NIRMA UNIVERSITY
INSTITUTE OF TECHNOLOGY
B. Tech. Semester - III (Electrical), July 2012
2EE209: NETWORK ANALYSIS & SYNTHESIS

HANDOUT 1
NETWORK TOPOLOGY

Session: 1

Contents:

1. Definition of network
2. Classification of Networks
3. Sources of Energy and other Network Components
4. Importance of network topology
5. Graph, Tree & links
6. Tie set schedule

Network: The interconnection of two or more simple circuit elements is called electric network. If a network contains at least one closed path, it is termed an electric circuits.

The electrical networks are classified in a number of ways depending upon kind of elements and in terms of general properties of its responses to excitation. The types of networks are

- Lumped and distributed networks
- Unilateral and bilateral networks
- Active and passive networks

Mainly there are two types of sources voltage source and current source which may be classified as ideal or independent and dependent sources.

The solution of network consists in finding the currents in the branches (or elements) or the voltages across the elements. Network topology is on technique of network analysis using which linear network can be solved.

Graph is representation of networks irrespective of types and elements of network. From graph certain braches are called tree branch and remaining are called links. Based on

links tie set schedule is prepared for network which can be used to find current from each branches depending on Kirchhoff's voltage law.

Session: 2

Contents:

1. Cut set schedule
2. Current variable method
3. voltage variable method

A fundamental cut set of a graph G with respect to a tree T is a cut set that is formed by one twig and a unique set of links (chords). The orientation of a cut set is chosen to coincide with that of its defining twig. In other words, a fundamental cut set is assigned the same orientation as that of the twig it contains.

Current variable method (Loop analysis based on graph theory)

1. Choose a tree T of the graph of the network. Determine the fundamental tie set corresponding to this tree.
2. Write down the matrix loop equations from kirchhoff's voltage law.
3. Determine the V from the relationship V = R I.
4. Replace the values of resistances and voltage or current sources given in network.
5. Solve the KVL equations and find out link currents.
6. Using values of link currents find out values of branch current and branch voltage.

Voltage variable method (Nodal analysis based on graph theory)

1. Choose a tree T of the graph of the network. Determine the fundamental cut set corresponding to this tree.
2. Write down the node equations from kirchhoff's current law.
3. Determine the I from the relationship I = V/R.
4. Replace the values of resistances and voltage or current sources given in network.
5. Solve the KCL equations and find out tree branch voltages.
6. Using values of tree branch voltages find out values of branch current and branch voltage.

Session: 3

Contents:

1. Source Transformation
2. Duality

Source Transformation:

The concept of super mesh and super node is already defined. The other simpler method is to make the source transformation. There are certain techniques under which network can be reduce in such a form that at last there will be one resistor in series with one voltage source.

- Source transformation from voltage source to current source
- Source transformation from current source to voltage source
- Rules under which sources may be combined.
- Resistor R connected across a voltage source.
- Resistor R connected in series with current source
- Procedure for shifting the voltage source through node.
- Procedure by which one current source is replaced by two sources.
- Procedure for shifting current source in the network.

Duality:

Several analogous situations will have been noted in the preceding discussions, while analyzing the networks. The statements of two kirchhoff's laws are almost similar word for word with 'voltage' substituted for 'current', 'independent loop' for 'independent node pair' etc. This repeated similarity is only part of a larger pattern of identical behavior patterns in the roles played by voltage and current in network analysis. This similarity with all the implications is termed the principle of duality. The following procedure may be followed in construction the dual of a given network.

1. Inside each loop place a node and give it a number for all loops. Place an extra node, the datum node external to the network.
2. Place the same numbered nodes on separate space on the paper for construction of the dual.
3. Draw a line between two nodes of the original network traversing only one element at a time. Thus draw lines from node to node through the elements in the original network.
4. Continue this process until the number of possible paths through single elements is exhausted.
5. The network so constructed is dual network.