E
46

Experiment - 5

Aim :- Calculation and verification of Norton's Theorem.

Apparatus :- DC Power Supply, Ammeter (0-1A) Voltmeter (0-150V), Rheostats, Multimeter.

Circuit Diagram :-

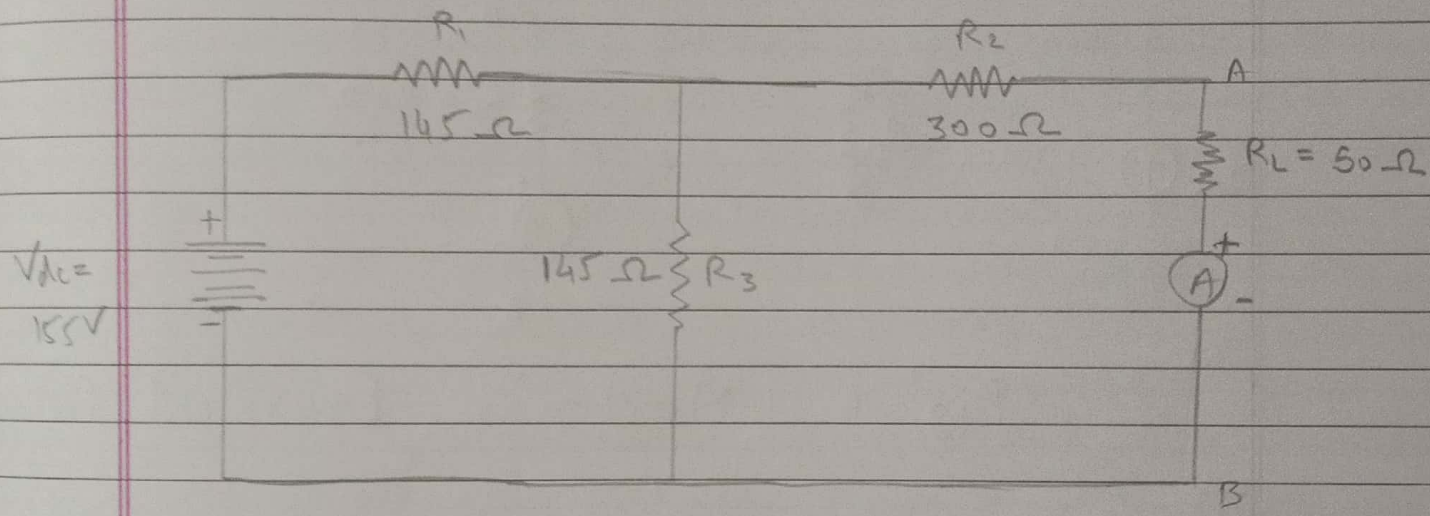

Fig : 1 : Basic Circuit

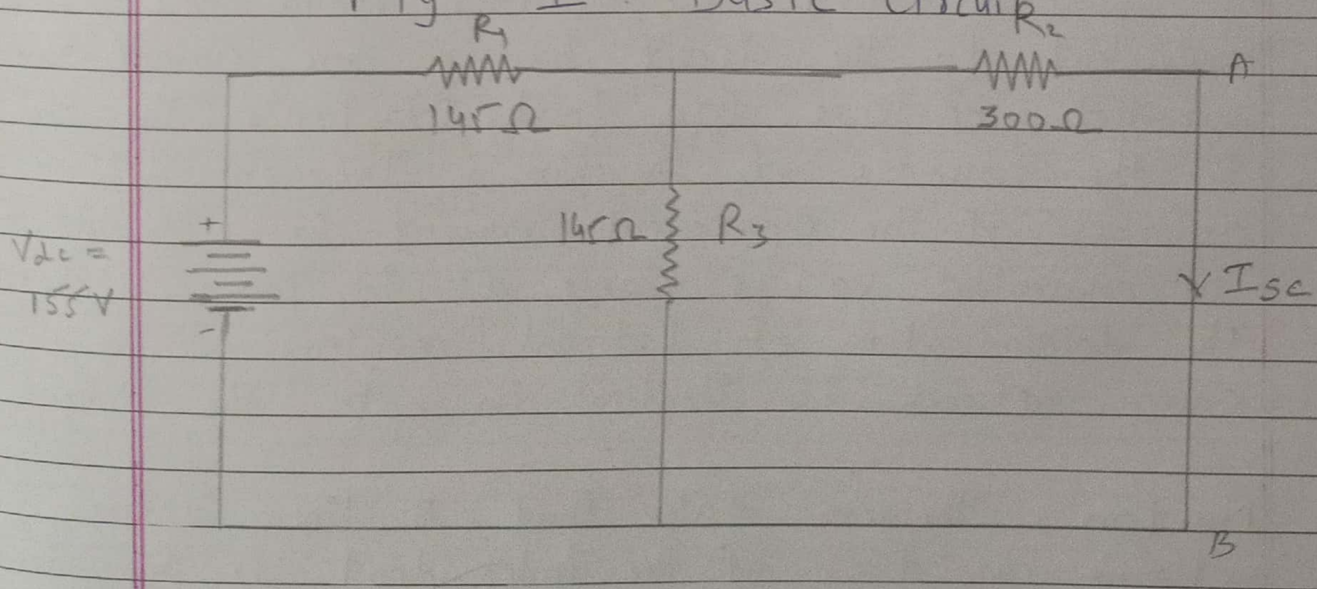

Fig . 2 : Calculation of I_{sc}

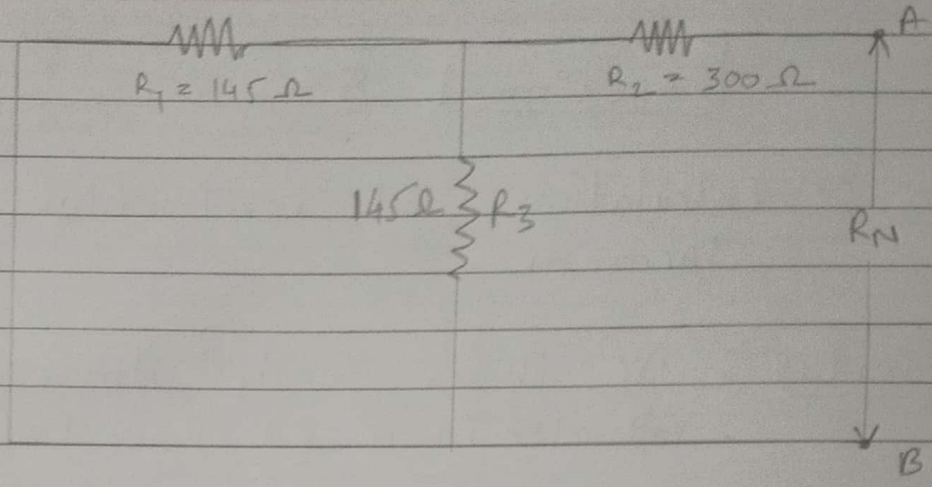

Fig. 3 : Calculation of R_N

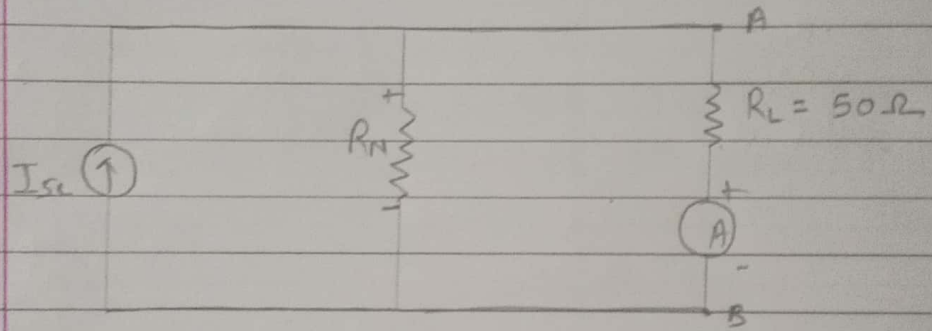

Fig 4 : Norton's Equivalent Circuit

Theory :-

The Norton's theorems reduce the networks equivalent to the circuit having one current source, parallel resistence and load. Norton's theorem is the converse of Thevenin's Theorem. It consists of the equivalent current source instead of an equivalent voltage source as in Thevenin's theorem. The determination of Internal resistence of the source network is identical in both the theorems.

Norton's theorem states that, "A linear active network consisting of the independent or dependent voltage source and current sources and the various circuit elements can be sustituted by an equivalent circuit consisting of a current source in parallel with a resistance. The current source being the short-circuited current across the load terminal i.e. I_{sc} and the resistence being the internal resistance of the source network i.e., R_N."

Procedure :-

1) Connect the circuit as shown in Fig. 1.
2) Measure the current through the load resistor (I_L) using ammeter and note it down
3) Remove the load resistor and calculate the short circuit current (I_{sc}) across the terminals A & B as shown in Fig. 2.
4) Short circuit the voltage source and calculate Norton's equivalent resistance (R_N) across the terminals A & B as shown in Fig. 3.
5) Connect the circuit as shown in Fig 4. i.e. Norton's equivalent circuit and calculate the current through load resistor by using ammeter and note it down.

Page No. :
Date : / /2018

Observation :-

Parameters	Observed Values	Calculated Values
Load current, I_L	0.19A	0.183 A
Short Circuit Current, I_{sc}	0.23 A	0.208 A
Norton's equivalent resistance, R_N	400 Ω	372.5 Ω
Load current using Norton's theorem, I_L'	0.20 A	0.183 A

Calculations :-

1) Finding R_N

$$R_N = R_1 \parallel R_3 + R_2$$

$$= \frac{145 \times 145}{145+145} + 300$$

$$= \frac{142}{2} + 300$$

$$\boxed{R_N = 372.5\ \Omega}$$

2) Finding I_{sc}

$$R_{eq} = \frac{300 \times 145}{300+145} + 145 = 242.75\ \Omega$$

$$I_{sc} = \frac{145}{300+145} \times \frac{V_{dc}}{R_{eq}} = \frac{145}{445} \times \frac{155}{242.75} = 0.208\ A$$

Page No.:
Date: / /2018

3) Finding I_L'

$$I_L' = \frac{R_N}{R_L + R_N} \times I_{sc} = \frac{372.5}{50 + 372.5} \times 0.208$$

$$\boxed{I_L' = 0.1833A}$$

Questions :-

1) Calculate the current through load resistor using Norton's theorem for circuit shown in Fig.1. for following values of load resistor

(a) $R_L = 75\,\Omega$

$$I_L' = \frac{R_N}{R_L + R_N} \times I_{sc} = \frac{372.5}{75 + 372.5} \times 0.208$$

$$\boxed{I_L' = 0.173A}$$

(b) $R_L = 100\,\Omega$

$$I_L' = \frac{372.5}{100 + 372.5} \times 0.208 = 0.1639\,A$$

Result

(1) Load resistor current = $I_L = 0.183A$
(2) Norton's equivalent resistance $R_N = 372.5$
(3) Short circuit current $I_{sc} = 0.208A$
(4) Load current using Norton's theorem $I_L' = 0.183A$

Conclusion:

As the current through load resistor in both calculation is same, Norton's theorem is verified.