

Electrical Circuit (1)

Introduction (week3 class2)

Dr. Akram Al-Mahrouk

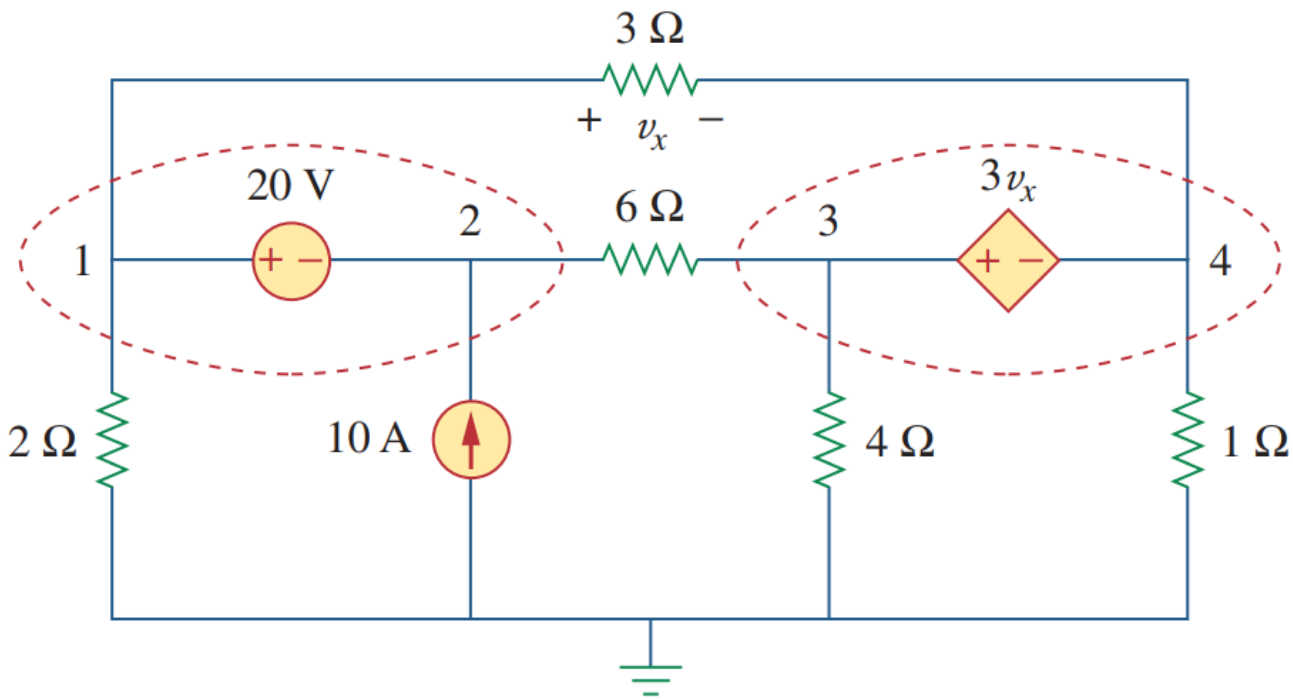
Philadelphia University

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Advanced

Nodal Analysis with Voltage Sources



Nodal Analysis with Voltage Sources

Basic equation

$$V_1 = V_2 + 20$$

$$V_3 = V_4 + 3(V_1 - V_4)$$

$$\frac{V_1}{2} + \frac{V_1 - V_4}{3} + (-10) + \frac{V_2 - V_3}{6} = 0$$

$$\frac{V_3}{4} + \frac{V_3 - V_2}{6} + \frac{V_4}{1} + \frac{V_4 - V_1}{3} = 0$$

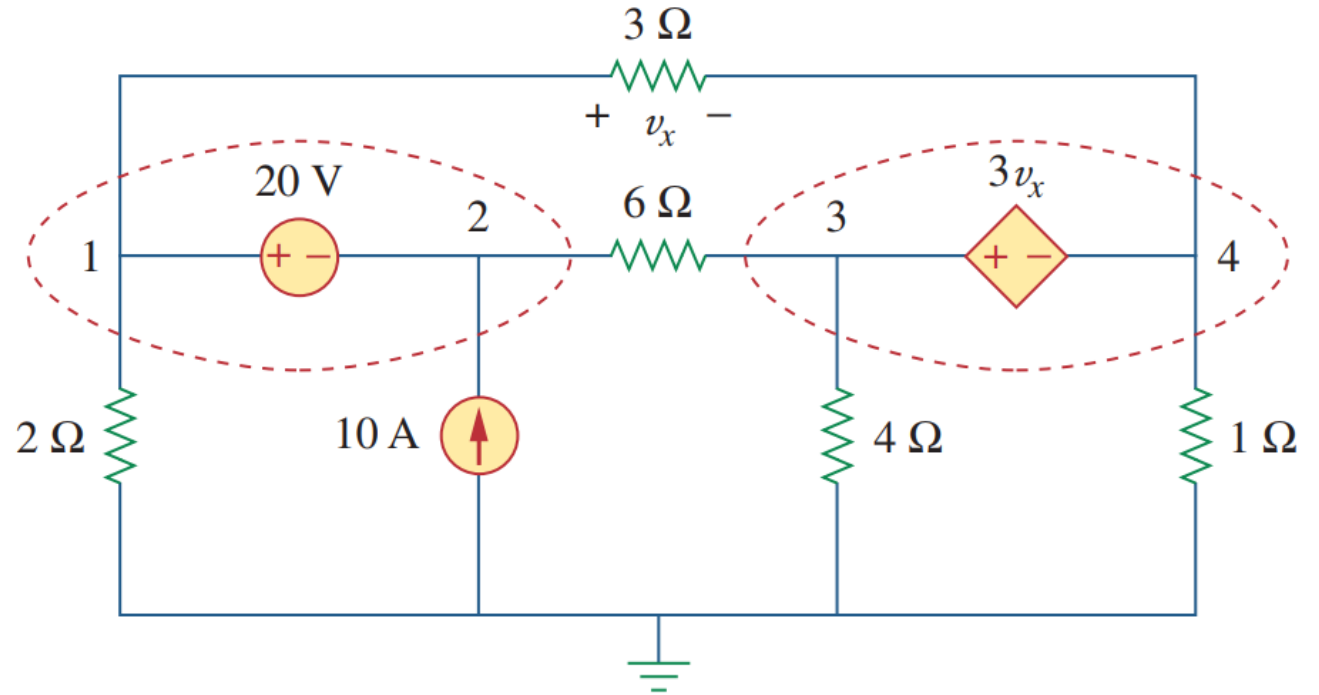
Formulated equation

$$V_1 - V_2 = 20$$

$$3V_1 - V_3 - 2V_4 = 0$$

$$\left(\frac{1}{2} + \frac{1}{3}\right)V_1 + \left(\frac{1}{6}\right)V_2 + \left(\frac{-1}{6}\right)V_3 + \left(\frac{-1}{3}\right)V_4 = 10$$

$$\frac{-1}{3}V_1 + \frac{-1}{6}V_2 + \left(\frac{1}{4} + \frac{1}{6}\right)V_3 + \left(1 + \frac{1}{3}\right)V_4 = 0$$



Final answer

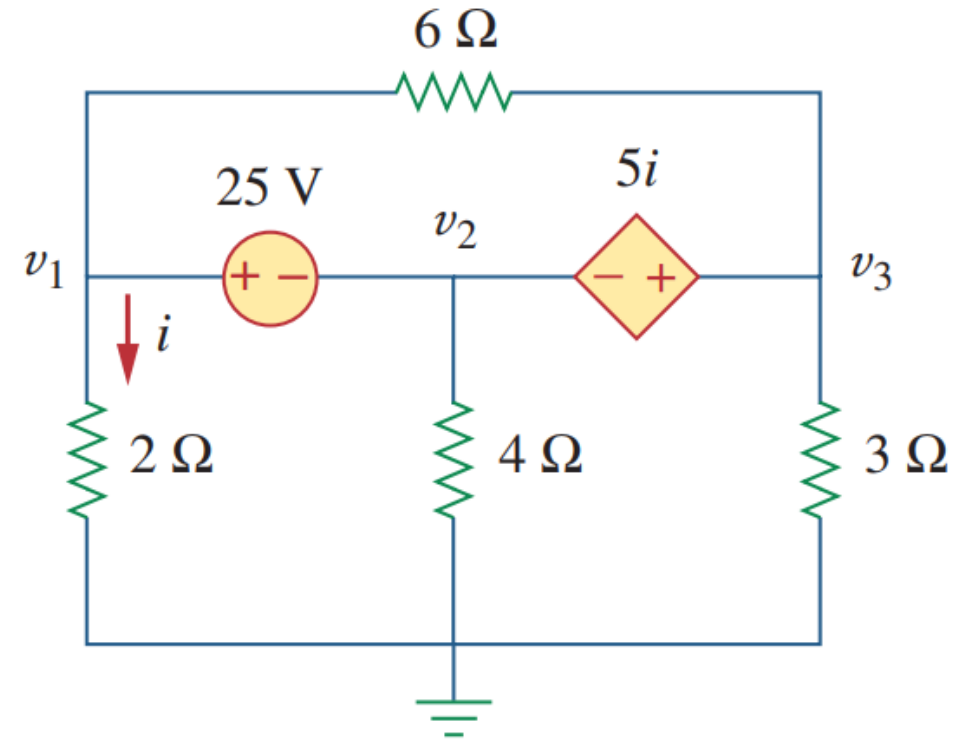
$$V_1 = -26.6667 \text{ V}$$

$$V_2 = 6.66667 \text{ V}$$

$$V_3 = 173.333 \text{ V}$$

$$V_4 = -46.6667 \text{ V}$$

Nodal Analysis with Voltage Sources



Nodal Analysis with Voltage Sources

Basic equation

$$V_1 = V_2 + 25$$

$$V_3 = V_2 + 5\left(\frac{V_1}{2}\right)$$

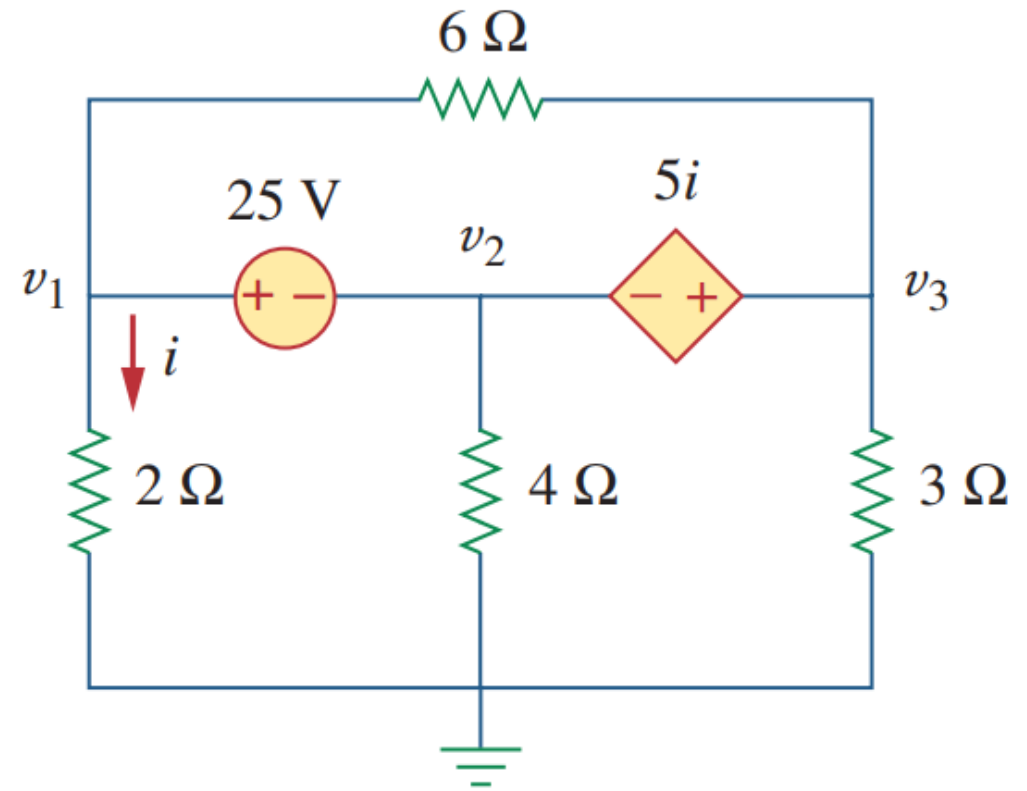
$$\frac{V_1}{2} + \frac{V_2}{4} + \frac{V_3}{3} = 0$$

Formulated equation

$$V_1 - V_2 = 25$$

$$\left(\frac{5}{2}\right)V_1 + V_2 - V_3 = 0$$

$$\left(\frac{1}{2}\right)V_1 + \left(\frac{1}{4}\right)V_2 + \left(\frac{1}{3}\right)V_3 = 0$$



Final answer

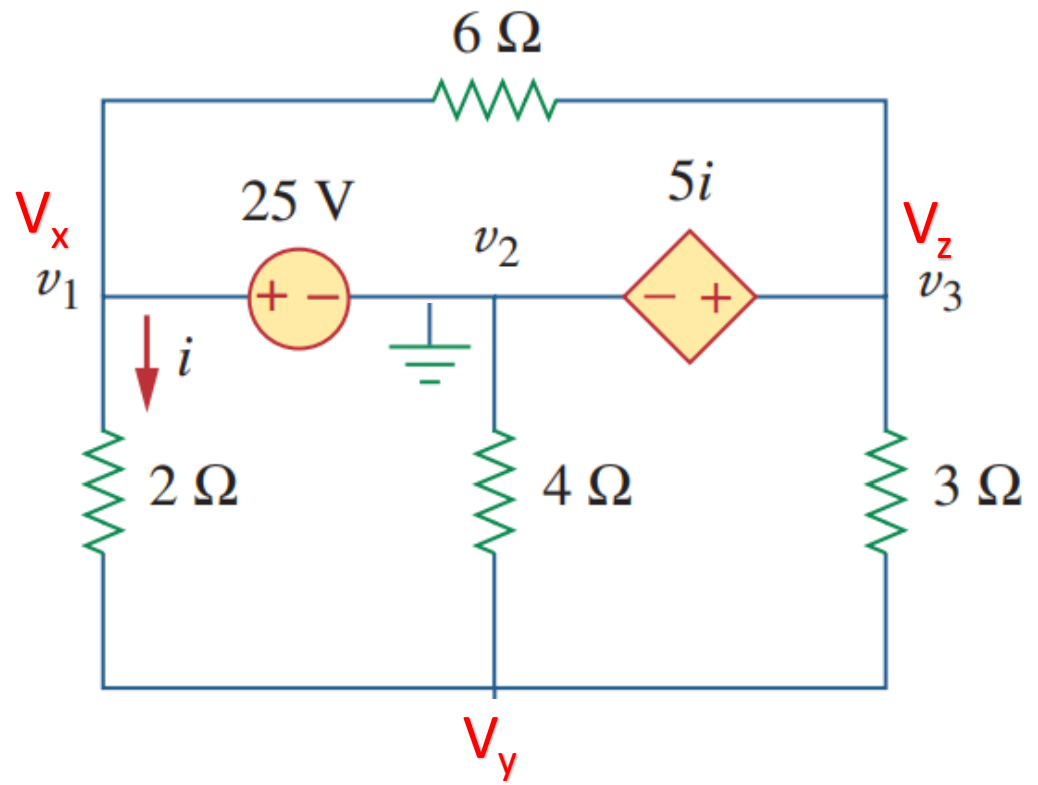
$$V_1 = 7.608 \text{ V}$$

$$V_2 = -17.39 \text{ V}$$

$$V_3 = 1.630 \text{ V}$$

Nodal Analysis with Voltage Sources

Without super node



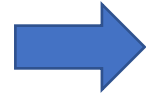
Nodal Analysis with Voltage Sources

Without super node

Basic equation

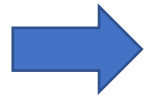
$$V_x = 25$$

$$V_z = 5\left(\frac{V_x - V_y}{2}\right)$$

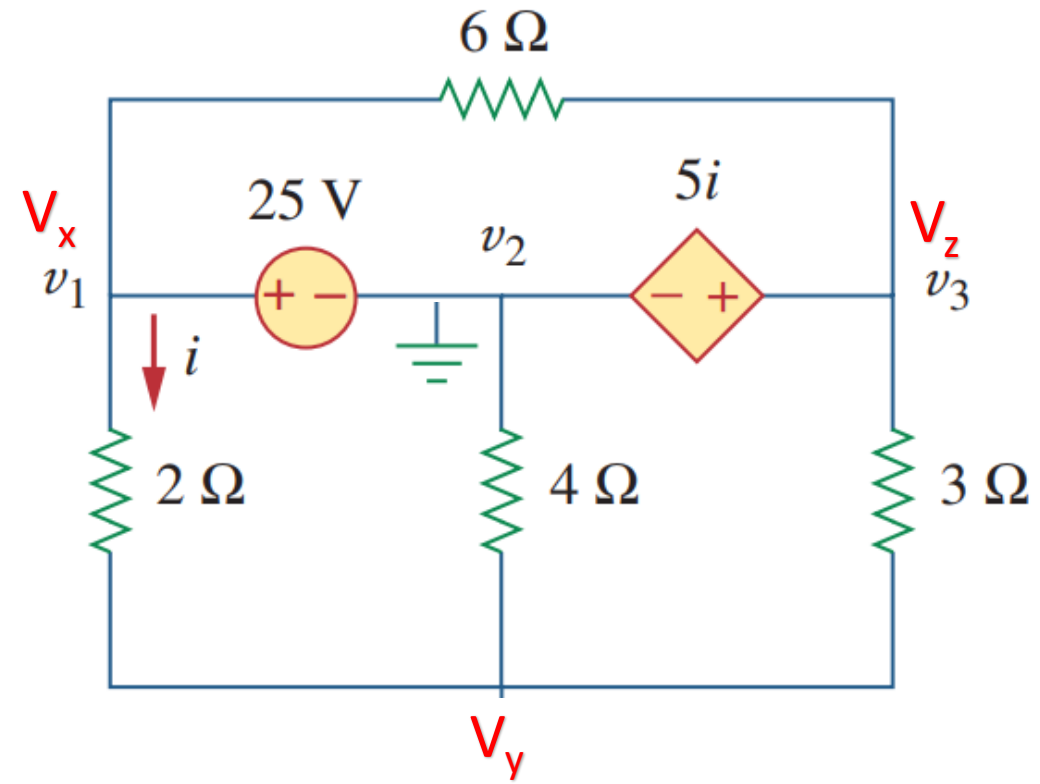


$$V_z = 5\left(\frac{25 - V_y}{2}\right)$$

$$\frac{V_y - V_x}{2} + \frac{V_y}{4} + \frac{V_y - V_z}{3} = 0$$



$$\frac{V_y - 25}{2} + \frac{V_y}{4} + \frac{V_y - V_z}{3} = 0$$



Formulated equation

$$\left(\frac{5}{2}\right)V_y + V_z = \left(\frac{5 * 25}{2}\right)$$

$$\left(\frac{1}{2} + \frac{1}{4} + \frac{1}{3}\right)V_y + \frac{-1}{3}V_z = \frac{25}{2}$$

Final answer

$$V_x = 25 \text{ V}$$

$$V_y = 17.39 \text{ V}$$

$$V_z = 19.021 \text{ V}$$

$$V_1 = V_x - V_y = 25 - 17.39 = 7.608 \text{ V}$$

$$V_2 = -V_y = -17.39 \text{ V}$$

$$V_3 = V_z - V_y = 19.021 - 17.39 = 1.630 \text{ V}$$

