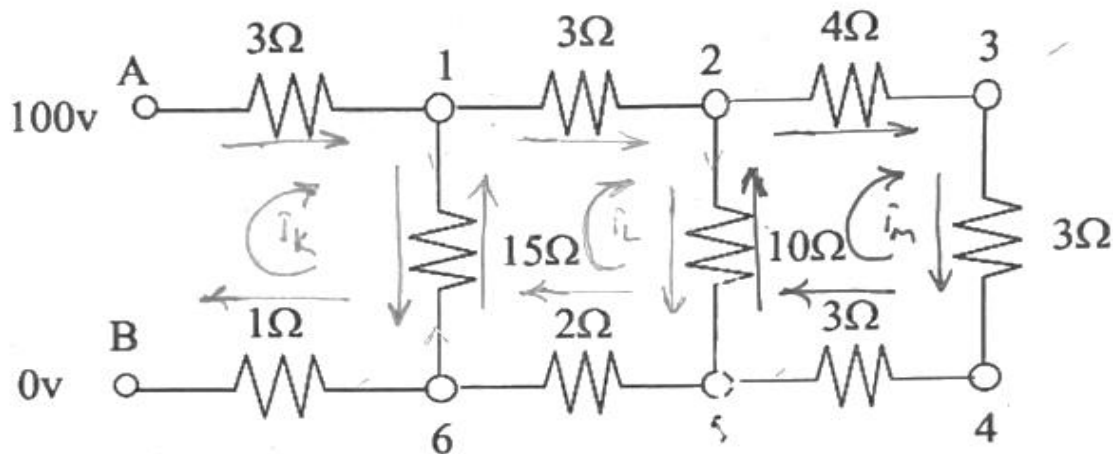


21/03/2022

(a) Derive the linear equations whose solutions are the potentials at nodes 1 through 6

Node-1

$$\frac{100 - V_1}{3} + \frac{V_2 - V_1}{3} + \frac{V_6 - V_1}{15} = 0 \Rightarrow$$

$$500 - 5V_1 + 5V_2 - 5V_1 + V_6 - V_1 = 0$$

$$11V_1 - 5V_2 - V_6 = 500 \quad (1)$$

Node-2

$$\frac{V_1 - V_2}{3} + \frac{V_3 - V_2}{4} + \frac{V_5 - V_2}{10} = 0 \Rightarrow$$

$$20V_1 - 20V_2 + 15V_3 - 15V_2 + 6V_5 - 6V_2 = 0$$

$$20V_1 - 41V_2 + 15V_3 + 6V_5 = 0 \quad (2)$$

Node-3

$$\frac{V_2 - V_3}{4} + \frac{V_4 - V_3}{3} = 0 \Rightarrow$$

$$3V_2 - 3V_3 + 4V_4 - 4V_3 = 0$$

$$3V_2 - 7V_3 + 4V_4 = 0 \quad (3)$$

Node-4

$$\frac{V_3 - V_4}{3} + \frac{V_5 - V_4}{3} = 0 \Rightarrow$$

$$V_3 - 2V_4 + V_5 = 0$$

$$\boxed{V_3 - 2V_4 + V_5 = 0} \quad (4)$$

Node-5

$$\frac{V_4 - V_5}{\frac{3}{10}} + \frac{V_1 - V_5}{\frac{10}{2}} + \frac{V_6 - V_5}{\frac{2}{15}} = 0 \Rightarrow$$

$$10V_4 - 10V_5 + 2V_1 - 3V_5 - 15V_5 + 15V_6 = 0$$

$$\boxed{3V_1 + 10V_4 - 28V_5 + 15V_6 = 0} \quad (5)$$

Node-6

$$\frac{V_3 - V_6}{\frac{2}{15}} + \frac{V_1 - V_6}{\frac{15}{2}} + \frac{V_2 - V_6}{\frac{1}{20}} = 0 \Rightarrow$$

$$15V_3 - 15V_6 + 2V_1 - 2V_6 - 30V_6 = 0$$

$$\boxed{12V_1 + 15V_3 - 47V_6 = 0} \quad (6)$$

$$\underline{\underline{a)}} \quad \begin{bmatrix} 11 & -5 & 0 & 0 & 0 & -1 \\ 20 & -41 & 15 & 0 & 6 & 0 \\ 0 & 3 & -7 & -4 & 0 & 0 \\ 0 & 0 & 1 & -2 & 1 & 0 \\ 0 & 3 & 0 & 10 & -28 & 15 \\ 2 & 0 & 0 & 0 & 15 & -47 \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \\ V_3 \\ V_4 \\ V_5 \\ V_6 \end{bmatrix} = \begin{bmatrix} 500 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix}$$