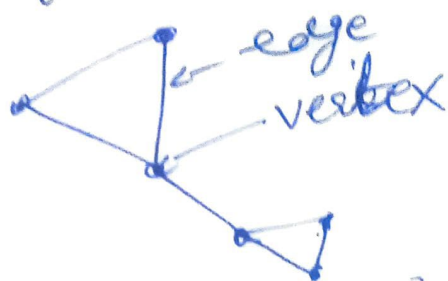
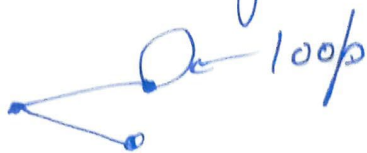


Graph - A mathematical structure consisting of vertices (nodes) and edges

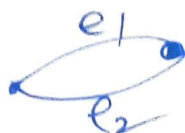


$G(6, 7)$, 6 vertices, 7 edges

Loop :- A vertex is joined to itself by an edge.



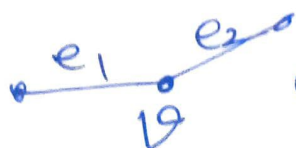
Parallel edges



e_1, e_2 : are parallel edges



Edge e is incident on vertices v_1 & v_2 .



edges e_1, e_2 are adjacent edges.

~~Loop~~ ~~Multi~~

Degree of a vertex : The no. of edges incident on a vertex v is called degree of vertex v , $\deg(v)$



$\deg(v) = 3$

Multiple edges - 2 or more edges joining the same 2 vertices.



Graph / Simple Graph - Graph without ^{II (2)}
loops & multiple edges

Pseudograph - A graph with both parallel edges & loops



Thm The sum of ~~deg~~ degrees of all the vertices of a graph G = twice the no. of edges in G .

$$\sum_{i=1}^n \deg(v_i) = 2e \quad \text{where } n: \text{no. of vertices} \\ e: \text{no. of edges}$$

Pf. Consider graph $G(n, e)$ with n vertices $v_1, v_2, \dots, v_n$. Since each edge is counted twice while summing all the degrees of G
 $\therefore$ The sum of all the degrees of the vertices will be $2e$.

Path in a graph:

$u-v-w-x$] $u-x$ paths

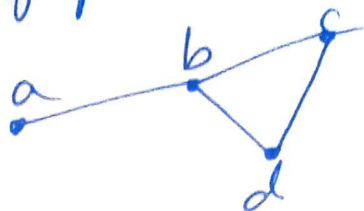
$u-v-x$

$u-v-x$ is shortest $u-x$ path

Length of a path: no. of edges in a path. In $u-v-x$, the length of path is 2.

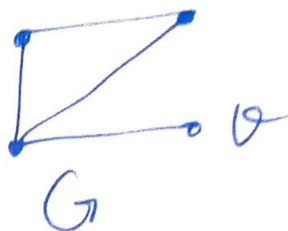
Cycle in a graph -

II (3)

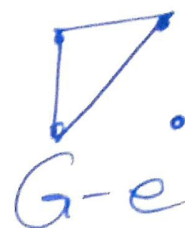
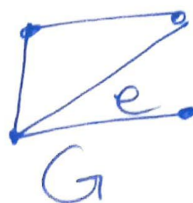


b-c-d-b is a cycle/circuit of length 3.

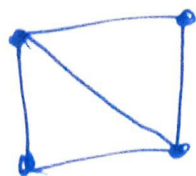
Simple Operations on graph -
Deletion of a vertex.



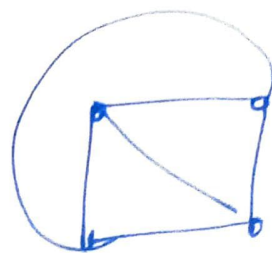
Deletion of an edge



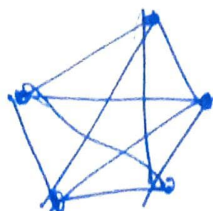
Planar Graph - It can be drawn on a plane in such a way that no 2 edges cross each other.



Planar graph



Planar graph

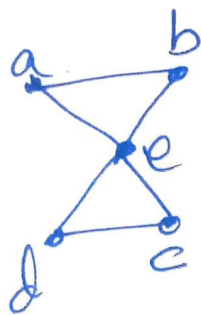


Non-Planar graph.

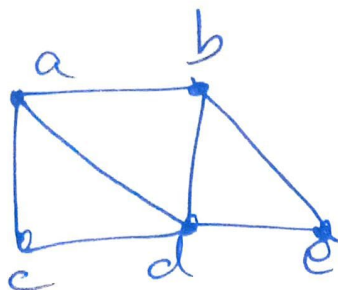
Euler Path:- A path which covers Euler every edge exactly once.

Euler Circuit:- It is a circuit which contains every edge of the graph exactly once. i.e., it is an Euler Path that is a circuit.

Euler graph - A graph containing an Euler circuit is called an Euler graph.



a, e, c, d, e, b, a: Euler Circuit



a, c, d, e, b, d, a, b: Euler Path