Electrical Circuit (1)

Introduction (week3 class2)

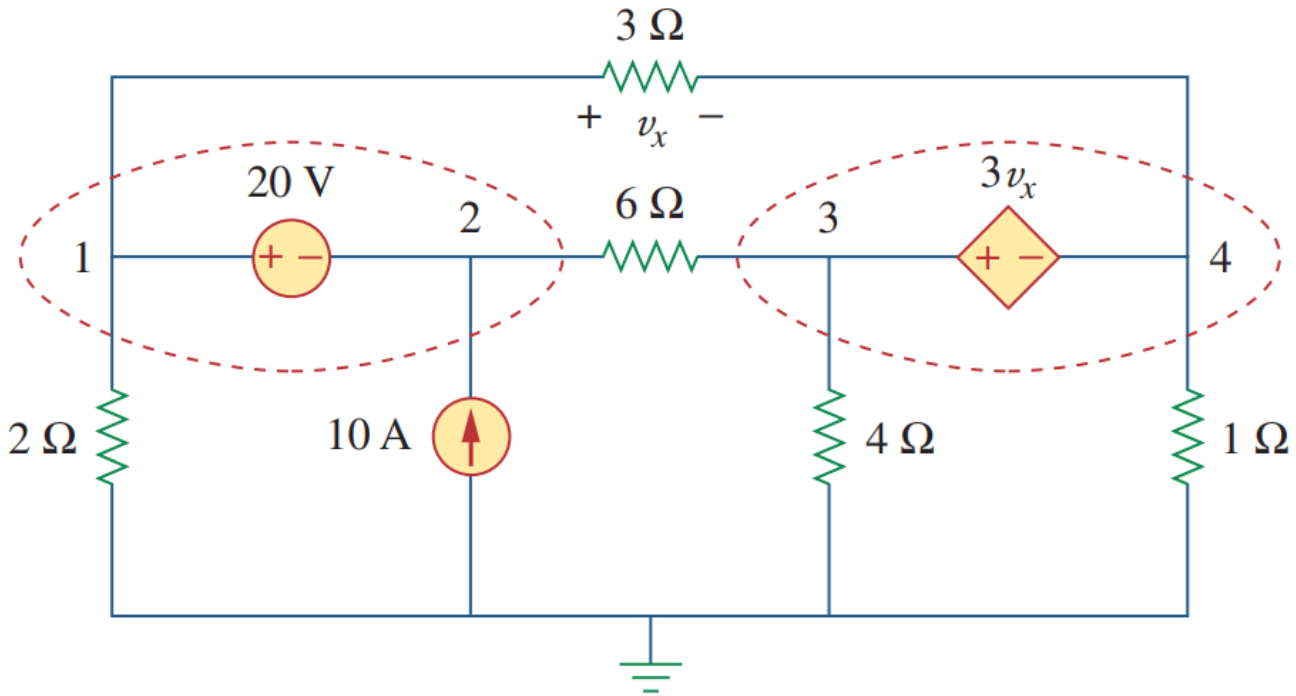
Dr. Akram Al-Mahrouk

Philadelphia University

Chapter 3 Methods of Analysis 81

Advanced

Nodal Analysis with Voltage Sources



Nodal Analysis with Voltage Sources

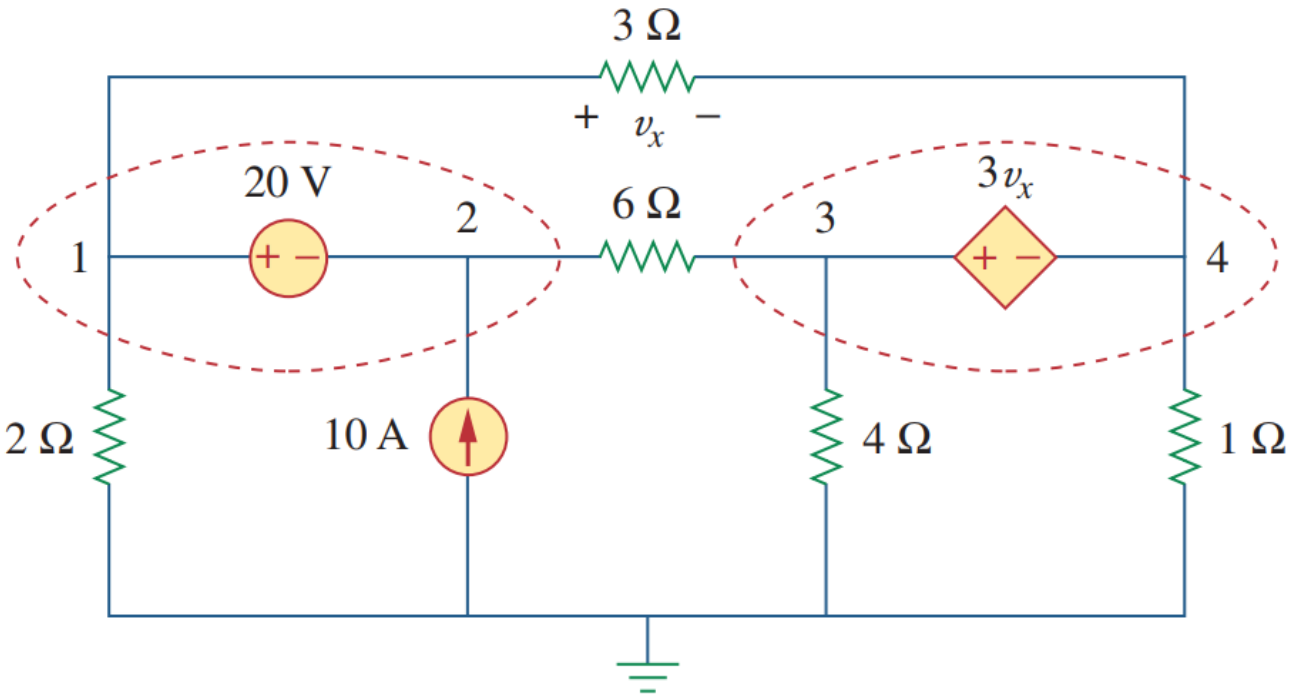
Basic equation

$$V_1 = V_2 + 20$$

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

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

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



Formulated equation

$$V_1 - V_2 = 20$$

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

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

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

Final answer

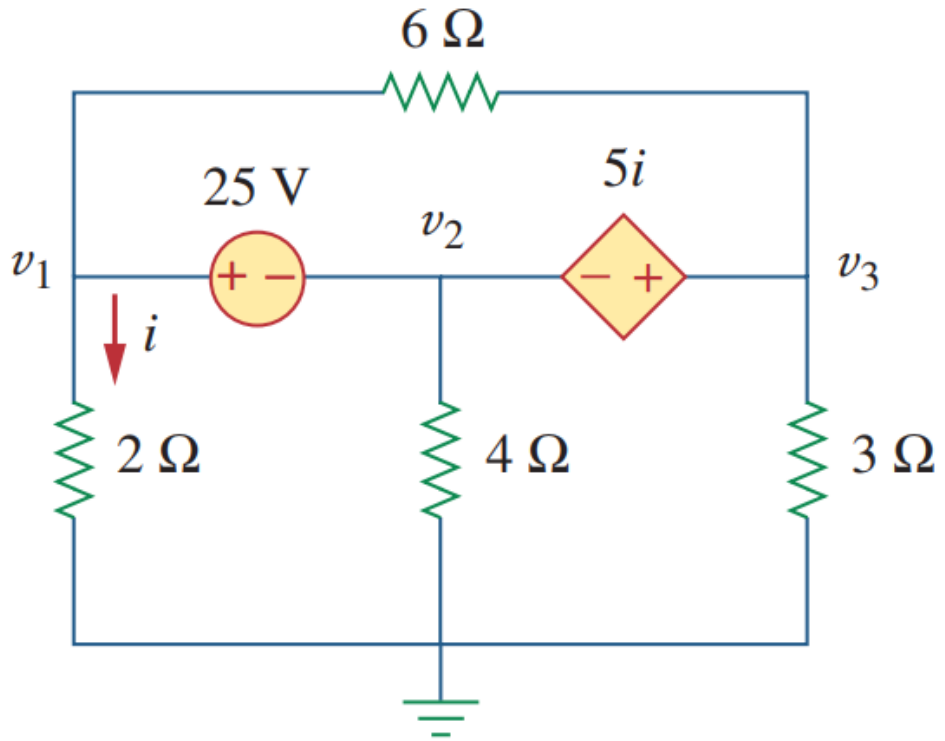
$$V_1 = -26.6667\ V$$

$$V_2 = 6.66667\ V$$

$$V_3 = 173.333\ V$$

$$V_4 = -46.6667\ V$$

Nodal Analysis with Voltage Sources



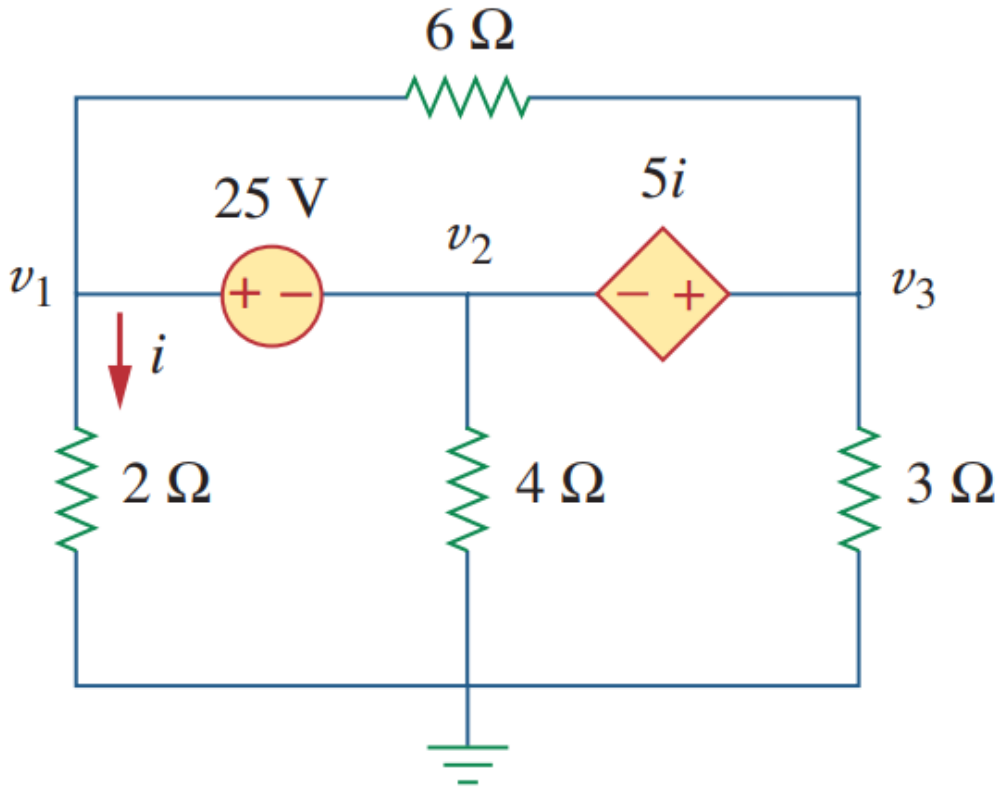
Nodal Analysis with Voltage Sources

Basic equation

$V_1 = V_2 + 25$

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

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



Formulated equation

$V_1 - V_2 = 25$

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

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

Final answer

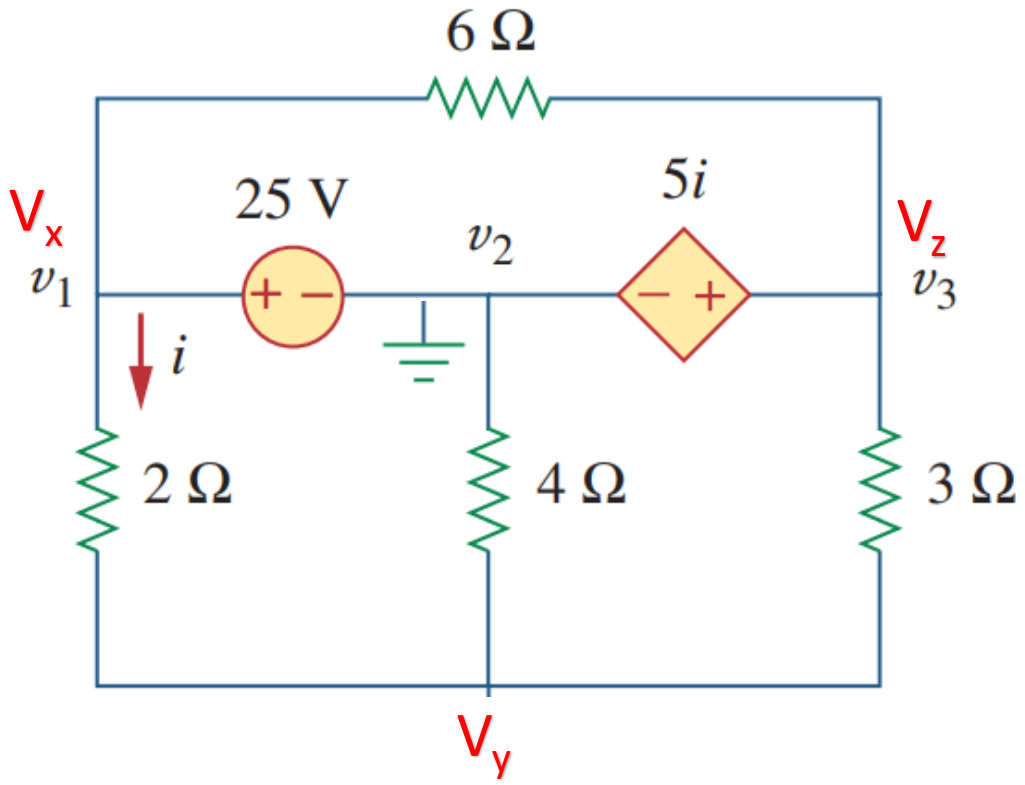
$V_1 = 7.608\ V$

$V_2 = -17.39\ V$

$V_3 = 1.630\ V$

Nodal Analysis with Voltage Sources

Without super node



Nodal Analysis with Voltage Sources

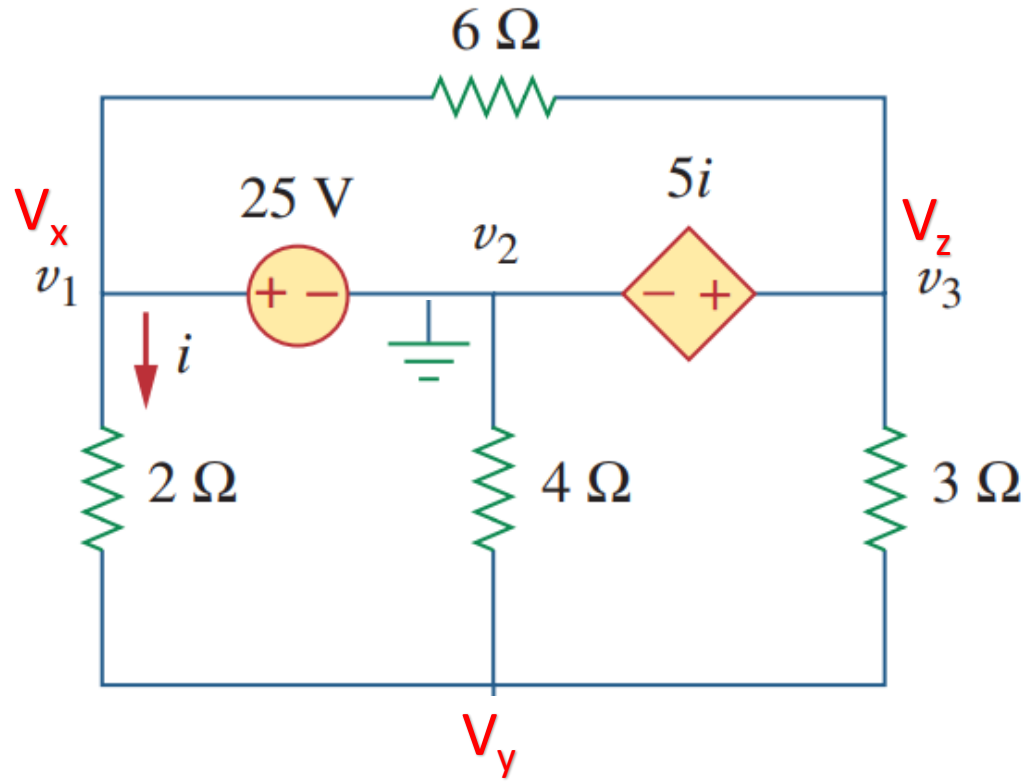
Without super node

Basic equation

$$V_x = 25$$

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

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



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

$V_x = 25\ V$

$V_y = 17.39\ V$

$V_z = 19.021\ V$

$V_1 = V_x - V_y = 25 - 17.39 = 7.608\ V$

$V_2 = -V_y = -17.39\ V$

$V_3 = V_z - V_y = 19.021 - 17.39 = 1.630\ V$