# Assignment - I
## Unit - I

01

Q.1 What is graph? Explain its characteristics:

Ans→ Graph is a collection of edges and vertices graph is denoted by G(E,V).

→ Edge is a line b/w two points.
Vertex can be refers to the points.

### characteristics of graph :-

1) Vertices (Nodes) :-
Think of there as points or dots in a graph. Each point represent something, like a person, city, or object.

2) Edges (links) :-
These are the lines connecting the points. They show relationships or connection between the points.

3) Directed Vs. undirected :-

- Directed :- The connection has a direction, like a one-way street.
- undirected :- The connection goes both ways, like a two-way street.

4) Weighted Vs. unweighted :-

- Weighted : The connection have values. like distance or costs.
- unweighted : All connections are treated the same, with no special values.

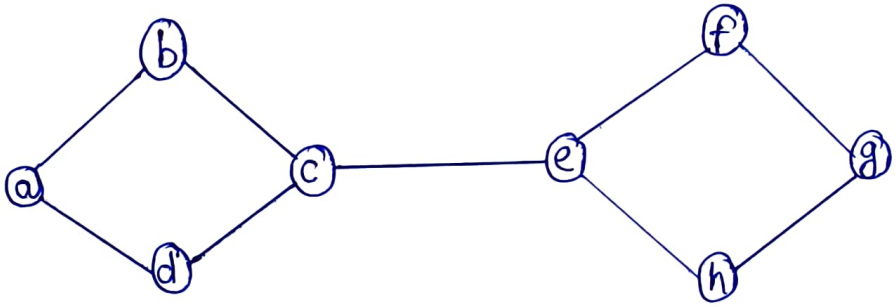
Q2) Explain cut edges, cut vertices and degree of vertices with Examples.

cut - Edges :- Let 'G' be a connected graph.
An edge 'e' $\in$ G is called cut edge if 'G-e' result in a disconnected graph.

If removing an edge in a graph results in to two or more graphs, then that edge is called a cut edge.

Example:-

In the following graph, the cut edges is [(c,e)]




By removing the edge (c,e) from the graph, it becomes a disconnected graph.


In the above graph, removing the Edges (c,e) break the graph into two which is nothing but a disconnected graph.

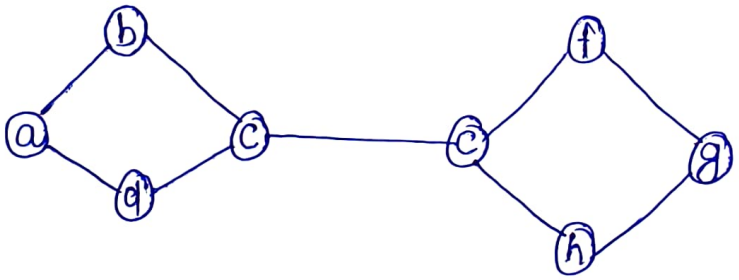
**Cut - vertices :-** let 'G' be a connected graph.

A vector $V \in G$ is called a cut vertices of 'G', if 'G-V' ( Delete 'V' from 'G') result in a disconnected graph. Removing a cut vertex from a graph breaks it in to two or more graph.

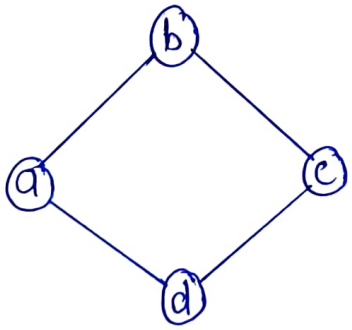
**Note :-** Removing a cut vertex may render a graph disconnected

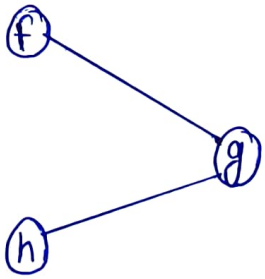
**Example :-**

In the following graph, vertices 'e' and 'c' are the cut vertices.




By removing 'e' or 'c', the graph will become a disconnected graph.



without 'g' there is no path between vertices 'c' and vertex 'h' and many other. Hence it is a disconnected graph with cut vertex as 'e' Similarly, 'c' is also a cut vertex for the above graph.

Q3. Define Adjacency and Incidence Matrices?

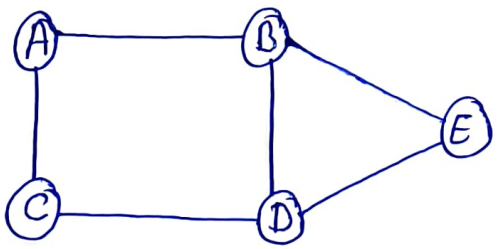
# Adjacency Matrices :- A Adjacency matrix is a Square matrix that represent a graph using 1s and 0s to indicate whether vertices are adjacent to each other

A graph G(V,E) where
V = {0, 1, - - - - n-1} can be represent using 2D array

Size = h x h
int adj[20][20]

→ Suppose adj[i][j] = 1 indicate the of Edges.

→ A graph is represented with Square matrix




undirected graph

No. of Edges = 7
Vertex = 5

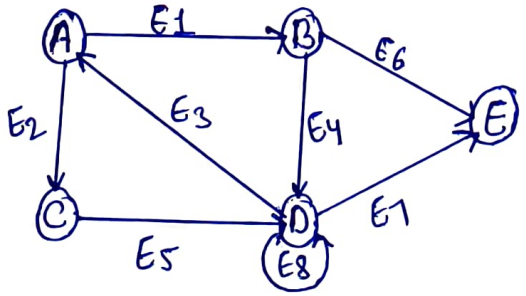
| | A | B | C | D | E |
|---|---|---|---|---|---|
| A | 0 | 1 | 1 | 1 | 0 |
| B | 1 | 0 | 0 | 1 | 1 |
| C | 1 | 0 | 0 | 1 | 0 |
| D | 1 | 1 | 1 | 0 | 1 |
| E | 0 | 1 | 0 | 1 | 0 |

Directed graph

# Incidence Matrices :- In the incidence matrix rows represent vertices and column represent edges. this matrix filled with value either 0, 1, -1, here 0 represent row edge is not connected to column,

1 → row edge is connected by outgoing edges to column vertex.

-1 → row edge is connected to incoming edge to column vertex.



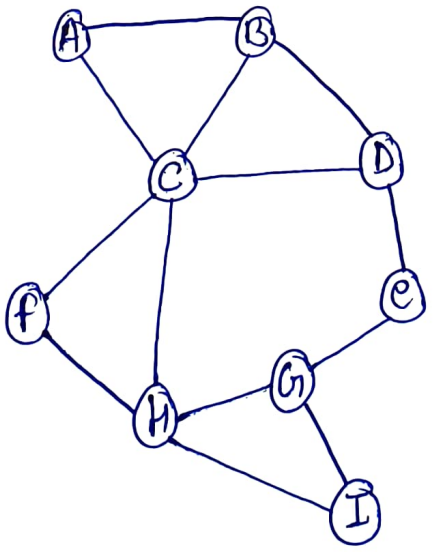

| | E1 | E2 | E3 | E4 | E5 | E6 | E7 | E8 |
|---|---|---|---|---|---|---|---|---|
| A | 1 | 1 | -1 | 0 | 0 | 0 | 0 | 0 |
| B | -1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 |
| C | 0 | -1 | 0 | 0 | 1 | 0 | 0 | 0 |
| D | 0 | 0 | 1 | -1 | -1 | 0 | 1 | -1 |
| E | 0 | 0 | 0 | 0 | 0 | -1 | -1 | 0 |

Q.4) Define the path, walk and cycles with Examples.

Ans ⇒ Path :- A path is a type of open walk where neigher edges nor vertices are allowed to repeat. There is a possibility that only the starting veren and ending veren are the same in a path. In an open walk, the length of the walk must be more than 0.

So for a path, the following two points are imp., which are described as follows :-

- Edges cannot be repeated
- Veren cannot be repeated



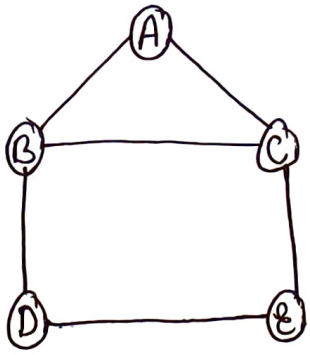

Walk :- A walk can be defined as a sequence of Edges and vertices of graph. when we have a graph and traverse it, then that traverse will be known as a walk.

In a walk, there can be repeated edges and vertices. The number of edges which is covered in a walk will be known as the length of the walk there can be more than one walk.

- Edges can be repeated
- Vertex can be repeated

- For Example :-

In this Example, we have a graph, which is described as follows:




In the above graph, there can be many walks, but some of them are described as follows:

1) A, B, C, E, D ( Number of length =4)

2) D, E, A, C, E, D, C (Number of length =7)

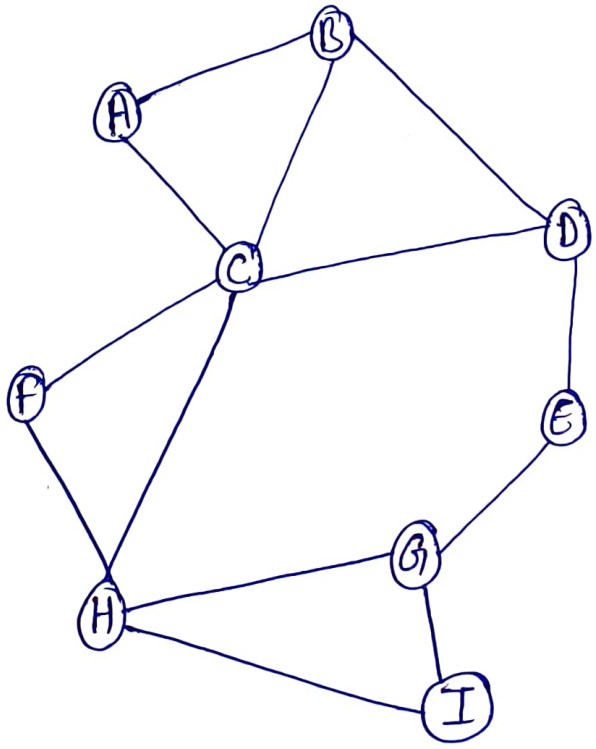
3) E, C, B, A, C, E, D ( Number of length = 6)

- Cycles :- A closed path in the graph theory is also known as a cycle. A cycle is a type of closed walk where neither edges nor vertices are allowed to repeat.

There is possibility that only the starting vertex and Ending vertex are the same in a cycle.

So far a cycle, the following two points are important, which are described as follows:

- Edges cannot be repeated
- Vertex cannot be repeated



Q5) Explain De-Bruijn cycle Algorithm & Graph with Example.

Ans:- Given an integer n and a set of characters A of size K, find a string S such that every possible string on A of length n appears exactly once as a substring in S. Such a string is called de-bruijn sequence

Gname → AAABBBBA

3 mers → AAA, AAB, ABB, BBB, BBB, BBA

2 mers → AA, AA AA, AB AB, BB BB, BB BB, BB BB, BA

1 mers → AA AB AB BB BB BA