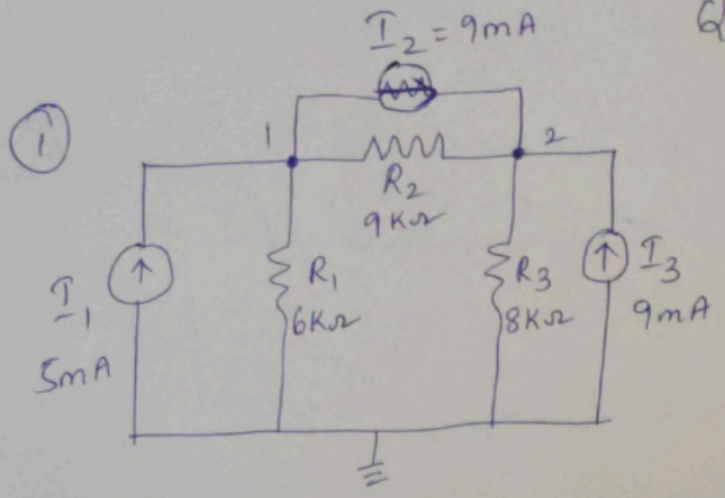
EECE105L

Quiz-4 Solutions



$I_1 = 5mA$, $I_2 = 9mA$, $I_3 = 9mA$

$R_1 = 6K\Omega$, $R_2 = 9K\Omega$, $R_3 = 8K\Omega$

$V_1 = V_2 = ?$

KCL at node 1:

$$5 = 9 + \frac{V_1}{6K} + \frac{V_1 - V_2}{9K}$$

$$\frac{V_1}{6} + \frac{V_1}{9} - \frac{V_2}{9} = -4$$

$$V_1\left[\frac{1}{6} + \frac{1}{9}\right] + V_2\left[\frac{-1}{9}\right] = -4 \quad -(1)$$

KCL at node 2:

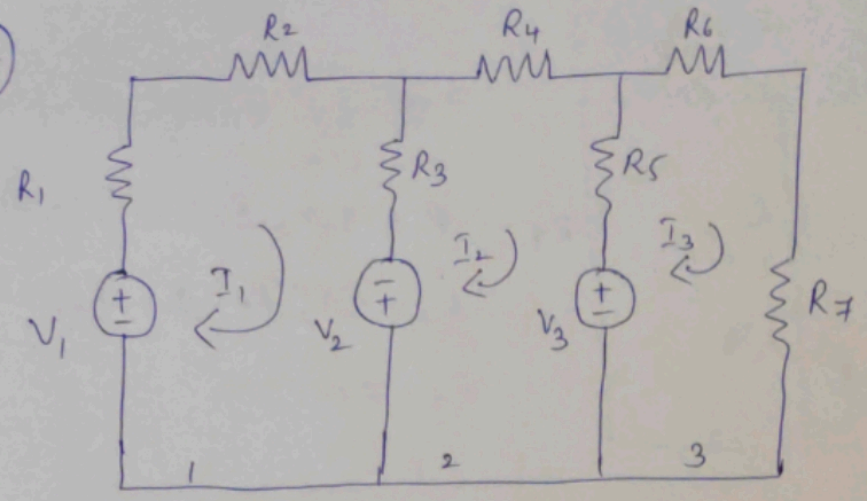
$$9 + 9 = \frac{V_2 - V_1}{9} + \frac{V_2}{8}$$

$$V_1\left[\frac{-1}{9}\right] + V_2\left[\frac{1}{8} + \frac{1}{9}\right] = 18 \quad -(2)$$

$$\begin{bmatrix} 5/18 & -1/9 \\ -1/9 & 17/72 \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \end{bmatrix} = \begin{bmatrix} -4 \\ 18 \end{bmatrix}$$

$V_1 = 19.91V$ $\quad$ $V_2 = 85.95V$

(2)



Applying KVL in mesh 1

$$-V_1 + I_1R_1 + I_1R_2 + (I_1 - I_2)R_3 - V_2 = 0$$

$$I_1(R_1 + R_3 + R_2) + I_2(-R_3) = V_1 + V_2 \quad -(1)$$

Applying KVL in mesh 2

$$V_2 + R_3(I_2 - I_1) + I_2R_4 + R_5(I_2 - I_3) + V_3 = 0$$

$$I_1(-R_3) + I_2(R_3 + R_4 + R_5) + I_3(-R_5) = -(V_2 + V_3) \quad -(2)$$

Applying KVL in mesh 3

$$-V_3 + R_5(I_3 - I_2) + I_3R_6 + I_3R_7 = 0$$

$$I_2(-R_5) + I_3(R_5 + R_6 + R_7) = V_3 \quad -(3)$$

$$\begin{bmatrix} R_1+R_2+R_3 & -R_3 & 0 \\ -R_3 & R_3+R_4+R_5 & -R_5 \\ 0 & -R_5 & R_5+R_6+R_7 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} V_1+V_2 \\ -(V_2+V_3) \\ V_3 \end{bmatrix}$$

$a_{11} = R_1 + R_2 + R_3$ Ω

$a_{22} = R_3 + R_4 + R_5$ Ω

$a_{33} = R_5 + R_6 + R_7$ Ω