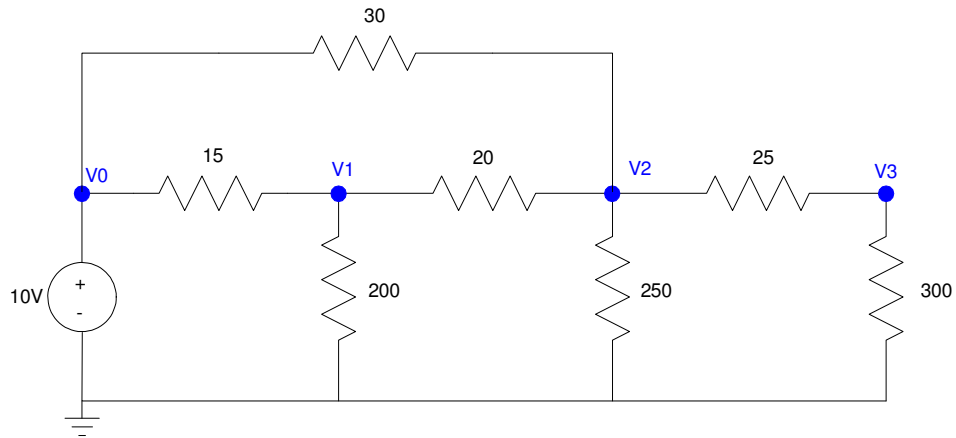


# ECE 111: Intro to ECE

## Week #9 Circuits I Handout

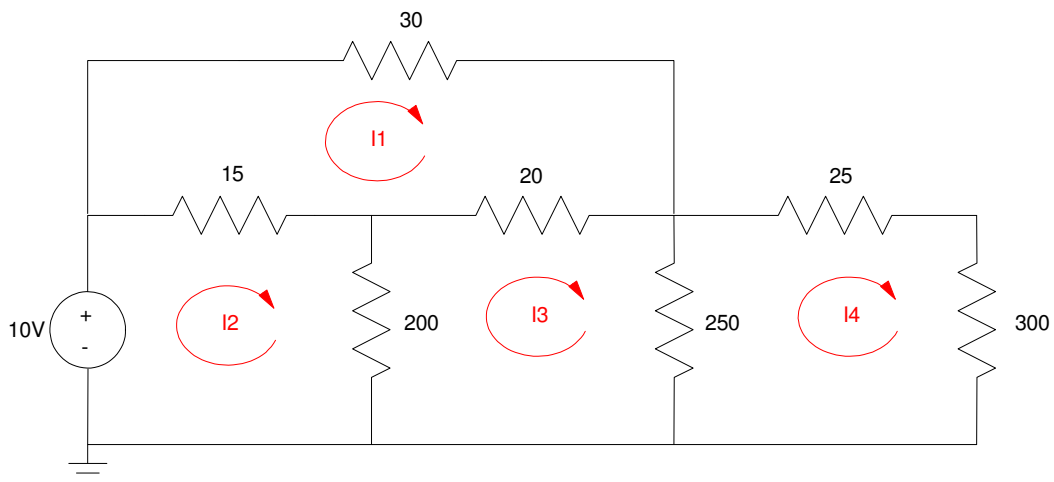
1) Write the voltage node equations for the following circuit

- Place them in matrix form

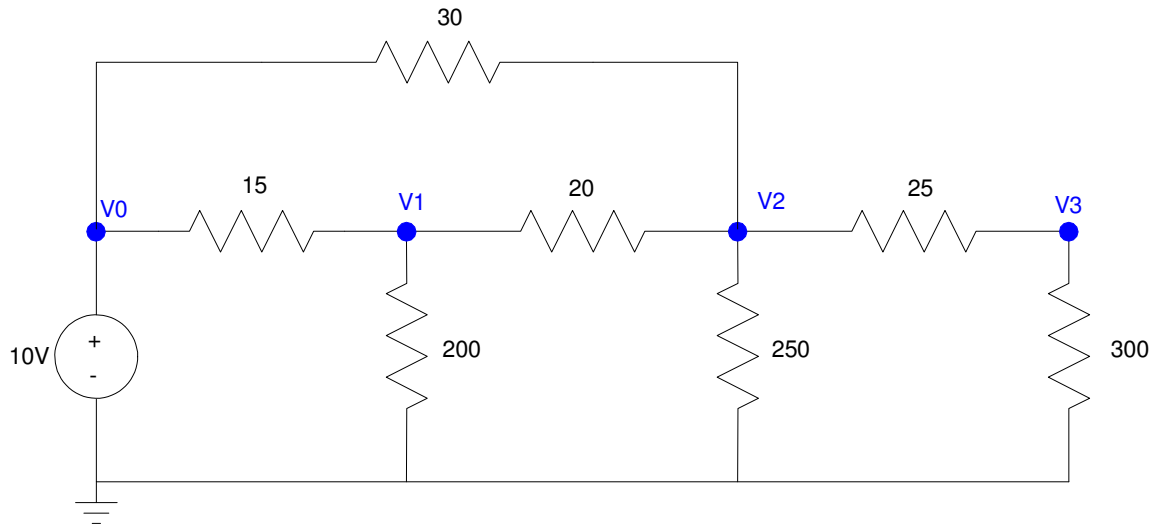


2) Write the current loop equations for the following circuit

- Place them in matrix form



1) Write the voltage node equations for the following circuit



Start with the voltage source

$$V_0 = 10$$

Node equations

$$\left(\frac{V_1 - V_0}{15}\right) + \left(\frac{V_1}{200}\right) + \left(\frac{V_1 - V_2}{20}\right) = 0$$

$$\left(\frac{V_2 - V_1}{20}\right) + \left(\frac{V_2 - V_0}{30}\right) + \left(\frac{V_2}{250}\right) + \left(\frac{V_2 - V_3}{25}\right) = 0$$

$$\left(\frac{V_3 - V_2}{25}\right) + \left(\frac{V_3}{300}\right) = 0$$

Group terms

$$V_0 = 10$$

$$\left(\frac{-1}{15}\right)V_0 + \left(\frac{1}{15} + \frac{1}{200} + \frac{1}{20}\right)V_1 + \left(\frac{-1}{20}\right)V_2 = 0$$

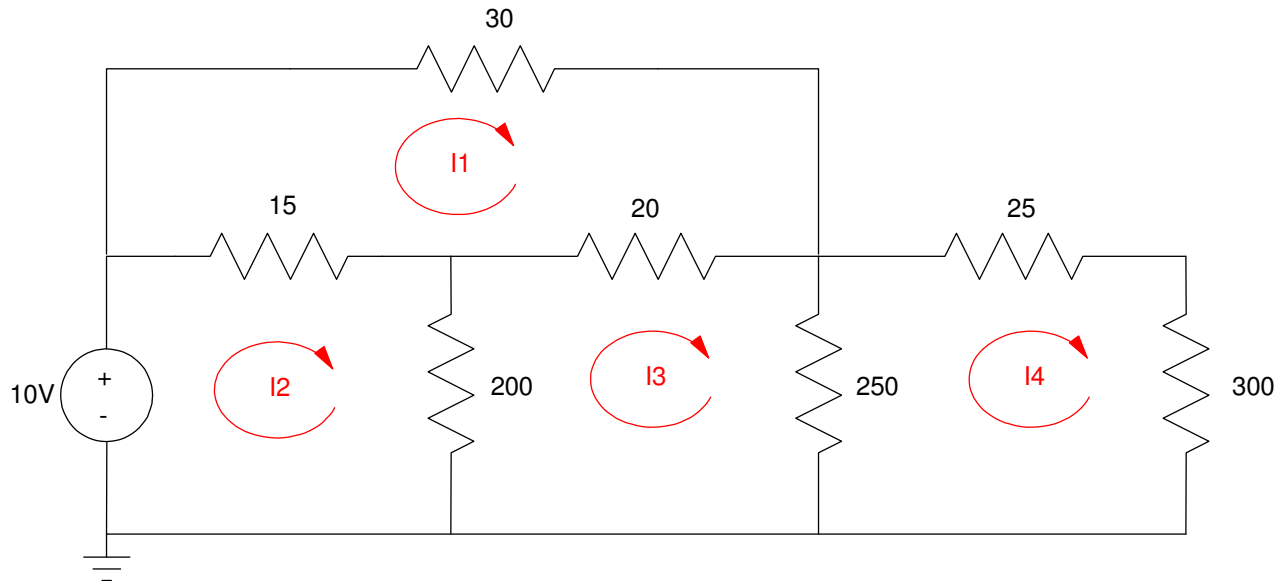
$$\left(\frac{-1}{30}\right)V_0 + \left(\frac{-1}{20}\right)V_1 + \left(\frac{1}{20} + \frac{1}{30} + \frac{1}{250} + \frac{1}{25}\right)V_2 + \left(\frac{-1}{25}\right)V_3 = 0$$

$$\left(\frac{-1}{25}\right)V_2 + \left(\frac{1}{25} + \frac{1}{300}\right)V_3 = 0$$

Place in matrix form

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ \left(\frac{-1}{15}\right) & \left(\frac{1}{15} + \frac{1}{200} + \frac{1}{20}\right) & \left(\frac{-1}{20}\right) & 0 \\ \left(\frac{-1}{30}\right) & \left(\frac{-1}{20}\right) & \left(\frac{1}{20} + \frac{1}{30} + \frac{1}{250} + \frac{1}{25}\right) & \left(\frac{-1}{25}\right) \\ 0 & 0 & \left(\frac{-1}{25}\right) & \left(\frac{1}{25} + \frac{1}{300}\right) \end{bmatrix} \begin{bmatrix} V_0 \\ V_1 \\ V_2 \\ V_3 \end{bmatrix} = \begin{bmatrix} 10 \\ 0 \\ 0 \\ 0 \end{bmatrix}$$

2) Write the current loop equations for the following circuit



$$30I_1 + 20(I_1 - I_3) + 15(I_1 - I_2) = 0$$

$$-10 + 15(I_2 - I_1) + 200(I_2 - I_3) = 0$$

$$200(I_3 - I_2) + 20(I_3 - I_1) + 250(I_3 - I_4) = 0$$

$$250(I_4 - I_3) + 25I_4 + 300I_4 = 0$$

Group terms

$$65I_1 - 15I_2 - 20I_3 = 0$$

$$-15I_1 + 215I_2 - 200I_3 = 10$$

$$-20I_1 - 200I_2 + 470I_3 - 250I_4 = 0$$

$$-250I_3 + 575I_4 = 0$$

Place in matrix form

$$\begin{bmatrix} 65 & -15 & -20 & 0 \\ -15 & 215 & -200 & 0 \\ -20 & -200 & 470 & -250 \\ 0 & 0 & -250 & 575 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \\ I_4 \end{bmatrix} = \begin{bmatrix} 0 \\ 10 \\ 0 \\ 0 \end{bmatrix}$$