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STUDY ON CIRCUIT ANALYSIS WITH RESPECT TO SIGNALS AND SYSTEMS IN INSTRUMENTATION

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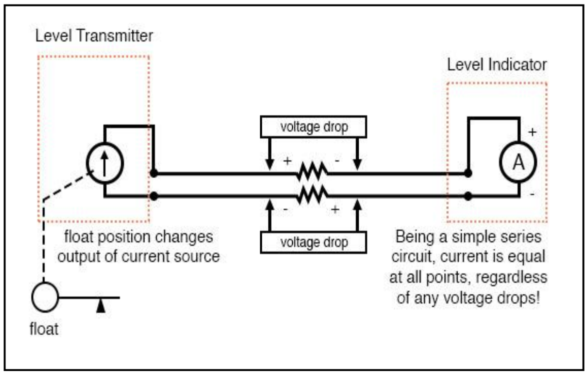
ABSTRACT

An element is said to be bilateral, when the same relation exists between voltage and current for the current flowing in both directions. Ex: Voltage source, Current source, resistance, inductance & capacitance. The circuits containing them are called bilateral circuits. An element is said to be unilateral, when the same relation does not exist between voltage and current when current flowing in both directions. The circuits containing them are called unilateral circuits. Ex: Vacuum diodes, Silicon Diodes, Selenium Rectifiers etc. Lumped and Distributed Elements Lumped elements are those elements which are very small in size & in which simultaneous actions takes place. Typical lumped elements are capacitors, resistors, inductors. Distributed elements are those which are not electrically separable for analytical purposes. For example a transmission line has distributed parameters along its length and may extend for hundreds of miles. The circuits containing them are called unilateral circuits.



KEYWORDS :*Circuit, Elements, Voltage etc.*

INTRODUCTION :

An Electric circuit is an interconnection of various elements in which there is at least one closed path in which current can flow. An Electric circuit is used as a component for any engineering system. The performance of any electrical device or machine is always studied by drawing its electrical equivalent circuit. By simulating an electric circuit, any type of system can be studied for e.g., mechanical, hydraulic thermal, nuclear, traffic flow, weather prediction etc. All control systems are studied by representing them in the form of electric circuits. The analysis, of any system can be learnt by mastering the techniques of circuit theory. The analysis of any system can be learnt by mastering the techniques of circuit theory. Elements of an Electric circuit: An Electric circuit consists of following types of elements. Active elements: Active elements are the elements of a circuit which possess energy of their own and can impart it to other element of the circuit. Active elements are of two types

a) Voltage source
b) Current source

REVIEW OF LITERATURE

A Voltage source has a specified voltage across its terminals, independent of current flowing through it. A current source has a specified current through it independent of the voltage appearing across it.

PASSIVE ELEMENTS:

The passive elements of an electric circuit do not possess energy of their own. They receive energy from the sources. The passive elements are the resistance, the inductance and the capacitance. When electrical energy is supplied to a circuit element, it will respond in one and more of the following ways. If the energy is consumed, then the circuit element is a pure resistor. If the energy is stored in a magnetic field, the element is a pure inductor. And if the energy is stored in an electric field, the element is a pure capacitor.

LINEAR AND NON-LINEAR ELEMENTS.

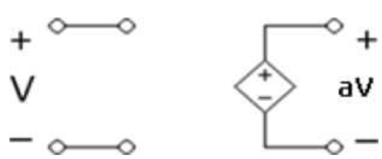
Linear elements show the linear characteristics of voltage & current. That is its voltage-current characteristics are at all-times a straight-line through the origin. For example, the current passing through a resistor is proportional to the voltage applied through its and the relation is expressed as V I or V = IR. A linear element or network is one which satisfies the principle of superposition, i.e., the principle of homogeneity and additively. Resistors, inductors and capacitors are the examples of the linear elements and their properties do not change with a change in the applied voltage and the circuit current. Non linear element's V-I characteristics do not follow the linear pattern i.e. the current passing through it does not change linearly with the linear change in the voltage across it. Examples are the semiconductor devices such as diode, transistor.

MATERIAL AND METHODS

Types of Sources:

Independent & Dependent sources: If the voltage of the voltage source is completely independent source of current and the current of the current source is completely independent of the voltage, then the sources are called as independent sources. The special kind of sources in which the source voltage or current depends on some other quantity in the circuit which may be either a voltage or a current anywhere in the circuit are called Dependent sources or Controlled sources. There are four possible dependent sources:

a. Voltage dependent Voltage source
b. Current dependent Current source
c. Voltage dependent Current source
d. Current dependent Current source



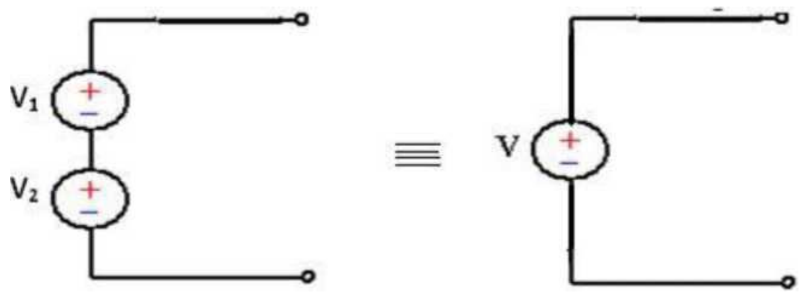
Voltage Dependent Voltage Source.

The constants of proportionalities are written as B, g, a, r in which B & a has no units, r has units of ohm & g units of mhos.

Independent sources actually exist as physical entities such as battery, a dc generator & an alternator. But dependent sources are used to represent electrical properties of electronic devices such as OPAMPS & Transistors.

IDEAL & PRACTICAL SOURCES:

1. An ideal voltage source is one which delivers energy to the load at a constant terminal voltage, irrespective of the current drawn by the load.
2. An ideal current source is one, which delivers energy with a constant current to the load, irrespective of the terminal voltage across the load.
3. A Practical voltage source always possesses a very small value of internal resistance r. The internal resistance of a voltage source is always connected in series with it & for a current source; it is always connected in parallel with it. As the value of the internal resistance of a practical voltage source is very small, its terminal voltage is assumed to be almost constant within a certain limit of current flowing through the load.
4. A practical current source is also assumed to deliver a constant current, irrespective of the terminal voltage across the load connected to it.

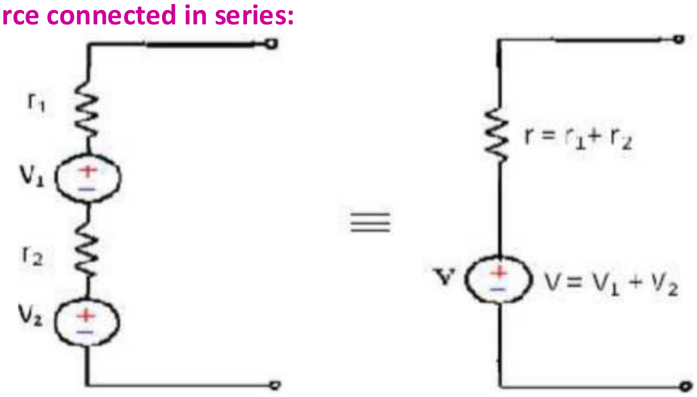


RESULTS AND DISCUSSION

The equivalent single ideal voltage some is given by V= V1 + V2

Any number of ideal voltage sources connected in series can be represented by a single ideal voltage some taking in to account the polarities connected together in to consideration.

Practical voltage source connected in series:



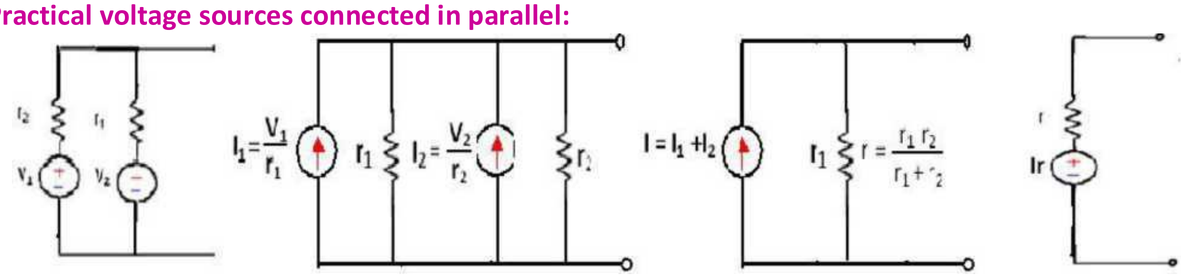
When two ideal voltage sources of emf's V1 & V2 are connected in parallel, what voltage appears across its terminals is ambiguous.

Hence such connections should not be made.

However if V1 = V2= V, then the equivalent voltage some is represented by V.

In that case also, such a connection is unnecessary as only one voltage source serves the purpose.

Practical voltage sources connected in parallel:



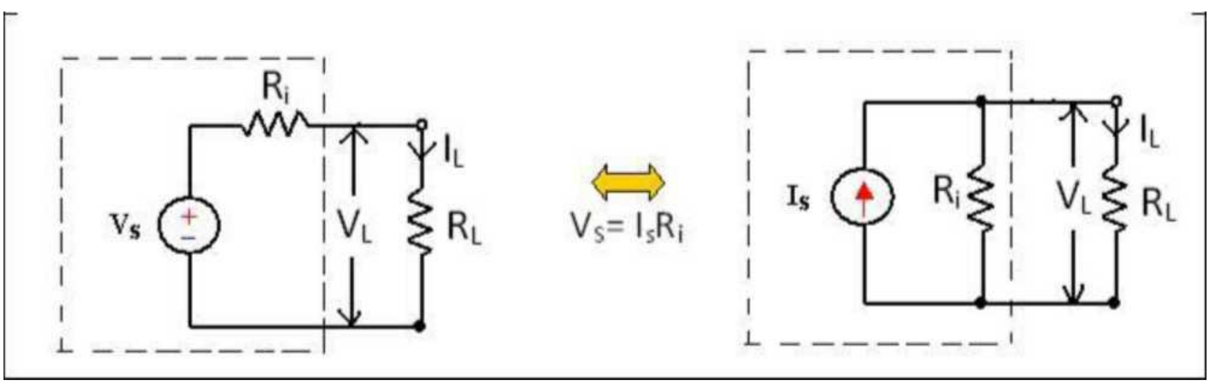
Equivalent Circuit

current flows through the line is ambiguous. Hence such a connection is not permissible.
However, it I1 = I2 = I, then the current in the line is I.
But, such a connection is not necessary as only one current source serves the purpose.

Source transformation:

A current source or a voltage source drives current through its load resistance and the magnitude of the current depends on the value of the load resistance.

Consider a practical voltage source and a practical current source connected to the same load resistance RL as shown in the figure



R1's in figure represents the internal resistance of the voltage source VS and current source IS.

Two sources are said to be identical, when they produce identical terminal voltage VL and load current IL.

The circuit in figure represents a practical voltage source & a practical current source respectively, with load connected to both the sources.

The terminal voltage VL and load current IL across their terminals are same.

Hence the practical voltage source & practical current source shown in the dotted box of figure are equal.

The two equivalent sources should also provide the same open circuit voltage & short circuit current.

Hence a voltage source Vs in series with its internal resistance R can be converted into a current source VsI = , with its internal resistance R connected in parallel with it. Similarly a current source Iin parallel with its internal resistance R can be converted into a voltage source V = IR in series with itsinternal resistance R.

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