EEE Digital Assignment (Software)

Thevenin Theorm

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THEVENIN THEORM

AIM:

Solve any DC circuit by network Theorems

APPARATUS/TOOL REQUIRED:

Apparatus/Tool required:

ORCAD / PSpice simulator -> **Analog Library – R,**
Source Library – Vdc, Idc &
Ground (GND) – 0 (zero)

Simulation Settings: **Analysis Type - Bias Point**

THEORY:

Thévenin's theorem holds that:

- Any linear electrical network with voltage and current sources and only resistances can be replaced at terminals A-B by an equivalent voltage source V_{th} in series connection with an equivalent resistance R_{th}.
- The equivalent voltage V_{th} is the voltage obtained at terminals A-B of the network with terminals A-B open circuited.
- The equivalent resistance R_{th} is the resistance that the circuit between terminals A and B would have if all ideal voltage sources in the circuit were replaced by a short circuit and all ideal current sources were replaced by an open circuit.
- If terminals A and B are connected to one another, the current flowing from A to B will be V_{th}/R_{th}. This means that R_{th} could alternatively be calculated as V_{th} divided by the short-circuit current between A and B when they are connected together.

In circuit theory terms, the theorem allows any one-port network to be reduced to a single voltage source and a single impedance.

The theorem also applies to frequency domain AC circuits consisting of reactive and resistive impedances.

Thévenin's theorem and its dual, Norton's theorem, are widely used to make circuit analysis simpler and to study a circuit's initial-condition and steady-state response.[7][8] Thévenin's theorem can be used to convert any circuit's sources and impedances to a **Thévenin equivalent**; use of the theorem may in some cases be more convenient than use of Kirchhoff's circuit laws.

PROCEDURE:

Step 1: Open Capture CIS

Step 2: Click on the File button

Step 3: Click on New Project

Step 4: Select Blank Project

Step 5: Go to Library

Step 6: Select Analog Library – R

Step 7: Select Source Library – Vac, Vdc &Ground (GND) – 0 (zero)

Step 8: Click on New Simulation

Step 9: Analysis Type - Bias Point

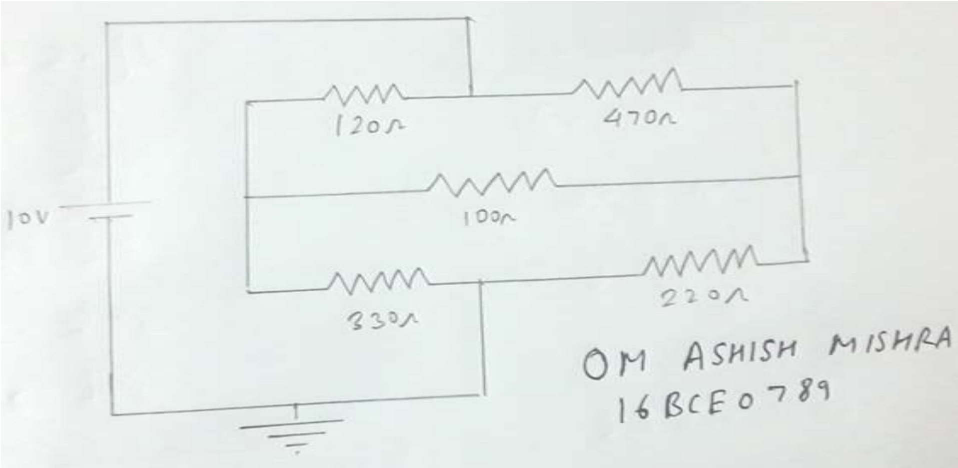
Step 10: Run to time - 40ms (for 2 cycles)

Step 11: Apply it

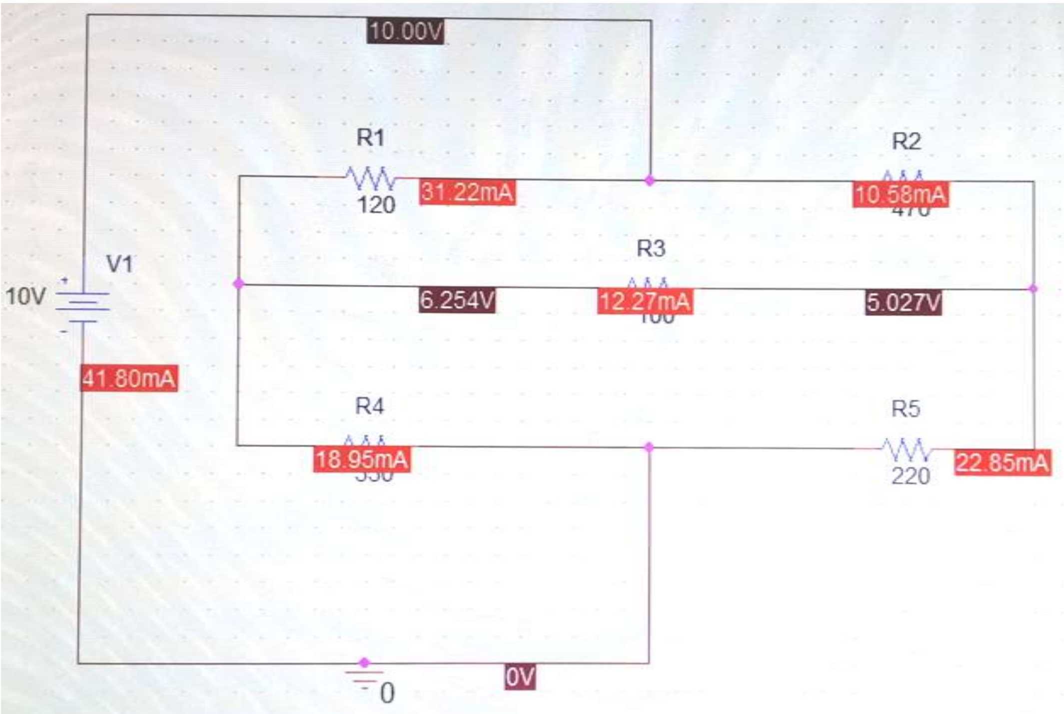
Step 12: Then we run the simulated program

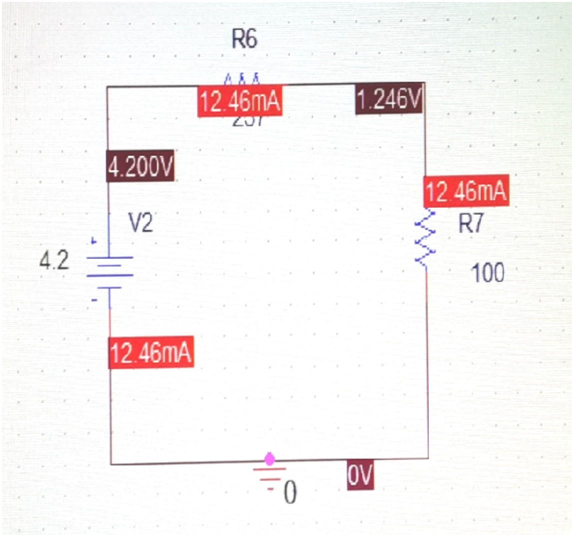
Step 13: Then we get the output.

CIRCUIT DIAGRAM:



SIMULATION CIRCUITS DIAGRAM:





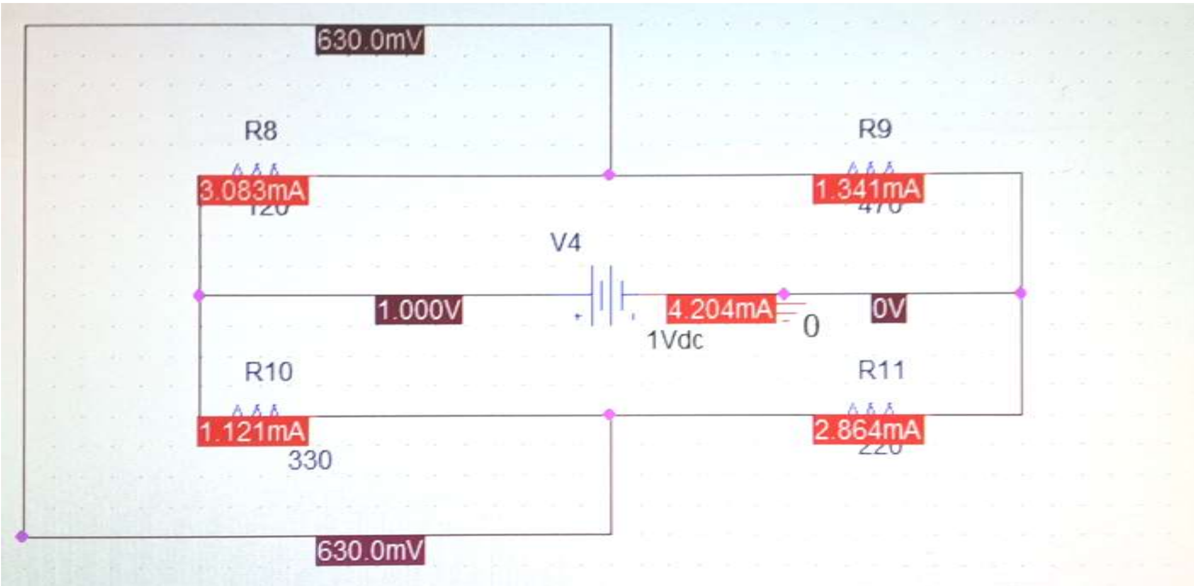
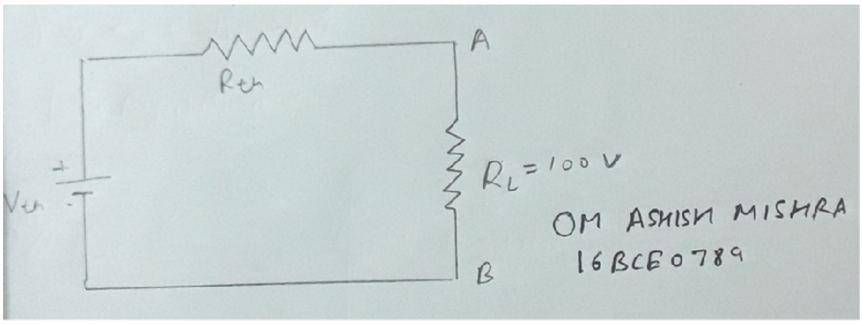


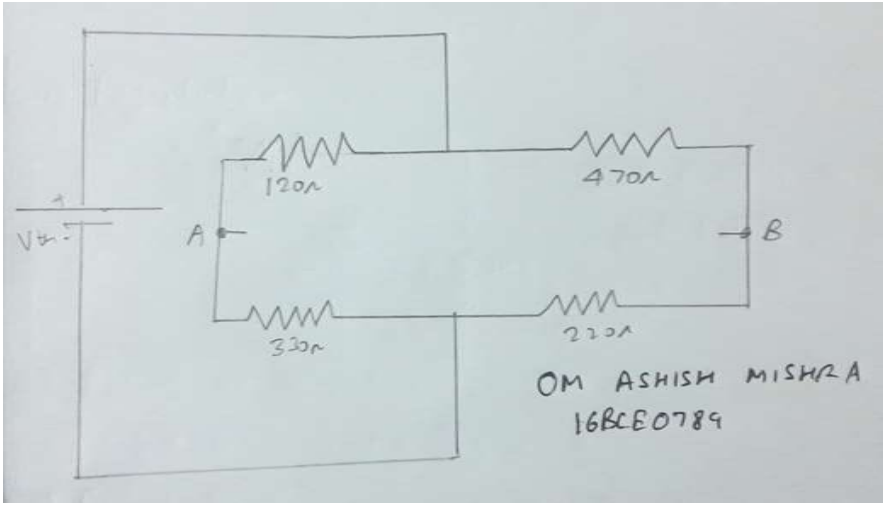
Fig: The circuits with current and voltage

MANUAL CALCULATIONS:

For Thevenin Theorem we have to reduce the circuit to the form: -



For that we first remove 100Ω resistance and mark its ends as A and B :-



Calculation for V_{th} is:

We know, $V_{th} = V_A - V_B$

$$V_A = \text{Total Voltage} \times \frac{\text{Same Resistance}}{\text{Total Resistance}}$$

$$V_A = 10 \times \frac{330}{330+120} = 7.3\,V$$

$$V_B = 10 \times \frac{220}{470+220} = 3.1\,V$$

$$\therefore V_{th} = V_A - V_B$$

$$= 7.3 - 3.1\,V$$

$$= 4.2\,V$$

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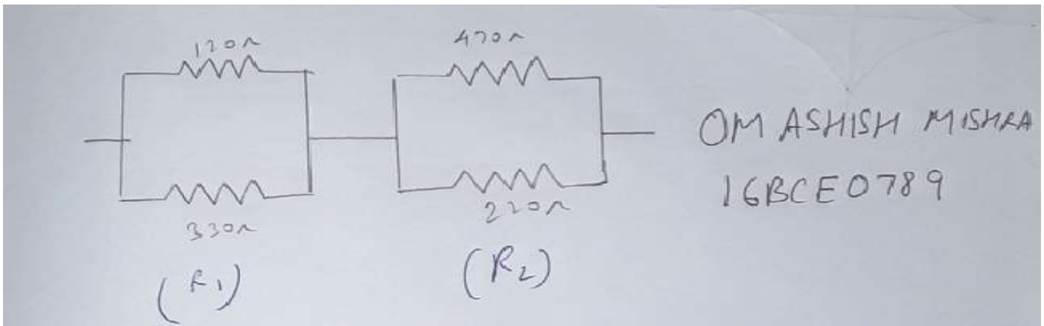
Calculation for R_{th} is:

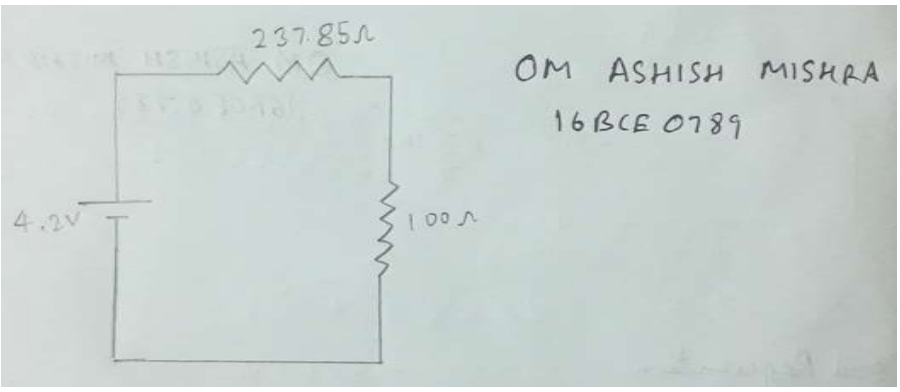


$$R_1 = \frac{330 \times 120}{330 + 120} = 88\,\Omega \qquad R_2 = \frac{470 \times 220}{220 + 470} = 149.85\,\Omega$$

$$R_{eq} = R_1 + R_2 = 237.85\,\Omega$$

$$\therefore R_{th} = 237.85\,\Omega$$

Thus the circuit become:-



Thus the current through the 100 Ω is:-

$$I_L = \frac{V_{th}}{R_L + R_{th}} = \frac{4.2}{100 + 237.85} = 12.431\,mA$$

$$\therefore I_L = 12.431\,mA$$

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RESULT:

Thus we can see from this experiment that :

	Manual Calculations	Simulated Result
I_L	12.431 mA	12.27 mA
V_{TH}	4.2 V	4.2 V
R_{TH}	237.85 Ω	237 Ω

Since the result is not very high in difference, thus we say that the experimental and the theoretical values are same if the experimental errors are removed.

INFERENCE:

In this experiment cleared our knowledge about Thevenin Theorem and helped us to theoretically and experimentally compare the data.