UNIVERSITY
OF WOLLONGONG
IN DUBAI

Assignment Cover Sheet

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Subject code and name	ECTE202 – Circuits and Systems
Lab Instructor	Ms. Eva Barbulescu
Title of Assignment	Lab 2
Lab Number	2

Student declaration and acknowledgment

By submitting this assignment online, the submitting student declares on behalf of the team that:

1. All team members have read the subject outline for this subject, and this assessment item meets the requirements of the subject detailed therein.
2. This assessment is entirely our work, except where we have included fully documented references to the work of others. The material in this assessment item has yet to be submitted for assessment.
3. Acknowledgement of source information is by the guidelines or referencing style specified in the subject outline.
4. All team members know the late submission policy and penalty.
5. The submitting student undertakes to communicate all feedback with the other team members.

Lab 2

Task 1: Application of the Nodal Analysis

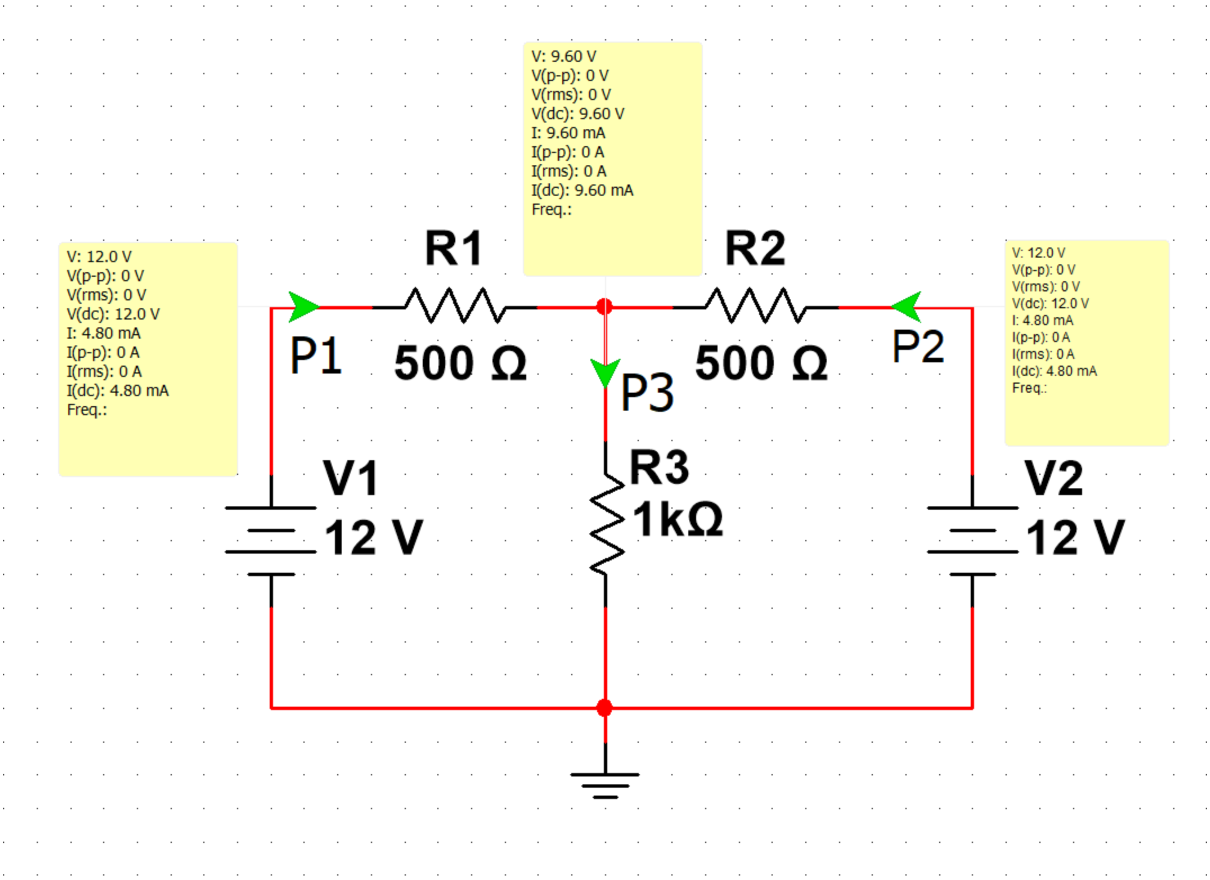


Table 1: Nodal Analysis Readings

I_1	4.8 mA
I_2	4.8 mA
I_3	9.6 mA
V_3	9.6 V

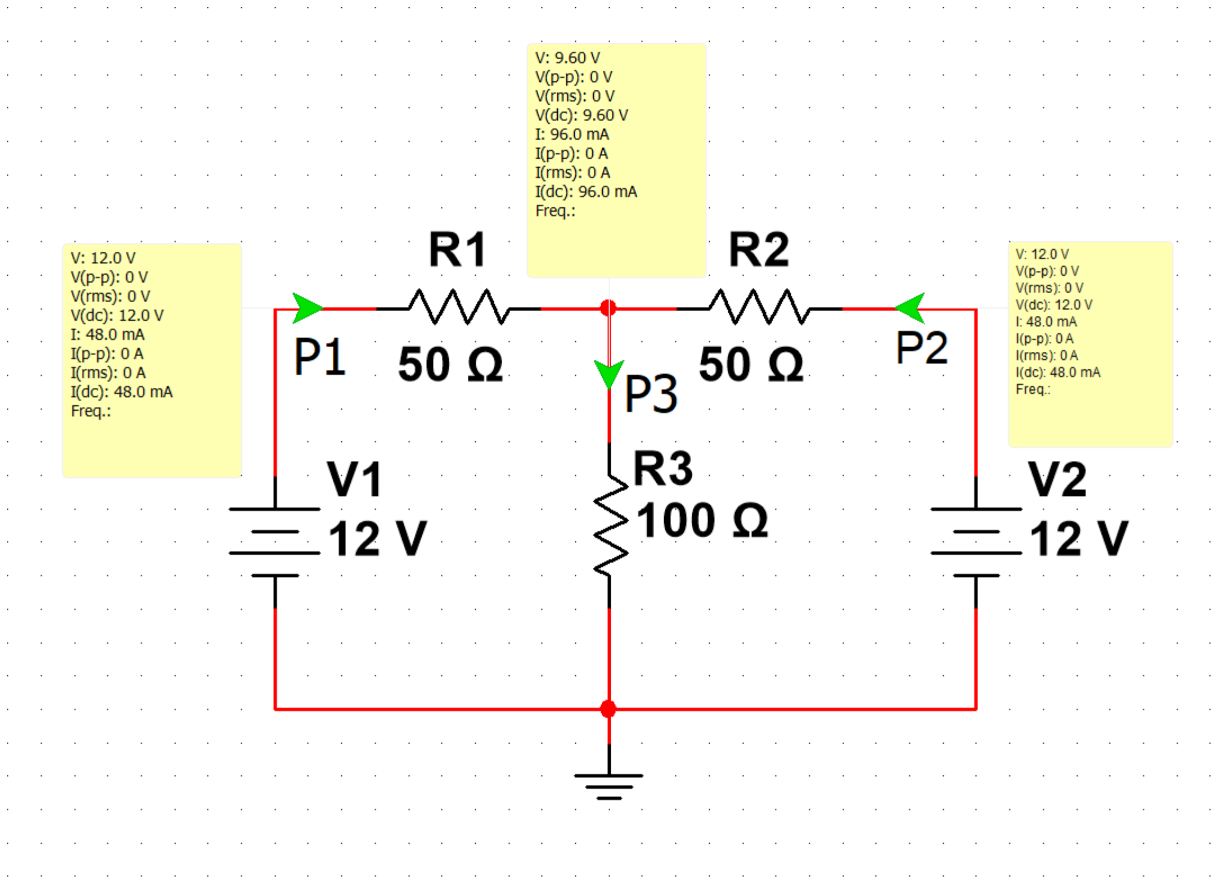


Table 2: Updated Nodal Analysis Readings

I_1	48 mA
I_2	48 mA
I_3	96 mA
V_3	9.6 V

Yes, the current values multiplied by 10 as the resistance was divided by 10.

At Node V_3

$$\frac{12 - V_3}{50} + \frac{12 - V_3}{50} = \frac{V_3}{100}$$

$$2\left(\frac{12 - V_3}{50}\right) = \frac{V_3}{100}$$

$$200\left(\frac{12 - V_3}{50}\right) = V_3$$

$$4(12 - V_3) = V_3 \ \Rightarrow 48 - 4V_3 = V_3 \ \Rightarrow 48 = 5V_3$$

$$V_3 = \frac{48}{5}$$

$$\boldsymbol{V_3 = 9.6\ V}$$

Task 2: Application of the Mesh Analysis

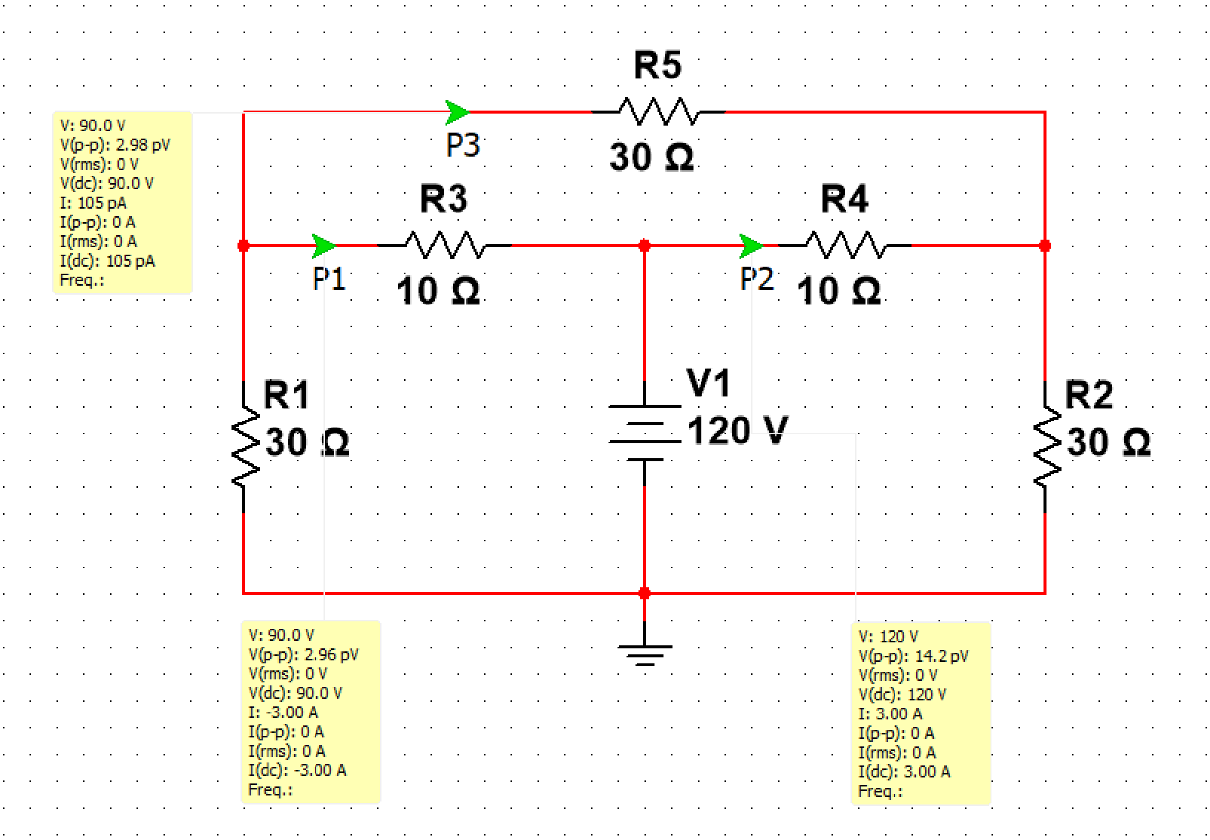


Table 3: Current Readings

I_1	-3 A
I_2	3 A
I_3	105 pA

$$120 = 10I_3 - 40I_1 \text{ --(1)}$$

$$120 = 40I_2 - 10I_3 \text{ --(2)}$$

$$I_3 = \frac{10I_1 + 10I_2}{40} \text{ --(3)}$$

Replacing Equation 3 in Equations 1 and 2, we get

$$120 = 10\left(\frac{10I_1 + 10I_2}{40}\right) - 40I_1 \text{ --(4)}$$

$$120 = 40I_2 - 10\left(\frac{10I_1 + 10I_2}{40}\right) \text{ --(5)}$$

Rearranging Equation 4, we get

$$120 = 100\left(\frac{I_1 + I_2}{40}\right) - 40I_1$$

$$120 = 2.5(I_1 + I_2) - 40I_1$$

$$120 = 2.5I_1 + 2.5I_2 - 40I_1$$

$$120 = 2.5I_2 - 37.5I_1 \Longrightarrow\ 120 + 37.5I_1 = 2.5I_2$$

$$I_2 = \frac{120 + 37.5I_1}{2.5} = 48 + 15I_1 - -(6)$$

Replacing this in equation 5, we get the value of I_1 as

$$120 = 40(48 + 15I_1) - 10\left(\frac{10I_1 +\ 10I_2}{40}\right)$$

$$120 = 40(48 + 15I_1) - 2.5I_1 -\ 2.5I_2$$

$$120 = 40(48 + 15I_1) - 2.5I_1 -\ 2.5(48 + 15I_1)$$

$$120 = 40(48 + 15I_1) - 2.5I_1 -\ 120 - 37.5I_1$$

$$120 = 1920 + 600I_1 - 2.5I_1 - 120 - 37.5I_1$$

$$560I_1 = -1680\ \Longrightarrow I_1 =\ -\frac{1680}{560}$$

$$\boldsymbol{I_1 =\ -3\ A}$$

Replacing this in Equation 6, we get I_2 as

$$I_2 = 48 + 15I_1$$

$$I_2 = 48 + 15(-3) \Longrightarrow\ I_2 = 48 - 45$$

$$\boldsymbol{I_2 = 3\ A}$$

Replacing this in Equation 3, we get I_3 as

$$I_3 = \frac{10I_1 +\ 10I_2}{40}$$

$$I_3 = \frac{10(-3) +\ 10(3)}{40}$$

$$I_3 = \frac{0}{40} \Longrightarrow\ \boldsymbol{I_3 = 0\ A}$$

This matches the readings in Multisim. The value of I_3 in the simulation is 105×10^{-12} A, which is likely a simulation error and can be safely ignored.

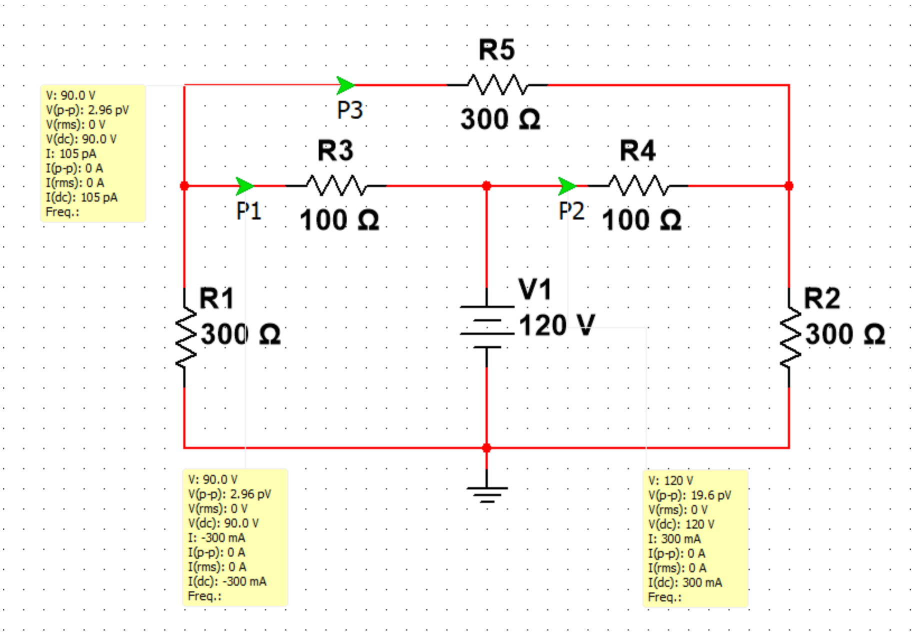
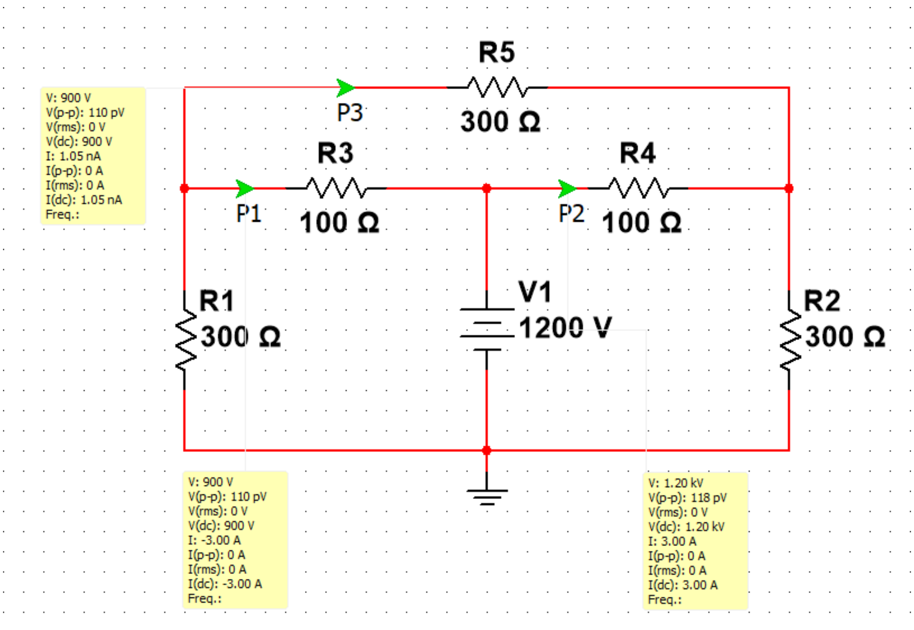


Table 4: Current Readings

I_1	-300 mA
I_2	300 mA
I_3	105 pA

The current values were divided by 10 when the resistance values were multiplied by 10.



The current values were multiplied by 10 when the voltage source was multiplied by 10.

Task 3: Mesh Analysis with Dependent Sources

Solving the three equations

$$-3 + (100 + 200)I_1 - 200I_2 = 0 - -(1)$$

$$200(I_2 - I_1) - 5V_x + 300I_2 = 0 \quad - -(2)$$

$$V_x = 200(I_1 - I_2) \qquad\qquad - -(3)$$

Obtaining I_1 in terms of I_2

$$-3 + (100 + 200)I_1 - 200I_2 = 0$$

$$-3 + 300I_1 - 200I_2 = 0$$

$$300I_1 = 200I_2 + 3$$

$$I_1 = \frac{200I_2 + 3}{300} - -(4)$$

Replacing Equations 2 and 4 in Equation 2, we get

$$200\left(I_2 - \frac{200I_2 + 3}{300}\right) - 1000\left(\frac{200I_2 + 3}{300} - I_2\right) + 300I_2 = 0$$

$$200I_2 - 2\left(\frac{200I_2 + 3}{3}\right) + 1000I_2 - 10\left(\frac{200I_2 + 3}{3}\right) + 300I_2 = 0$$

$$200I_2 - \frac{400I_2}{3} - 2 + 1000I_2 - 10 - \frac{2000I_2}{3} + 300I_2 = 0$$

$$200I_2 - \frac{400I_2}{3} + 1000I_2 - \frac{2000I_2}{3} + 300I_2 = 12$$

$$700I_2 = 12$$

$$I_2 = \frac{12}{700} = \frac{3}{175}$$

$$I_2 = 17.1\ mA$$

Replacing this in Equation 4, we obtain I_1

$$I_1 = \frac{200I_2 + 3}{300}$$

$$I_1 = \frac{200(0.0171) + 3}{300}$$

$$I_1 = \frac{107}{5000}$$

$$I_1 = 21.4\ mA$$

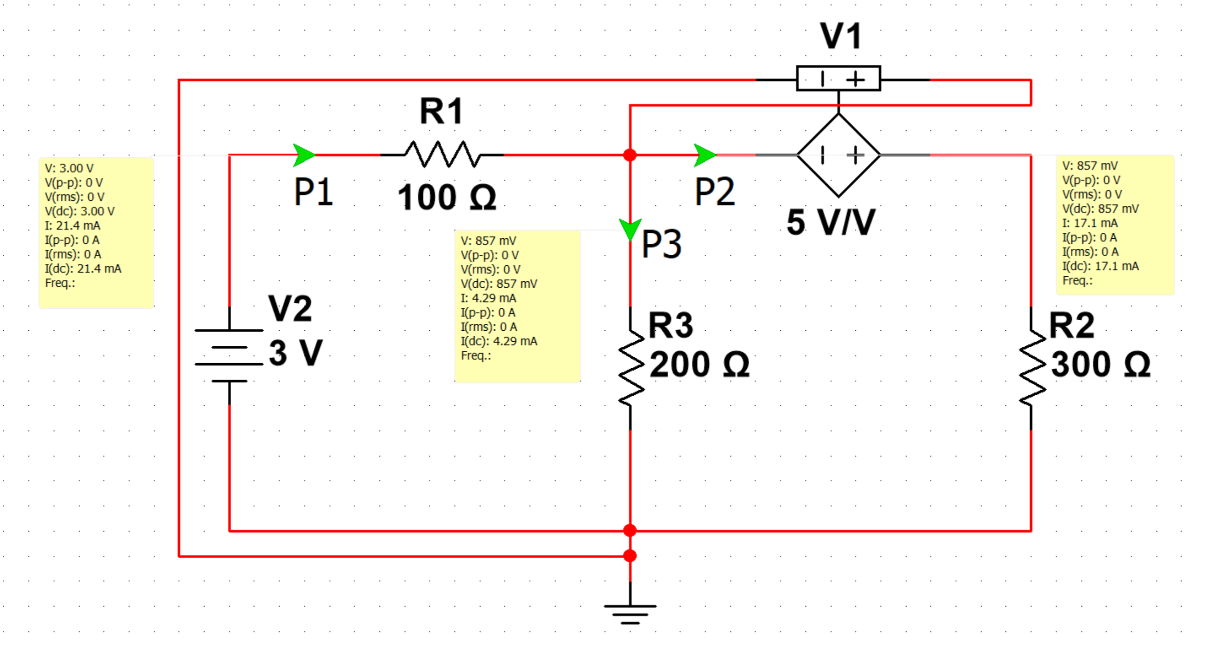
To find V_x, we simply replace the obtained values of I_1 and I_2 into Equation 3.

$$V_x = 200(I_1 - I_2)$$

$$V_x = 200(21.4 - 17.1)$$

$$V_x = 200(4.3)$$

$$V_x = 860\ mV$$



The results in Multisim closely match the results in the calculations. The slight difference is due to rounding off the numbers and can be fixed by taking more significant digits into consideration during calculations.