Norton's theorem :-

This theorem states that any two terminal network consisting of linear impedances and generators can be replaced by an equivalent circuit containing a current source I in parallel with an admittance Y'. The value of I' is the short circuited current between the terminals of the network and Y' is the admittance measured betw. the terminals with all generators removed (but not their admittance).

This theorem proved by considering a Thevenin's equivalent network in figure (1)(a). The load impedance Z_R is appearing between two terminals a and b. Now this Thevenin's equivalent circuit may be easily converted into a circuit containing current source I' in parallel with Y' and Y_R appearing between two terminals a and b as shown in figure (1)(b) given below–

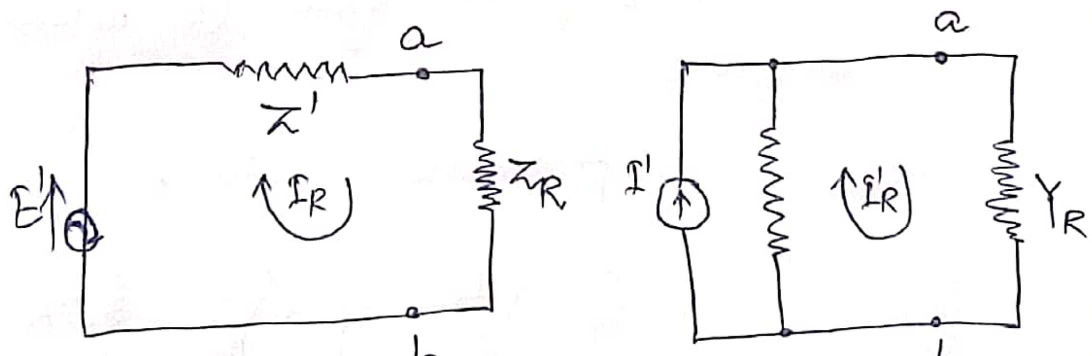

fig. (1)(a)   fig.(1)(b)

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The value of I_R from fig. (1)(a) is given by,

$$I_R = \frac{E'}{Z' + Z_R}$$

$$\Rightarrow I_R = \frac{E'}{\frac{1}{Y'} + \frac{1}{Y_R}}$$

$$\Rightarrow I_R = \frac{E'Y'Y_R}{Y' + Y_R} \quad \text{———} \quad (1)$$

where, Y' and Y_R are the reciprocal of Z' and Z_R respectively known as admittances.

Now, Applying the current division law in figure (1)(b) we have,

$$I'_R = \frac{I' Y_R}{Y' + Y'_R} \quad \text{———} \quad (2)$$

The load current I'_R clearly indicates that circuit (1)(a) and (1)(b) is equivalent to the original figure (3) which is given below -

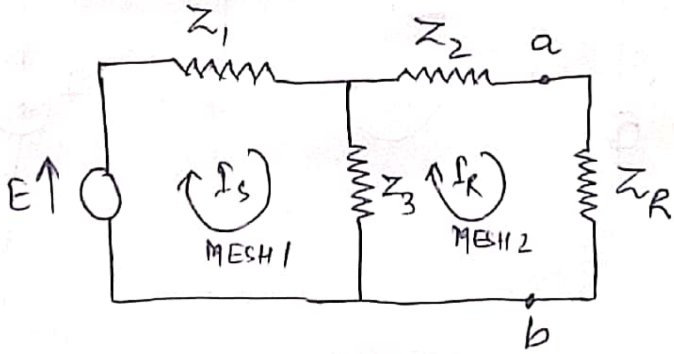

fig. (3)

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The load current I'_R can be equal to I_R. Then the comparison of eqⁿ. (1) & (2) gives,

$$I' = E'Y'$$
$$= \frac{E'}{Z'} \quad \text{———} \quad (3)$$

Equation (3) clearly indicates that circuit (1)(a) and (1)(b) be the same.

Thus we see that interchange of voltage and current source with the help of Thevenin's and Nortons theorem give a method of circuit analyses. As described earlier voltage source is removed from a circuit by short circuiting its e.m.f. whereas a current source is removed by opening its circuit.

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