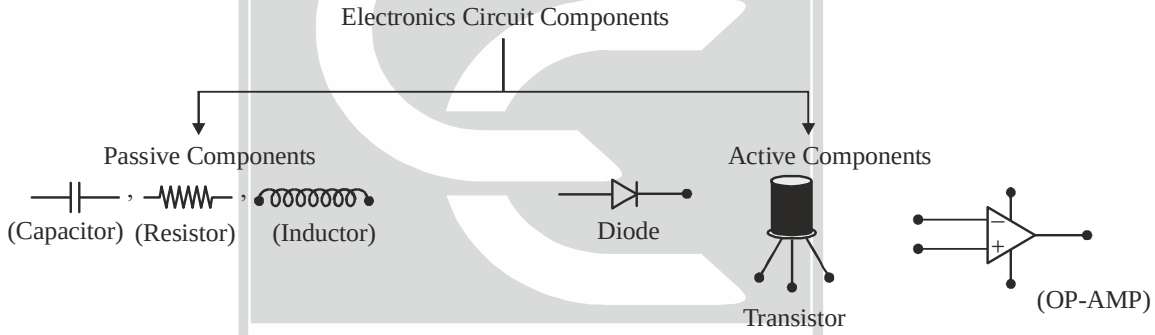
Chapter 1

NETWORK THEORY

Introduction:

Nowadays electronics instruments like Computer, Phone, iPad, communication systems are playing vital roles in our everyday life. These electronics device consists of electronics circuit and circuit consists of electronics component like capacitor, resistor, inductor, semiconductor devices, voltage and current sources. To understand the operation of electronics devices it is necessary to know the current and voltage in all parts of this circuit. To analysis these circuits we frequently use the known laws of the electrical circuits. Thus, the performance analysis or the design of any electronics circuit requires a knowledge of circuit analysis.

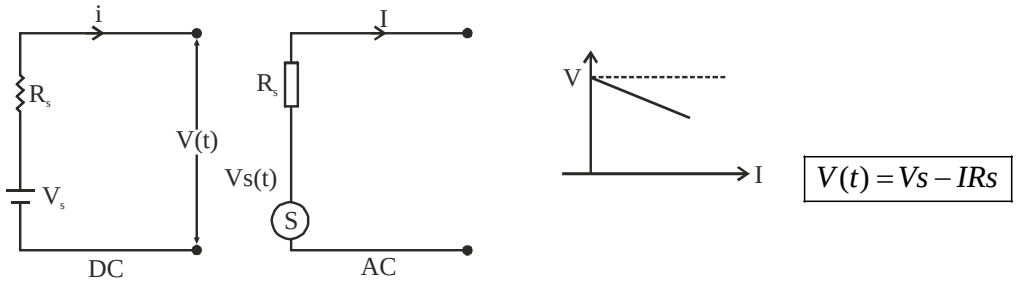
Circuit Components:



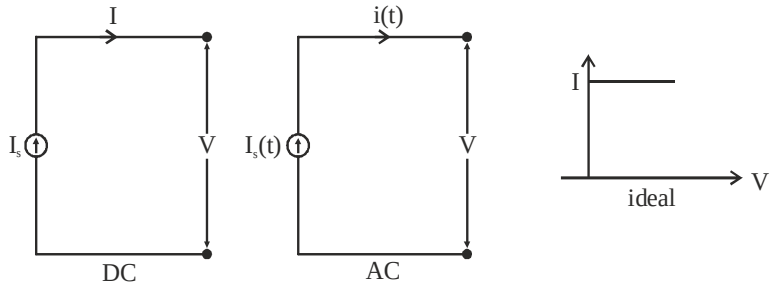
Voltage and Current Sources:

Voltage Source: Ideal voltage source delivers energy at a specified voltage (V), which is independent on current delivers by sources. The internal resistance of a voltage source is zero.

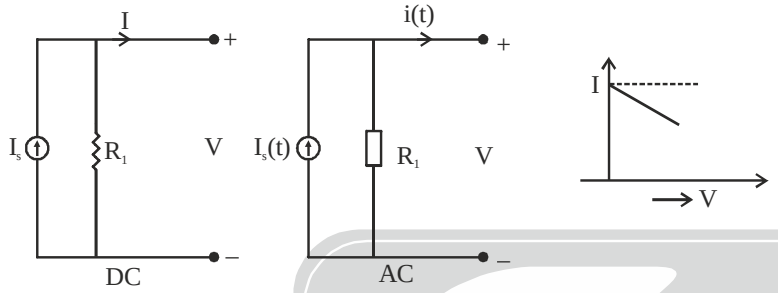
Practical Voltage Sources: It delivers energy at specified (V) which depends on current delivers by sources.



Current Sources: Ideal current source delivers energy at a specified (I), which is independent on voltage across the source. Internal resistance of ideal current source = ∞.



Practical Current Sources: Practical current sources delivers energy at specified current I, which is dependent on voltage across the source. In real time system current source does not exist.



Network definitions:

Circuit : A circuit may be defined as a complete path for electric current flow.

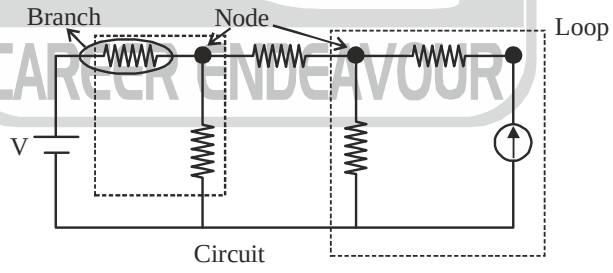
Branch : A group of circuit components having two terminals is called a branch.

Loop : A loop is any closed path formed by a number of branches in a circuit.

Node : A node is simply a common point where two or more than two components meet.

Short Circuit: If any two terminals of a network are connected by a wire of almost zero resistance, then the terminal are said to be short circuited.

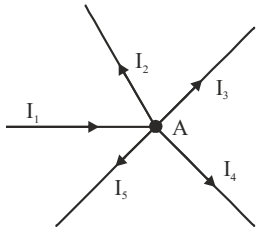
Open Circuit: If the connected path between the terminals is made open then the terminals are said to be open circuited.



Kirchhoff's current law:

The algebraic sum of the currents meeting at a junction point in a network is zero.

$$\sum_{i=1}^{n} I_i = 0$$

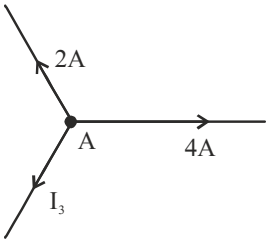


So, applying KCL at the node, we can write,

$$-I_1 + I_2 + I_3 - I_4 + I_5 = 0$$

When current enter into the junction we will take it as negative and when current flow out from the junction, we take it as a positive current.

Example: Suppose three branches are connected at the node A. Two of them current are known.



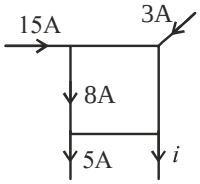
What will the current in 3rd wire?

Soln. According to Krichhoff's current law,

$\Sigma I = 0 \Rightarrow 2A + 4A + I_3 = 0 \Rightarrow I_3 = -6A$

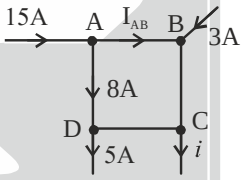
So, current will enter to the junction.

Example: Consider the following circuit the value of current *i* is?



Soln. According to KCL, at the junction A,

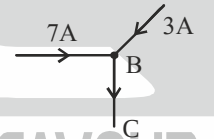
$-15 + 8 + I_{AB} = 0 \Rightarrow I_{AB} = 7A$



So, current will flow A to B direction.

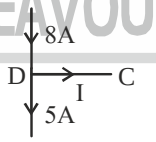
Applying KCL at B, we can write,

$-7A - 3A + I_{BC} = 0 \Rightarrow I_{BC} = 10A$



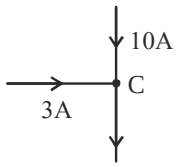
Applying KCL at D we can write

$-8A + 5A + I_{DC} = 0 \Rightarrow I_{DC} = 3A$



Applying KCL at C, we can write,

$-10A - 3A + I = 0 \Rightarrow I = 13A$



Kirchhoff's voltage law:

The algebraic sum of all voltage drops around a closed path in a network is zero.

$-V + IR_1 + IR_2 + IR_3 = 0$