidence matrix M is the $n \times M$ matrix whose ij-th entry is 1 if vertex i is incident to edge j and otherwise entry is 0."

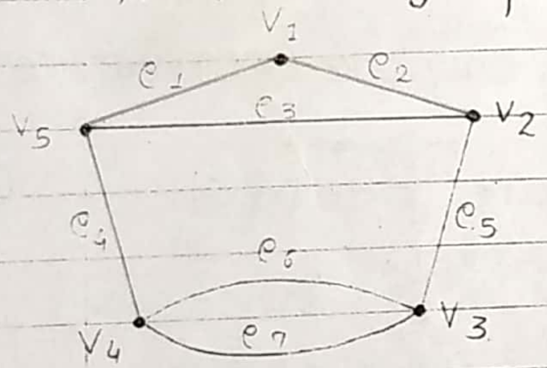
$m = V$

Adjacency Matrix (A):

If G is a graph with vertices labelled $\{1, 2, \dots, n\}$, "Adjacency matrix A is the $n \times n$ matrix whose ij-th entry is the number of edges (incident) joint vertex i and vertex j."

(How many edges connect to those two vertex)

Q: 1 Write Adjacency Matrix & Incidence Matrix from the graph.



Incidence Matrix:

$M(G) =$

	e_1	e_2	e_3	e_4	e_5	e_6	e_7
v_1	1	1	0	0	0	0	0
v_2	0	1	1	0	1	0	0
v_3	0	0	0	0	1	1	1
v_4	0	0	0	1	0	1	1
v_5	1	0	1	1	0	0	0

5×7
vert. Edge

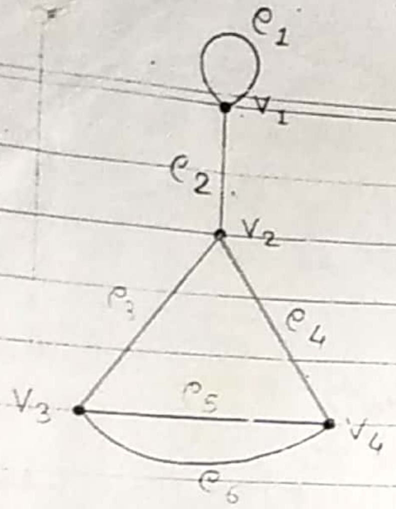
Adjacency Matrix:

$A(G) =$

	v_1	v_2	v_3	v_4	v_5
v_1	0	1	0	0	1
v_2	1	0	1	0	1
v_3	0	1	0	2	0
v_4	0	0	2	0	1
v_5	1	1	0	1	0

5×5
ver. ver.

IMP
Ex:2



Incidence Matrix:

M(G) =

	e1	e2	e3	e4	e5	e6
v1	1	1	0	0	0	0
v2	0	1	1	1	0	0
v3	0	0	1	0	1	1
v4	0	0	0	1	1	1

4 x 6
ver. Edges

Adjacency Matrix:

A(G) =

	v1	v2	v3	v4
v1	1	1	0	0
v2	1	0	1	1
v3	0	1	0	2
v4	0	1	2	0

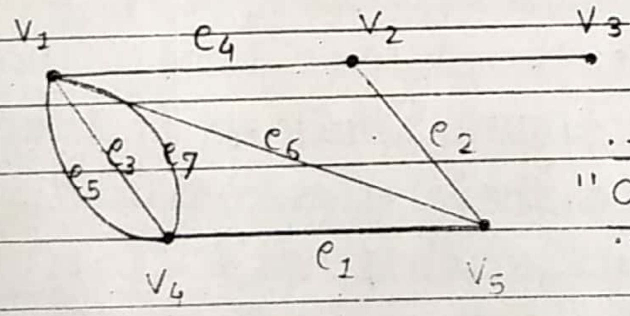
4 x 4
ver. ver.

Ex:3 Draw the graph whose incidence matrix is (5 x 8).

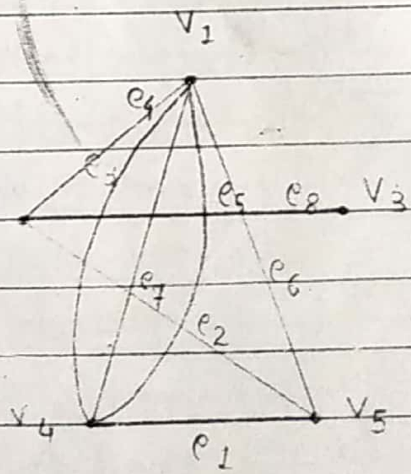
M(G) =

	e1	e2	e3	e4	e5	e6	e7	e8
v1	0	0	1	1	1	1	1	0
v2	0	1	0	1	0	0	0	1
v3	0	0	0	0	0	0	0	1
v4	1	0	1	0	1	0	1	0
v5	1	1	0	0	0	1	0	0

5 x 8.

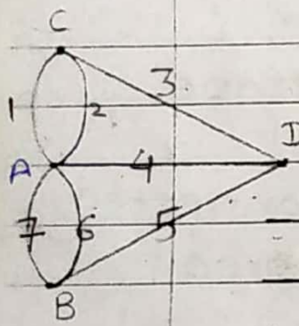


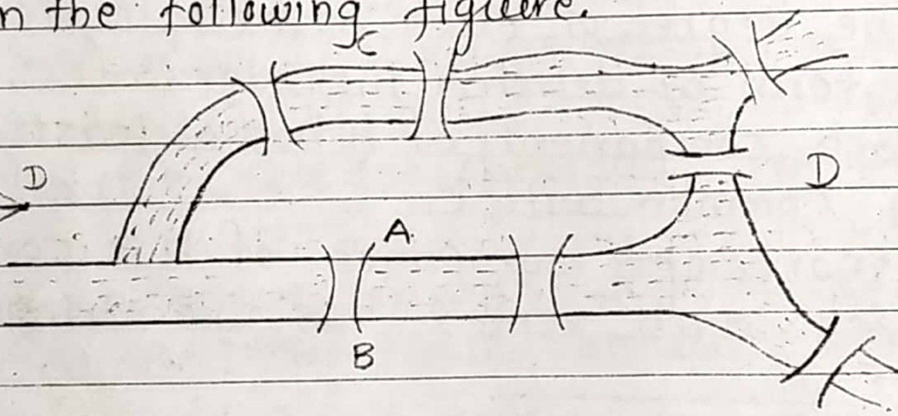
"OR"



(☆) Uni-07 Konigsberg Bridge problem:

The banks of the pregel river in Konigsberg was crossed by seven bridges which connects two islands in the river as shown as in the following figuere.

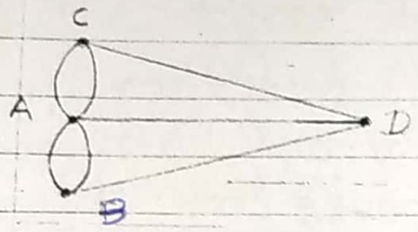




Is it possible to cross each of the seven bridges exactly once and return to the starting point (place).

[Euler]

Represent the above situation by means of a graph as under in which the vertices represents the islands and the edges represent the bridge.



The degree of each vertex of the above connected graph is not even.

∴ It is not Eulerian.

It is not possible to crossed each of the seven bridges exactly once and return to the starting point.