Model test paper

Sub-Circuit Analysis

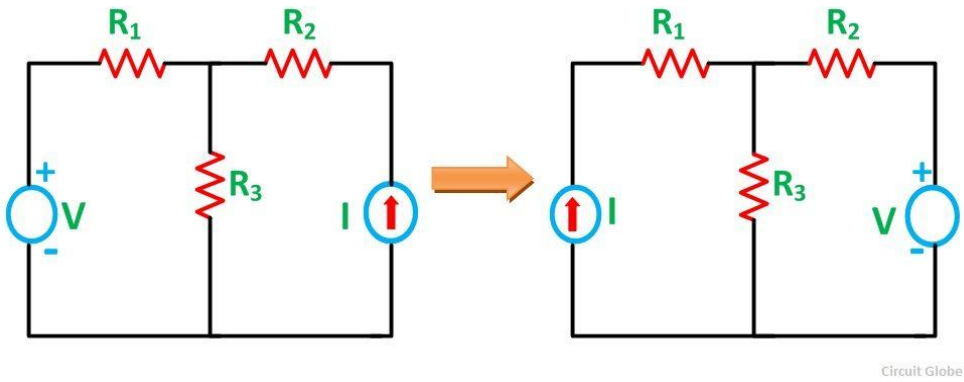
EL-202

Q.1 Explain Reciprocity Theorem?

Reciprocity Theorem states that – In any branch of a network or circuit, the current due to a single source of voltage (V) in the network is equal to the current through that branch in which the source was originally placed when the source is again put in the branch in which the current was originally obtained. This theorem is used in the bilateral linear network which consists bilateral components.

The location of the voltage source and the current source may be interchanged without a change in current. However, the polarity of the voltage source should be identical with the direction of the branch current in each position.

The Reciprocity Theorem is explained with the help of the circuit diagram shown below



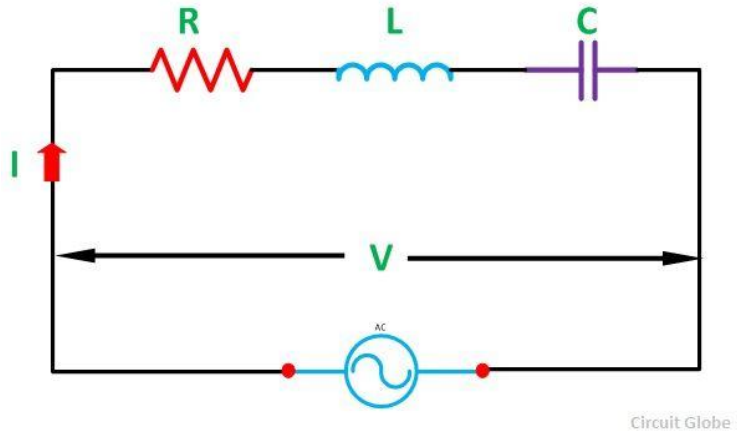
The various resistances R_1, R_2, R_3 is connected in the circuit diagram above with a voltage source (V) and a current source (I). It is clear from the figure above that the voltage source and current sources are interchanged for solving the network with the help of Reciprocity Theorem.

The limitation of this theorem is that it is applicable only to single source networks and not in the multi-source network. The network where reciprocity theorem is applied should be linear and consist of resistors, inductors, capacitors and coupled circuits. The circuit should not have any time-varying elements.

Q.2 Write short note on Series resonance?

In the RLC series circuit, when the circuit current is in phase with the applied voltage, the circuit is said to be in **Series Resonance.** The resonance condition arises in the series RLC Circuit when the inductive reactance is equal to the capacitive reactance $X_L = X_C$ or ($X_L - X_C = 0$). A series resonant circuit has the capability to draw heavy current and power from the

mains; it is also called as Acceptor Circuit. The series resonance RLC circuit is shown in the figure below



At the resonance : $X_L - X_C = 0$ or $X_L = X_C$

The Impedance will be

$$Z_r = \sqrt{R^2 + (X_L - X_C)^2} \ldots\ldots\ldots\ldots (1)$$

Where Zr is the resonance impedance of the circuit.

Putting the value of $X_L - X_C = 0$ in equation (1) we will get

Zr = R

Current I = V/ Zr = V/R

Since at resonance the opposition to the flow of current is only resistance (R) of the circuit. At this condition, the circuit draws the maximum current