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MATRIC NO: 15/ENG04/040

DEPARTMENT: ELECT/ELECT ENGR.

### ASSIGNMENT

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

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

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

$$5T_1 + 2T_2 - T_3 - T_4 + 2T_5 + T_6 = -3$$

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

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

### Solution

Manually use Gauss Elimination Method

$$\begin{array}{c} A \\ \left[ \begin{array}{cccccc} 1 & 1 & -2 & 1 & 3 & -1 \\ 2 & -1 & 1 & 2 & 1 & -3 \\ 1 & 3 & -3 & -1 & 2 & 1 \\ 5 & 2 & -1 & -1 & 2 & 1 \\ -3 & -1 & -2 & 3 & 1 & 3 \\ 4 & 3 & 1 & -6 & -3 & -2 \end{array} \right] \begin{array}{c} t_1 \\ t_2 \\ t_3 \\ t_4 \\ t_5 \\ t_6 \end{array} = \begin{array}{c} B \\ \left[ \begin{array}{c} 4 \\ 20 \\ -15 \\ -3 \\ 16 \\ -27 \end{array} \right] \end{array}$$

Step 1

$$\begin{array}{cccccc} 1 & 1 & -2 & 1 & 3 & -1 \\ 2 - \left( \frac{2}{1} \times 1 \right) & -1 - \left( \frac{2}{1} \times 1 \right) & 1 - \left( \frac{2}{1} \times -2 \right) & 1 - \left( \frac{2}{1} \times 1 \right) & 1 - \left( \frac{2}{1} \times 3 \right) & -3 - \left( \frac{2}{1} \times -1 \right) \\ 1 - \left( \frac{1}{1} \times 1 \right) & 3 - \left( \frac{1}{1} \times 1 \right) & -3 - \left( \frac{1}{1} \times -2 \right) & 1 - \left( \frac{1}{1} \times 1 \right) & 2 - \left( \frac{1}{1} \times 3 \right) & 1 - \left( \frac{1}{1} \times -1 \right) \\ 5 - \left( \frac{5}{1} \times 1 \right) & 2 - \left( \frac{5}{1} \times 1 \right) & 1 - \left( \frac{5}{1} \times -2 \right) & -1 - \left( \frac{5}{1} \times 1 \right) & 2 - \left( \frac{5}{1} \times 3 \right) & 1 - \left( \frac{5}{1} \times -1 \right) \\ -3 - \left( \frac{-3}{1} \times 1 \right) & -1 - \left( \frac{-3}{1} \times 1 \right) & 2 - \left( \frac{-3}{1} \times -2 \right) & 3 - \left( \frac{-3}{1} \times 1 \right) & 1 - \left( \frac{-3}{1} \times 3 \right) & 3 - \left( \frac{-3}{1} \times -1 \right) \\ 4 - \left( \frac{4}{1} \times 1 \right) & -3 - \left( \frac{4}{1} \times 1 \right) & 1 - \left( \frac{4}{1} \times -2 \right) & -6 - \left( \frac{4}{1} \times 1 \right) & -3 - \left( \frac{4}{1} \times 3 \right) & -2 - \left( \frac{4}{1} \times -1 \right) \end{array}$$

$$\begin{matrix} T \\ \begin{bmatrix} t_1 \\ t_2 \\ t_3 \\ t_4 \\ t_5 \\ t_6 \end{bmatrix} \end{matrix} = \begin{matrix} B \\ \begin{bmatrix} 4 \\ 20 - \left(\frac{2}{1} \times 4\right) \\ -15 - \left(\frac{1}{1} \times 4\right) \\ -3 - \left(\frac{5}{1} \times 4\right) \\ 16 - \left(\frac{-3}{1} \times 4\right) \\ -27 - \left(\frac{4}{1} \times 4\right) \end{bmatrix} \end{matrix}$$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 2 & -1 & -2 & -1 & 2 \\ 0 & -3 & 9 & -6 & -13 & 6 \\ 0 & 4 & -4 & 6 & 10 & 0 \\ 0 & -1 & 9 & -10 & -15 & 2 \end{bmatrix} \begin{bmatrix} t_1 \\ t_2 \\ t_3 \\ t_4 \\ t_5 \\ t_6 \end{bmatrix} = \begin{bmatrix} 4 \\ 12 \\ -19 \\ -23 \\ 28 \\ -43 \end{bmatrix}$$

step 2:

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 2 & -1 & -2 & -1 & 2 \\ 0 & -3 & 9 & -6 & -13 & 6 \\ 0 & 4 & -4 & 6 & 10 & 0 \\ 0 & -1 & 9 & -10 & -15 & 2 \end{bmatrix} \begin{bmatrix} t_1 \\ t_2 \\ t_3 \\ t_4 \\ t_5 \\ t_6 \end{bmatrix} = \begin{bmatrix} 4 \\ 12 \\ -19 \\ -23 \\ 28 \\ -43 \end{bmatrix}$$

Keeping Row 1 and Row 2 constant

where  $R_1$  represents the whole of Row 1

$$\begin{bmatrix} R_1 \\ 0 & 1 - \left(\frac{2}{-3} \times -3\right) & -1 - \left(\frac{2}{-3} \times 5\right) & -2 - \left(\frac{2}{-3} \times 0\right) & -1 - \left(\frac{2}{-3} \times -5\right) & 2 - \left(\frac{2}{-3} \times -1\right) \\ 0 & -3 - \left(\frac{-3}{-3} \times -3\right) & 9 - \left(\frac{-3}{-3} \times 5\right) & -6 - \left(\frac{-3}{-3} \times 0\right) & -13 - \left(\frac{-3}{-3} \times -5\right) & 6 - \left(\frac{-3}{-3} \times -1\right) \\ 0 & 4 - \left(\frac{4}{-3} \times -3\right) & -4 - \left(\frac{4}{-3} \times 5\right) & 6 - \left(\frac{4}{-3} \times 0\right) & 10 - \left(\frac{4}{-3} \times -5\right) & 0 - \left(\frac{4}{-3} \times -1\right) \\ 0 & -1 - \left(\frac{-1}{-3} \times -3\right) & 9 - \left(\frac{-1}{-3} \times 5\right) & -10 - \left(\frac{-1}{-3} \times 0\right) & -15 - \left(\frac{-1}{-3} \times -5\right) & 2 - \left(\frac{-1}{-3} \times -1\right) \end{bmatrix}$$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 0 & \frac{7}{3} & -2 & -\frac{13}{3} & \frac{4}{3} \\ 0 & 0 & 4 & -4 & -8 & 7 \\ 0 & 0 & \frac{8}{3} & 6 & \frac{10}{3} & -\frac{4}{3} \\ 0 & 0 & \frac{22}{3} & -10 & -\frac{40}{3} & \frac{7}{3} \end{bmatrix} \begin{bmatrix} t_1 \\ t_2 \\ t_3 \\ t_4 \\ t_5 \\ t_6 \end{bmatrix} = \begin{bmatrix} 4 \\ 12 \\ -11 \\ -23 \\ 44 \\ -47 \end{bmatrix}$$

$$\begin{aligned} t_3 &= -11 - \left(\frac{2}{-3} \times 12\right) = -11 \\ t_4 &= -23 - \left(\frac{-3}{-3} \times 12\right) = -35 \\ t_5 &= 44 - \left(\frac{4}{-3} \times 12\right) = 44 \\ t_6 &= -47 - \left(\frac{-1}{-3} \times 12\right) = -47 \end{aligned}$$

Step 3

Keeping the rows 1, 2, 3 constant and using Row 3 as the pivot row

$R_2$

$$\begin{bmatrix} 0 & 0 & \frac{7}{3} & -2 & -\frac{13}{3} & \frac{4}{3} \\ 0 & 0 & 4 - \left(\frac{12 \times 7}{7 \times 3}\right) & -4 - \left(\frac{12 \times -2}{7}\right) & -8 - \left(\frac{12 \times -13}{7 \times 3}\right) & 7 - \left(\frac{12 \times 4}{7 \times 3}\right) \\ 0 & 0 & \frac{8}{3} - \left(\frac{8 \times 7}{7 \times 3}\right) & 6 - \left(\frac{8 \times -2}{7}\right) & 10 - \left(\frac{8 \times -13}{7 \times 3}\right) & -4 - \left(\frac{8 \times 4}{7 \times 3}\right) \\ 0 & 0 & \frac{22}{3} - \left(\frac{22 \times 7}{7 \times 3}\right) & -10 - \left(\frac{22 \times -2}{7}\right) & -40 - \left(\frac{22 \times -13}{7 \times 3}\right) & \frac{7}{3} - \left(\frac{22 \times 4}{7 \times 3}\right) \end{bmatrix}$$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 0 & \frac{7}{3} & -2 & -\frac{13}{3} & \frac{4}{3} \\ 0 & 0 & 0 & -\frac{18}{7} & -\frac{4}{7} & \frac{33}{7} \\ 0 & 0 & 0 & \frac{58}{7} & \frac{58}{7} & -\frac{20}{7} \\ 0 & 0 & 0 & -\frac{26}{7} & \frac{2}{7} & -\frac{13}{7} \end{bmatrix} \begin{bmatrix} t_1 \\ t_2 \\ t_3 \\ t_4 \\ t_5 \\ t_6 \end{bmatrix} = \begin{bmatrix} 4 \\ 12 \\ -11 \\ -35 - \left(\frac{12 \times -11}{7}\right) = -113 = -16 \cdot 143 \\ 44 - \left(\frac{8 \times -11}{7}\right) = \frac{396}{7} = 56 \cdot 57 \\ -47 - \left(\frac{22 \times -11}{7}\right) = -\frac{87}{7} = -12 \cdot 43 \end{bmatrix}$$

Step 4: keeping rows 1, 2, 3, 4 constant and using Row 4 as the pivot row

$R_1$

$R_2$

$R_3$

$$\begin{bmatrix} 0 & 0 & 0 & -\frac{18}{7} & -\frac{4}{7} & \frac{33}{7} \\ 0 & 0 & 0 & \frac{58}{7} & \frac{58}{7} & -\frac{20}{7} \\ 0 & 0 & 0 & -\frac{26}{7} & \frac{2}{7} & -\frac{13}{7} \end{bmatrix} \begin{bmatrix} t_1 \\ t_2 \\ t_3 \\ t_4 \\ t_5 \\ t_6 \end{bmatrix} = \begin{bmatrix} 4 \\ 12 \\ -11 \\ -\frac{113}{7} \\ \frac{396}{7} \\ -\frac{87}{7} \end{bmatrix}$$

$$\Rightarrow \begin{array}{l} R_1 \\ R_2 \\ R_3 \\ 0 \end{array} \begin{array}{cccccc} & & & -18 & & -4 \\ & & & 7 & & 7 \\ 0 & 0 & 0 & \frac{58}{7} - \left[ \frac{-29 \times -18}{7 \quad 7} \right] & \frac{38}{7} - \left[ \frac{-29 \times -4}{7 \quad 7} \right] & \frac{-29}{7} - \left[ \frac{-29 \times 33}{7 \quad 7} \right] \\ 0 & 0 & 0 & \frac{-26}{7} - \left[ \frac{13 \times -18}{7 \quad 7} \right] & \frac{2}{7} - \left[ \frac{13 \times -4}{7 \quad 7} \right] & \frac{-13}{7} - \left[ \frac{13 \times 33}{7 \quad 7} \right] \end{array}$$

$$\Rightarrow \begin{array}{l} 1 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{array} \begin{array}{cccccc} 1 & -2 & 1 & 3 & -1 \\ -3 & 5 & 0 & -5 & -1 \\ 0 & \frac{7}{3} & -2 & -\frac{13}{3} & \frac{4}{3} \\ 0 & 0 & -\frac{18}{7} & -\frac{4}{7} & \frac{33}{7} \\ 0 & 0 & 0 & \frac{58}{9} & \frac{37}{3} \\ 0 & 0 & 0 & \frac{10}{9} & -\frac{26}{3} \end{array} \begin{array}{l} t_1 \\ t_2 \\ t_3 \\ t_4 \\ t_5 \\ t_6 \end{array} = \begin{array}{l} 4 \\ 12 \\ -11 \\ -11\frac{3}{7} \\ \frac{396 - (-29 \times -113)}{7 \left( \frac{9}{7} \right)} = \frac{41}{9} \\ \frac{-87 - (13 \times -113)}{7 \left( \frac{9}{7} \right)} = \frac{98}{9} = 10.888 \end{array}$$

$$\Rightarrow \begin{array}{l} 1 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{array} \begin{array}{cccccc} 1 & -2 & 1 & 3 & -1 \\ -3 & 5 & 0 & -5 & -1 \\ 0 & \frac{7}{3} & -2 & -\frac{13}{3} & \frac{4}{3} \\ 0 & 0 & -\frac{18}{7} & -\frac{4}{7} & \frac{33}{7} \\ 0 & 0 & 0 & \frac{58}{9} & \frac{37}{3} \\ 0 & 0 & 0 & \frac{10}{9} & -\frac{26}{3} \end{array} \begin{array}{l} t_1 \\ t_2 \\ t_3 \\ t_4 \\ t_5 \\ t_6 \end{array} = \begin{array}{l} 4 \\ 12 \\ -11 \\ -11\frac{3}{7} \\ \frac{41}{9} \text{ or } 4.56 \\ \frac{98}{9} \text{ or } 10.88 \end{array}$$

Step 5

Keeping Rows 1, 2, 3, 4, 5 constant and using Row 5 as the pivot row

$$\begin{array}{l} R_1 \\ R_2 \\ R_3 \\ R_4 \\ 0 \\ 0 \end{array} \begin{array}{cccccc} & & & & \frac{58}{9} & \frac{37}{3} \\ & & & & \frac{10}{9} - \left( \frac{5 \times 58}{29 \quad 9} \right) & -\frac{26}{3} - \left( \frac{5 \times 37}{29 \quad 3} \right) \end{array} \begin{array}{l} t_1 \\ t_2 \\ t_3 \\ t_4 \\ t_5 \\ t_6 \end{array} = \begin{array}{l} 4 \\ 12 \\ -11 \\ -11\frac{3}{7} \\ \frac{41}{9} \\ \frac{98 - (5 \times \frac{41}{9})}{9 \left( \frac{29}{9} \right)} = \frac{293}{29} \end{array}$$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 0 & \frac{7}{3} & -2 & -\frac{13}{3} & \frac{4}{3} \\ 0 & 0 & 0 & -\frac{18}{2} & -\frac{4}{2} & \frac{33}{2} \\ 0 & 0 & 0 & 0 & \frac{58}{4} & \frac{37}{3} \\ 0 & 0 & 0 & 0 & 0 & -\frac{313}{29} \end{bmatrix} \begin{bmatrix} t_1 \\ t_2 \\ t_3 \\ t_4 \\ t_5 \\ t_6 \end{bmatrix} = \begin{bmatrix} 4 \\ 12 \\ -11 \\ -\frac{113}{2} \\ \frac{41}{9} \\ \frac{293}{29} \end{bmatrix}$$

$$t_6 = \frac{293}{29} \div \frac{-313}{29} = \frac{293}{29} \times \frac{29}{-313} = \frac{-293}{313} = -0.936$$

$$t_5 \Rightarrow a_{55}t_5 + a_{56}t_6 = b_5$$

$$t_5 = \frac{b_5 - a_{56}t_6}{a_{55}} = \frac{\frac{41}{9} - \frac{39}{3}(-0.936)}{\frac{58}{4}} = \underline{\underline{2.4982}}$$

$$t_4 \Rightarrow a_{44}t_4 + a_{45}t_5 + a_{46}t_6 = b_4$$

$$t_4 = \frac{b_4 - a_{45}t_5 - a_{46}t_6}{a_{44}}$$

$$= \frac{-\frac{113}{2} - \left(-\frac{4}{2}(2.4982)\right) - \left(\frac{33}{2}(-0.936)\right)}{-\frac{18}{2}}$$

$$t_4 = \underline{\underline{4.0066}}$$

$$t_3 \Rightarrow a_{33}t_3 + a_{34}t_4 + a_{35}t_5 + a_{36}t_6 = b_3$$

$$t_3 = \frac{b_3 - a_{36}t_6 - a_{35}t_5 - a_{34}t_4}{a_{33}}$$

$$= \frac{-11 - \left(\frac{4}{3}(-0.936)\right) - \left(-\frac{13}{3}(2.4982)\right) - \left(-2(4.0066)\right)}{\frac{7}{3}}$$

$$t_3 = \underline{\underline{3.8943}}$$

$$t_2 = \frac{b_2 - a_{23}t_3 + a_{24}t_4 + a_{25}t_5 + a_{26}t_6}{a_{22}}$$

$$= \frac{12 - 5(3.8943) + \left(0(4.0066)\right) + \left(-5(2.4982)\right) + \left(-1(-0.936)\right)}{-3}$$

$$t_2 = \underline{\underline{-1.3610}}$$

$$t_1 = \frac{b_1 - a_{12}t_2 + a_{13}t_3 + a_{14}t_4 + a_{15}t_5 + a_{16}t_6}{a_{11}}$$

$$= \frac{4 - (1(-1.3610)) + (-2(3.8943)) + (1(4.0066)) + (3(2.4982)) + (1(-0.936))}{1}$$

$$t_1 = \underline{\underline{0.71246}}$$