

Electrical Electronics

$$(1) \quad T_1 + T_2 - 2T_3 + T_4 + 3T_5 - T_6 = 4$$

$$2T_1 - T_2 + T_3 + 2T_4 + T_5 - 3T_6 = 20$$

$$T_1 + 3T_2 - 8T_3 - T_4 + 2T_5 + T_6 = -15$$

$$3T_1 + 2T_2 - T_3 + T_4 + 2T_5 + T_6 = -3$$

$$-3T_1 - T_2 + 2T_3 + 3T_4 + T_5 + 3T_6 = 16$$

$$4T_1 - 3T_2 + T_3 - 6T_4 - 3T_5 - 2T_6 = -27$$

Solution

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 2 & -1 & 1 & 2 & 1 & -3 \\ 1 & 3 & -3 & -1 & 2 & 1 \\ 3 & 2 & -1 & -1 & 2 & 1 \\ -3 & -1 & 2 & 3 & 1 & 3 \\ 4 & 3 & 1 & -6 & -3 & -2 \end{bmatrix} \begin{bmatrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{bmatrix} = \begin{bmatrix} 4 \\ 20 \\ -15 \\ -3 \\ 16 \\ -27 \end{bmatrix}$$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 2 - \frac{2}{1} \times 1 & -1 - \frac{1}{1} \times 1 & 1 - \frac{2}{1}(-2) & 2 - \frac{1}{1}(1) & 1 - \frac{3}{1}(3) & -3 - \frac{1}{1}(-1) \\ 1 - \frac{1}{1} \times 1 & 3 - \frac{1}{1} \times 1 & -3 - \frac{1}{1}(-2) & -1 - \frac{1}{1}(1) & 2 - \frac{1}{1}(3) & 1 - \frac{1}{1}(-1) \\ 3 - \frac{3}{1} \times 1 & 2 - \frac{2}{1}(1) & -1 - \frac{2}{1}(-2) & -1 - \frac{2}{1}(1) & 2 - \frac{2}{1}(3) & 1 - \frac{2}{1}(-1) \\ -3 - \frac{1}{1} \times 1 & -1 - \frac{1}{1}(1) & 2 - \frac{1}{1}(-2) & 3 - \frac{1}{1}(1) & 1 - \frac{1}{1}(3) & 3 - \frac{1}{1}(-1) \\ 4 - \frac{4}{1} \times 1 & 3 - \frac{3}{1}(1) & 1 - \frac{4}{1}(-2) & -6 - \frac{4}{1}(1) & -3 - \frac{4}{1}(3) & -2 - \frac{4}{1}(-1) \end{bmatrix} \begin{bmatrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{bmatrix} = \begin{bmatrix} 4 \\ 20 - \frac{2}{1}(4) \\ -15 - \frac{1}{1}(4) \\ -3 - \frac{2}{1}(4) \\ 16 - \frac{1}{1}(4) \\ -27 - \frac{4}{1}(4) \end{bmatrix}$$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 2 & -1 & -2 & -1 & 2 \\ 0 & -2 & 9 & -6 & -13 & 6 \\ 0 & 2 & -4 & 6 & 10 & 0 \\ 0 & -1 & 9 & -10 & -15 & 2 \end{bmatrix} \begin{bmatrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{bmatrix} = \begin{bmatrix} 4 \\ 12 \\ -19 \\ -23 \\ 22 \\ -48 \end{bmatrix}$$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 2 - \frac{2}{3}(-3) & -1 - \frac{2}{3}(5) & -2 - \frac{2}{3}(0) & -1 - \frac{2}{3}(-5) & 2 - \frac{2}{3}(-1) \\ 0 & -3 - \frac{(-3)}{3}(-3) & 4 - \frac{3}{3}(5) & -6 - \frac{3}{3}(0) & -13 - \frac{3}{3}(-5) & 6 - \frac{3}{3}(-1) \\ 0 & 2 - \frac{2}{3}(-3) & -4 - \frac{2}{3}(5) & 6 - \frac{2}{3}(0) & 10 - \frac{2}{3}(-5) & 0 - \frac{2}{3}(-1) \\ 0 & -1 - \frac{1}{3}(-3) & 4 - \frac{1}{3}(5) & -10 - \frac{1}{3}(0) & -15 - \frac{1}{3}(-5) & 2 - \frac{1}{3}(-1) \end{bmatrix} \begin{bmatrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{bmatrix} = \begin{bmatrix} 4 \\ 12 \\ -19 - \frac{2}{3}(10) \\ -23 - \frac{3}{3}(12) \\ +28 - \frac{2}{3}(12) \\ -48 - \frac{1}{3}(12) \end{bmatrix}$$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 0 & \frac{7}{3} & -2 & -\frac{13}{3} & \frac{4}{3} \\ 0 & 0 & 4 & -6 & -8 & 7 \\ 0 & 0 & \frac{2}{3} & 6 & \frac{20}{3} & -\frac{2}{3} \\ 0 & 0 & \frac{22}{3} & -10 & -\frac{40}{3} & \frac{7}{3} \end{bmatrix} \begin{bmatrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{bmatrix} = \begin{bmatrix} 4 \\ 12 \\ -11 \\ -35 \\ 36 \\ -47 \end{bmatrix}$$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 0 & \frac{7}{3} & -2 & -\frac{13}{3} & \frac{4}{3} \\ 0 & 0 & 4 - \frac{4}{7/3} & -6 - \frac{4}{7/3} & -8 - \frac{4}{7/3} & 7 - \frac{4}{7/3} \\ 0 & 0 & \frac{2}{3} - \frac{2/3}{7/3} & 6 - \frac{2/3}{7/3} & \frac{20}{3} - \frac{2/3}{7/3} & -\frac{2}{3} - \frac{2/3}{7/3} \\ 0 & 0 & \frac{22}{3} - \frac{22/3}{7/3} & -10 - \frac{22/3}{7/3} & -\frac{40}{3} - \frac{22/3}{7/3} & \frac{7}{3} - \frac{22/3}{7/3} \end{bmatrix} \begin{bmatrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{bmatrix} = \begin{bmatrix} 4 \\ 12 \\ -11 \\ -35 - \frac{4}{7/3}(-11) \\ 36 - \frac{2/3}{7/3}(81) \\ -47 - \frac{22/3}{7/3}(-11) \end{bmatrix}$$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 0 & \frac{7}{3} & -2 & -\frac{13}{3} & \frac{4}{3} \\ 0 & 0 & 0 & -\frac{13}{7} & \frac{4}{7} & \frac{33}{7} \\ 0 & 0 & 0 & \frac{32}{7} & -\frac{2}{7} & -\frac{2}{7} \\ 0 & 0 & 0 & -\frac{26}{7} & \frac{2}{7} & -\frac{13}{7} \end{bmatrix} \begin{bmatrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{bmatrix} = \begin{bmatrix} 4 \\ 12 \\ -11 \\ \frac{113}{7} \\ \frac{230}{7} \\ -\frac{87}{7} \end{bmatrix}$$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 0 & \frac{7}{3} & -2 & -\frac{13}{3} & \frac{4}{3} \\ 0 & 0 & 0 & -\frac{13}{7} & -\frac{4}{7} & \frac{23}{7} \\ 0 & 0 & 0 & \frac{32}{7} - \frac{32}{7}(-\frac{13}{7}) & \frac{29}{7} - \frac{32}{7}(-\frac{4}{7}) & \frac{29}{7} - \frac{32}{7}(\frac{23}{7}) \\ 0 & 0 & 0 & -\frac{26}{7} - \frac{26}{7}(-\frac{13}{7}) & \frac{2}{7} - \frac{26}{7}(-\frac{4}{7}) & -\frac{13}{7} - \frac{26}{7}(\frac{23}{7}) \end{bmatrix} \begin{bmatrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{bmatrix} = \begin{bmatrix} 4 \\ 12 \\ -11 \\ -\frac{183}{7} \\ \frac{230}{7} - \frac{32}{7}(-\frac{113}{7}) \\ -\frac{87}{7} - \frac{26}{7}(-\frac{113}{7}) \end{bmatrix}$$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 0 & \frac{7}{3} & -2 & -\frac{13}{3} & \frac{4}{3} \\ 0 & 0 & 0 & -\frac{13}{7} & -\frac{4}{7} & \frac{23}{7} \\ 0 & 0 & 0 & 0 & \frac{32}{9} & \frac{29}{3} \\ 0 & 0 & 0 & 0 & \frac{10}{9} & -\frac{26}{3} \end{bmatrix} \begin{bmatrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{bmatrix} = \begin{bmatrix} 4 \\ 12 \\ -11 \\ -\frac{183}{7} \\ -\frac{11}{9} \\ \frac{98}{9} \end{bmatrix}$$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 0 & \frac{7}{3} & -2 & -\frac{13}{3} & \frac{4}{3} \\ 0 & 0 & 0 & -\frac{13}{7} & -\frac{4}{7} & \frac{23}{7} \\ 0 & 0 & 0 & 0 & \frac{32}{9} & \frac{29}{3} \\ 0 & 0 & 0 & 0 & \frac{10}{9} - \frac{10}{9}(-\frac{32}{9}) & -\frac{26}{3} - \frac{10}{9}(-\frac{29}{3}) \end{bmatrix} \begin{bmatrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{bmatrix} = \begin{bmatrix} 4 \\ 12 \\ -11 \\ -\frac{183}{7} \\ -\frac{11}{9} \\ \frac{98}{9} - \frac{10}{9}(-\frac{11}{9}) \end{bmatrix}$$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 0 & \frac{7}{3} & -2 & -\frac{13}{3} & \frac{4}{3} \\ 0 & 0 & 0 & -\frac{13}{7} & -\frac{4}{7} & \frac{23}{7} \\ 0 & 0 & 0 & 0 & \frac{32}{9} & \frac{29}{3} \\ 0 & 0 & 0 & 0 & 0 & -\frac{213}{19} \end{bmatrix} \begin{bmatrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{bmatrix} = \begin{bmatrix} 4 \\ 12 \\ -11 \\ -\frac{113}{7} \\ -\frac{11}{9} \\ \frac{213}{19} \end{bmatrix}$$

$$T_1 + T_2 - 2T_3 + T_4 + 3T_5 - T_6 = 4 \quad \dots \text{ (i)}$$

$$-3T_2 + 5T_3 - 5T_5 - T_6 = 12 \quad \dots \text{ (ii)}$$

$$\frac{7}{3}T_3 - 2T_4 - \frac{13}{3}T_5 + \frac{4}{3}T_6 = -11 \quad \dots \text{ (iii)}$$

$$-\frac{18}{7}T_4 - \frac{4}{7}T_5 + \frac{33}{7}T_6 = -\frac{183}{7} \quad \dots \text{ (iv)}$$

$$\frac{38}{9}T_5 + \frac{29}{3}T_6 = -\frac{11}{9} \quad \dots \text{ (v)}$$

$$-\frac{213}{19}T_6 = \frac{213}{19} \quad \dots \text{ (vi)}$$

From eqn (vi)

$$-\frac{213}{19}T_6 = \frac{213}{19}$$

$$T_6 = \frac{213}{19} \div -\frac{213}{19}$$

$$T_6 = \frac{213}{19} \times -\frac{19}{213}$$

$$T_6 = -1$$

Sub $T_6 = -1$ in eqn v

$$\frac{38}{9}T_5 + \frac{29}{3}(-1)T_6 = -\frac{11}{9}$$

$$\frac{38}{9}T_5 - \frac{29}{3} = -\frac{11}{9}$$

$$\frac{38}{9}T_5 = -\frac{11}{9} + \frac{29}{3}$$

$$\frac{38}{9}T_5 = \frac{76}{9}$$

$$T_5 = \frac{76}{9} \times \frac{9}{38}$$

$$T_5 = 2$$

Sub $T_6 = -1$, $T_5 = 2$ in eqn (iv)

$$-\frac{18}{7}T_4 - \frac{4}{7}(2) + \frac{33}{7}(-1) = -\frac{183}{7}$$

$$-\frac{18}{7}T_4 - \frac{8}{7} - \frac{33}{7} = -\frac{183}{7}$$

$$-\frac{18}{7}T_4 = -\frac{183}{7} + \frac{8}{7} + \frac{33}{7}$$

$$-\frac{18}{7}T_4 = -\frac{92}{7}$$

$$T_4 = -\frac{92}{7} \times -\frac{7}{18}$$

$$T_4 = 4$$

Sub $T_6 = -1$, $T_5 = 2$, $T_4 = 4$ in

eqn (iii)

$$\frac{7}{3}T_3 - 2(4) - \frac{13}{3}(2) + \frac{4}{3}(-1) = -11$$

$$\frac{7}{3}T_3 - 8 - \frac{26}{3} - \frac{4}{3} = -11$$

$$\frac{7}{3}T_3 = -11 + 8 + \frac{26}{3} + \frac{4}{3}$$

$$\frac{7}{3}T_3 = 7$$

$$T_3 = \frac{7}{1} \times \frac{3}{7}$$

$$T_3 = 3$$

Subs $T_6 = -1$, $T_5 = 2$, $T_4 = 4$, $T_3 = 3$ in eqn (11)

$$-3T_2 + 5(3) + 0 - 5(2) - (-1) = 12$$

$$-3T_2 + 15 - 10 + 1 = 12$$

$$-3T_2 = 12 - 15 + 10 - 1$$

$$-3T_2 = 6$$

$$T_2 = \frac{6}{-3}$$

$$T_2 = -2$$

Subs $T_6 = -1$, $T_5 = 2$, $T_4 = 4$, $T_3 = 3$, $T_2 = -2$ in eqn (10)

$$T_1 + T_2 - 2T_3 + T_4 + 3T_5 - T_6 = 4$$

$$T_1 + (-2) - 2(3) + 4 + 3(2) - (-1) = 4$$

$$T_1 - 2 - 6 + 4 + 6 + 1 = 4$$

$$T_1 = 4 + 2 + 6 - 4 - 6 - 1$$

$$T_1 = 1$$

Therefore

$$T_1 = 1$$

$$T_2 = -2$$

$$T_3 = 3$$

$$T_4 = 4$$

$$T_5 = 2$$

$$T_6 = -1$$