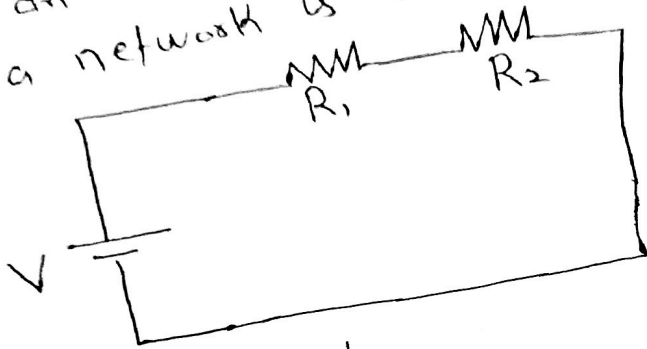


Linear Circuit Analysis

"Circuit analysis is the process of finding all the currents and voltages in an electrical network."

1) Electrical Network:
"Any arrangement of the various electrical energy sources along with the different circuit elements is called an electrical network."
Such a network is shown in the figure below.



2) Network elements:
"Any individual circuit element with two terminals which can be connected to other circuit element is called a network element."

a) Active elements:
"Active elements are the elements which supply energy to the network." voltage and current sources are the examples of active elements.

b) Passive elements:
"Passive elements are the elements which either store energy or dissipate energy in the form of heat."
Resistors, inductors and capacitors are the three basic passive elements. Inductors and capacitors can store energy and resistors dissipate energy in the form of heat.

(c). Branch:-
 "A part of the network which connects the various points of the network with one another is called a branch."

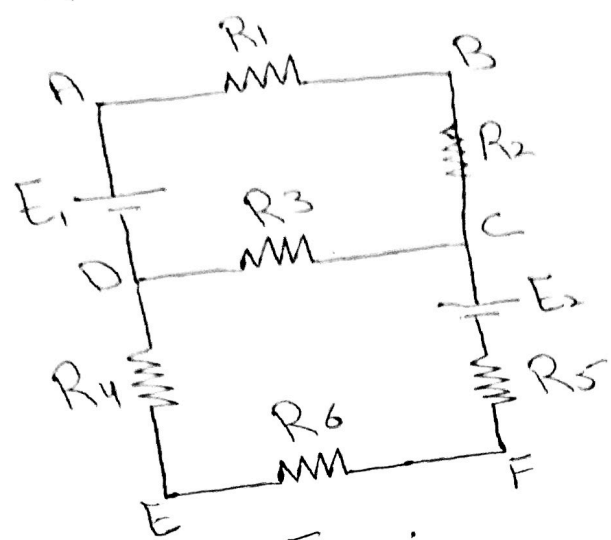


Fig (i)

In the above fig, AB, BC, CD, DA, DE, CF and EF are the various branches. A branch may consist of more than one element as in branch CF.

(d). Junction Point:-

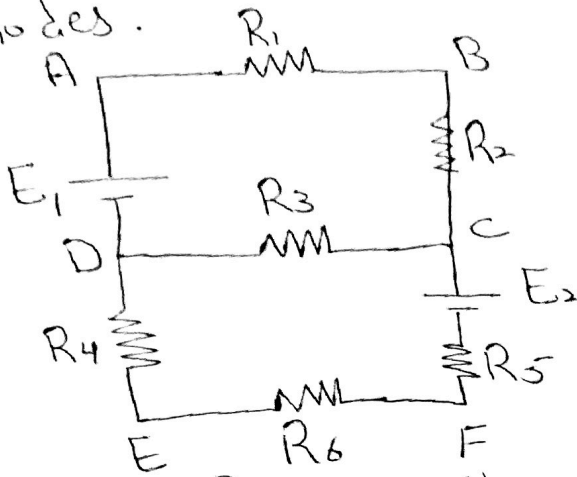
"A point where 3 or more branches meet is called a junction point." Point D, E, C are the junction points in the above fig (i).

(e). Node:-

"A point at which 2 or more elements are joined together is called a node." The junction points are also the nodes of the network. In the network shown in above fig (i), A, B, C, D, E and F are the nodes of the network.

Loop and Mesh:-

A loop can be defined as a closed path which originates ~~at the~~ from a particular node and terminating at the same node, and travelling through various other nodes.



In the above fig, path A-B-C-D-A, A-B-C-F-E-D-A, D-C-F-E-D are the loops of the network.

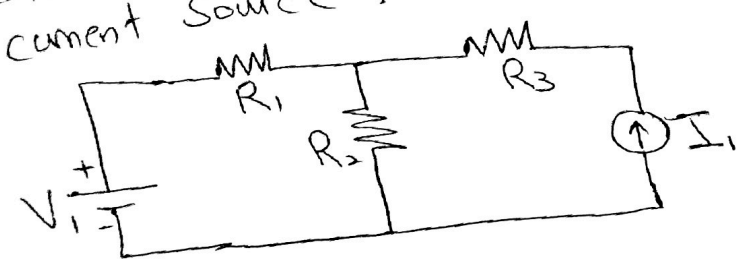
~~class~~

mesh:-

"A mesh is a closed path in a circuit with no other paths inside it!"

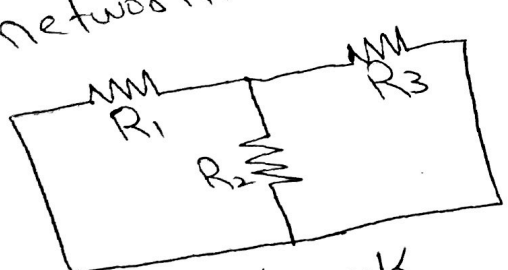
"The smallest loops ^{or} in a network is called mesh".
In the above fig, A-B-C-D-A and D-C-F-E-D are the 2 meshes.

3.1:- Active Network:-
 A circuit which contains at least one source of energy is called active network. An energy source may be a voltage or current source.



3.2:- Active Network

4.1:- Passive Network:-
 A circuit which contains no energy source is called passive network. as shown in the fig below.



4.2:- Passive Network

5.1:- Lumped Network :-
 A network in which all the network elements are physically separable is known as lumped network. Most of the electric networks are lumped in nature which consists elements like R, L, C, voltage source etc.

Distributed Network:-

A network in which the circuit elements like R, L & C cannot be physically separable for analysis purpose is called distributed network.

The best example of such a network is a transmission line where resistance, inductance and capacitance are distributed all along its length and cannot be shown as separate elements.

Linear network:-

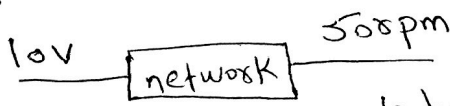
"In linear network, the relationship b/w I_{ip} & o_{ip} is linear as shown below:-



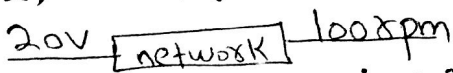
In other words, a linear network follows the principle of superposition i.e. homogeneity and additivity.

ex. homogeneity:-

Lets say at time 1 :-



and at time 2, we multiply the I_{ip} by a factor of 2 . i.e



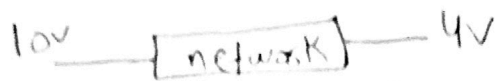
So at o_{ip} , we also get 1000pm means $500pm \times 2$.

So the above network follows homogeneity.

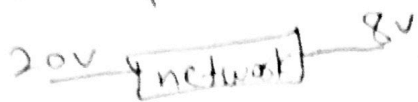
" I_{ip} output also gets scaled by the same factor as input, then we say that the network is homogeneous."

Pr: additivity:-

Let say at time 1, I_{lp} is $10V$ & o/p is $4V$. i.e



at time 2, I_{lp} is $20V$ & o/p is $8V$. i.e



Now at time 3, add 2 I_{lp} s which gives us $30V$.

So if at o/p , we also get the o/p of time 1 and 2, then we say that the above network follows the principle of additivity.

