Basic of Electrical Circuits
EHB 211E

Prof. Dr. Müştak E. Yalçın

Istanbul Technical University
Faculty of Electrical and Electronic Engineering

mustak.yalcin@itu.edu.tr

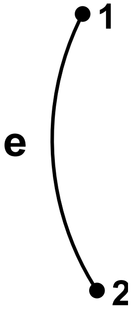
Lecture 3.

Contents I

Fundamentals of Graph Theory

Edge: A line segment together with its two distinct end points is called an edge.

Node: An end point of an edge is called a node (vertex).

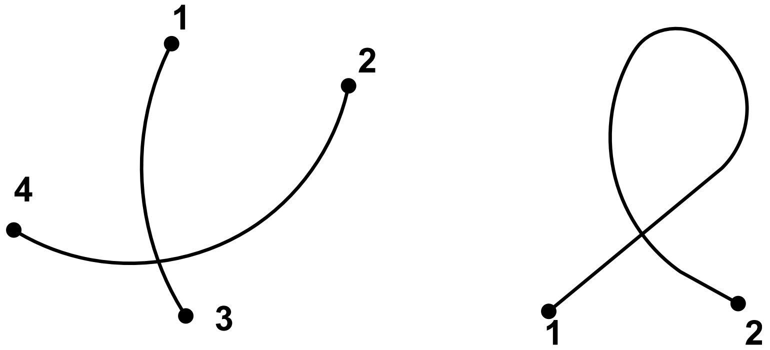


A node n_i and an edge e_i are incident with each other if n_i is one of the two end points of the edge e_i

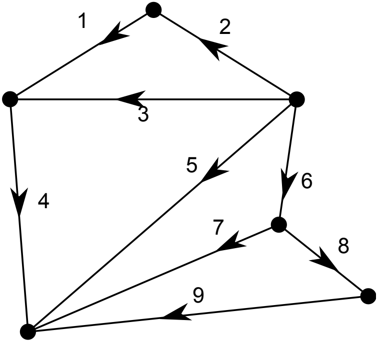
Fundamentals of Graph Theory

Graph: A graph $G = (N, E)$ is defined to be a set N of nodes and a set E of edges with a prescribed edge-node incidence relation, i.e., each edge is incident with two nodes in V.

A planar graph is a graph which can be drawn on a plane in such a way that no two branches intersect at a point which is not a node.

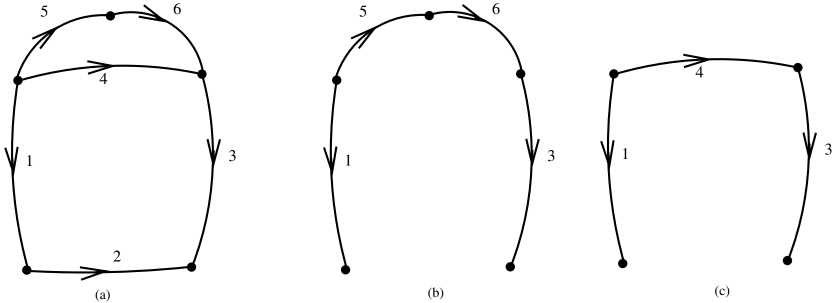


Graph: A graph $G = (N, E)$ is defined to be a set N of nodes and a set E of edges with a prescribed edge-node incidence relation, i.e., each edge is incident with two nodes in V.



Subgraph: G_1 is called a subgraph of G iff G_1 itself is a graph, N_1 is a subset of N, and E_1 is a subset of E.

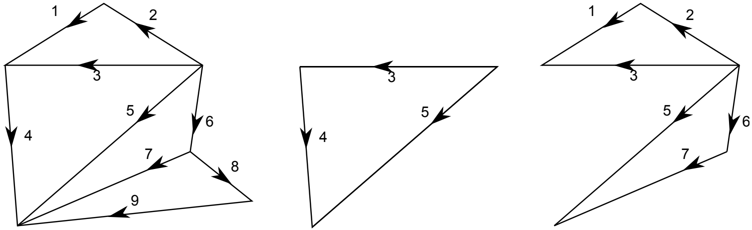
Path: A path graph is a graph that can be drawn so that all of its nodes and edges lie on a single straight line.



Connected graph : A graph which is connected If there is a path from any point to any other point in the graph. A graph that is not connected is said to be disconnected.

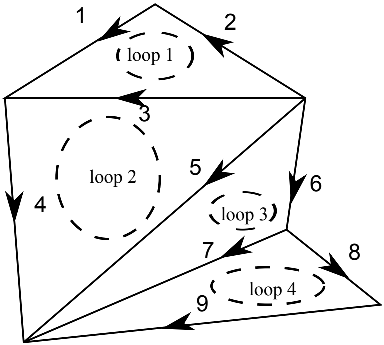
Loop: A loop G_L is defined to be a connected subgraph of G is defined to be a set of a closed node sequence and a set of edges between these nodes.

A loop G_L is defined to be a connected subgraph of G in which precisely two edges are incident with each node.



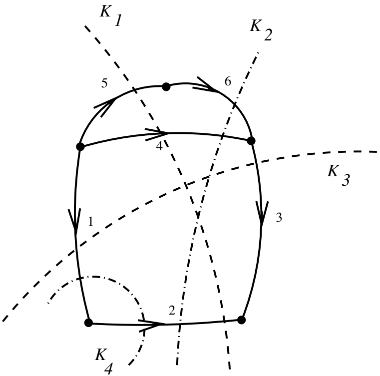
Fundamentals of Graph Theory

Mesh : A mesh is a loop of a graph drawn on a plane, which encircles nothing in its interior.



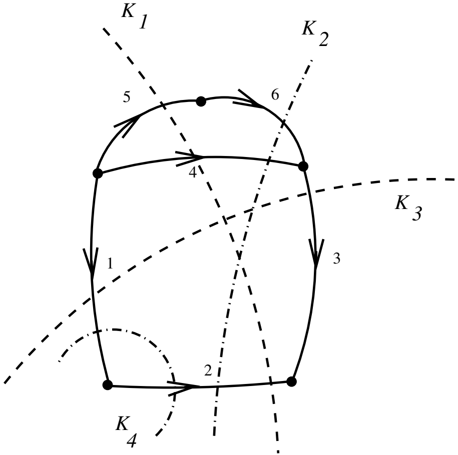
Cut set: Given a connected graph G a set of edges G_C of G is called a cut set iff

- the removal of all the edges of the cut set results in an unconnected graph.
- the removal of all but any one edge of G leaves the graph connected.



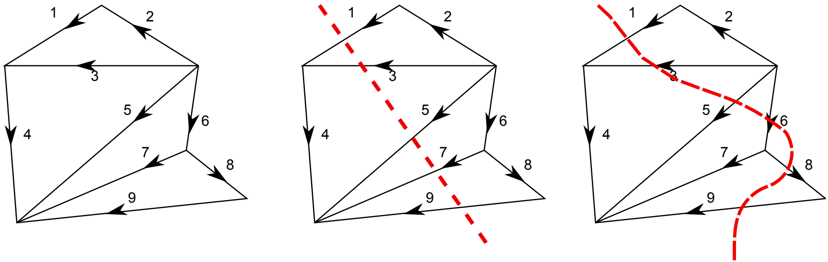
Fundamentals of Graph Theory

$G_{K1} = \{2, 4, 5\}$, $G_{K2} = \{2, 4, 6\}$, $G_{K3} = \{1, 3\}$, $G_{K4} = \{1, 2\}$.



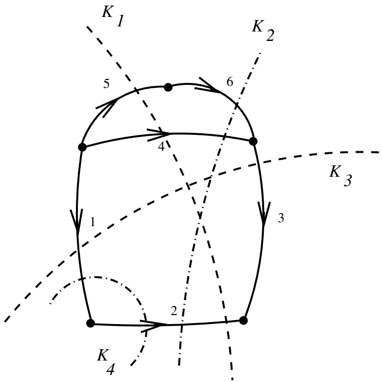
To any cut set corresponds a gaussian surface which cuts precisely the same edges.

Fundamentals of Graph Theory



Cut set for the node: A gaussian surface that surrounds only the node in question.

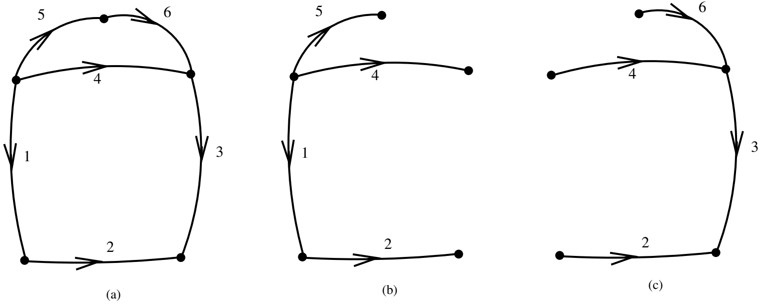
$G_{K4} = \{1, 2\}$ is the cut set of the node 4.



Fundamentals of Graph Theory

Tree: Let G be a connected graph and T is a connected subgraph of G. We say that T is a tree of the connected graph G if

- T is a connected subgraph,
- it contains all the nodes of G,
- it contains no loops.



$T_{A1} = \{1, 2, 4, 5\}$ and $T_{A2} = \{2, 3, 4, 6\}$ subgraphs are tree.

Fundamentals of Graph Theory

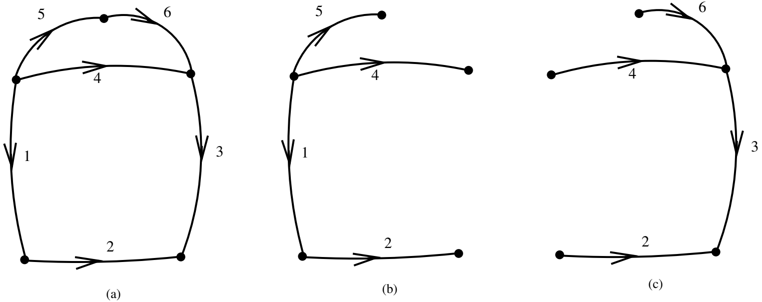
Theory: Given a connected graph G of n_n nodes and n_b edges, and a tree T of G, there is a unique path along the tree between any given pair of nodes.

Branch (twig): Given a connected graph G and a tree T, the edges of T are called branches.

Link: The edges of G not in T are called links (chords).

co-tree: The complement of tree (The edges of the co-tree are links).

There are $n_n - 1$ tree branches and $n_b - n_n - 1$ links.



Links of the trees G_{T1} and G_{T2} are $G_{L1} = \{3, 6\}$ and $G_{L2} = \{1, 5\}$, respectively.