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15/ENG06/1069
Mechanical

Assignment ENG381

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

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

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

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

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

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

The augmented matrix =>

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 2 & -1 & 1 & 2 & 1 & -3 \\ 1 & 3 & -3 & -1 & 2 & 1 \\ 5 & 2 & -1 & -1 & 2 & 1 \\ -3 & -1 & 2 & 3 & 3 & 1 \\ 4 & 3 & 1 & -6 & -3 & -2 \end{bmatrix} \cdot \begin{bmatrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{bmatrix} = \begin{bmatrix} 4 \\ 20 \\ -15 \\ -3 \\ 16 \\ -27 \end{bmatrix}$$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 2-(\frac{2}{1})\cdot 1 & -1-(\frac{2}{1})\cdot 1 & 1-(\frac{2}{1})\cdot -2 & 2-(\frac{2}{1})\cdot 1 & 1-(\frac{2}{1})\cdot 3 & -3-(\frac{2}{1})\cdot -1 \\ 1-(\frac{1}{1})\cdot 1 & 3-(\frac{1}{1})\cdot 1 & -3-(\frac{1}{1})\cdot -2 & -1-(\frac{1}{1})\cdot 1 & 2-(\frac{1}{1})\cdot 3 & -1-(\frac{1}{1})\cdot -1 \\ 5-(\frac{5}{1})\cdot 1 & 2-(\frac{5}{1})\cdot 1 & -1-(\frac{5}{1})\cdot -2 & -1-(\frac{5}{1})\cdot 1 & 2-(\frac{5}{1})\cdot 3 & 1-(\frac{5}{1})\cdot -1 \\ -3-(\frac{-3}{1})\cdot 1 & -1-(\frac{-3}{1})\cdot 1 & 2-(\frac{-3}{1})\cdot -2 & 3-(\frac{-3}{1})\cdot 1 & 3-(\frac{-3}{1})\cdot 3 & 1-(\frac{-3}{1})\cdot -1 \\ 4-(\frac{4}{1})\cdot 1 & 3-(\frac{4}{1})\cdot 1 & 1-(\frac{4}{1})\cdot -2 & -6-(\frac{4}{1})\cdot 1 & -3-(\frac{4}{1})\cdot 3 & -2-(\frac{4}{1})\cdot -1 \end{bmatrix} \cdot \begin{bmatrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{bmatrix} = \begin{bmatrix} 4 \\ 20-(\frac{2}{1})\cdot 4 \\ -15-(\frac{1}{1})\cdot 4 \\ -3-(\frac{5}{1})\cdot 4 \\ 16-(\frac{-3}{1})\cdot 4 \\ -27-(\frac{4}{1})\cdot 4 \end{bmatrix}$$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 2 & -1 & -2 & -1 & 2 \\ 0 & -3 & 9 & -6 & -13 & 6 \\ 0 & 2 & -4 & 6 & 10 & 0 \\ 0 & -1 & 9 & -10 & -15 & 2 \end{bmatrix} \begin{bmatrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{bmatrix} = \begin{bmatrix} 4 \\ 12 \\ -19 \\ -23 \\ 28 \\ 43 \end{bmatrix}$$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 2-(-\frac{2}{3})\cdot 3 & -1-(-\frac{2}{3})\cdot 5 & -1-(-\frac{2}{3})\cdot 0 & -1-(-\frac{2}{3})\cdot -5 & 2-(-\frac{2}{3})\cdot -1 \\ 0 & -3-(\frac{3}{3})\cdot -3 & 9-(\frac{-3}{3})\cdot 5 & -6-(\frac{3}{3})\cdot 0 & -13-(\frac{3}{3})\cdot -5 & 6-(\frac{3}{3})\cdot -1 \\ 0 & 2-(-\frac{2}{3})\cdot -3 & -4-(-\frac{2}{3})\cdot 5 & 6-(-\frac{2}{3})\cdot 0 & 10-(\frac{2}{3})\cdot -5 & 0-(\frac{2}{3})\cdot -1 \\ 0 & 1-(-\frac{1}{3})\cdot -3 & 9-(-\frac{1}{3})\cdot 5 & -10-(-\frac{1}{3})0 & 15-(-\frac{1}{3})\cdot -5 & 2-(-\frac{1}{3})\cdot -1 \end{bmatrix} \cdot \begin{bmatrix} I_1 \\ I_2 \\ I_3 \\ I_4 \\ I_5 \\ I_6 \end{bmatrix} = \begin{bmatrix} 4 \\ 12 \\ -14-(-\frac{2}{3})\cdot 12 \\ -23-(\frac{3}{3})\cdot 12 \\ 28-(-\frac{2}{3})\cdot 12 \\ -43-(-\frac{1}{3})\cdot 12 \end{bmatrix} = \begin{bmatrix} 1 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix}$$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 0 & 2.4 & -2 & -4.4 & 1.4 \\ 0 & 0 & 4 & -6 & -8 & 7 \\ 0 & 0 & -0.7 & 6 & 6.7 & -0.7 \\ 0 & 6 & 7.4 & -10 & -13.4 & 2.4 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \\ I_4 \\ I_5 \\ I_6 \end{bmatrix} = \begin{bmatrix} 4 \\ 12 \\ -11 \\ -35 \\ 36 \\ -47 \end{bmatrix}$$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 0 & 2.4 & -2 & -4.4 & 1.4 \\ 0 & 0 & 4-(\frac{4}{2.4})\cdot 2.4 & -6-(\frac{4}{2.4})\cdot -2 & -8-(\frac{4}{2.4})\cdot -4.4 & 7-(\frac{4}{2.4})\cdot 1.4 \\ 0 & 0 & -0.7-(\frac{-0.7}{2.4})2.4 & 6-(\frac{-0.7}{2.4})\cdot -2 & 6.7-(\frac{-0.7}{2.4})\cdot -4.4 & -0.7-(\frac{-0.7}{2.4})\cdot 1.4 \\ 0 & 6 & 7.4-(\frac{7.4}{2.4})\cdot 2.4 & -10-(\frac{7.4}{2.4})\cdot -2 & -13.4-(\frac{7.4}{2.4})\cdot -4.4 & 2.4-(\frac{7.4}{2.4})\cdot 1.4 \end{bmatrix} \cdot \begin{bmatrix} I_1 \\ I_2 \\ I_3 \\ I_4 \\ I_5 \\ I_6 \end{bmatrix} = \begin{bmatrix} 4 \\ 12 \\ -11 \\ -35-(\frac{4}{2.4})\cdot -11 \\ 36-(\frac{-0.7}{2.4})\cdot -11 \\ -47-(\frac{7.4}{2.4})\cdot -11 \end{bmatrix} = \begin{bmatrix} 1 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix}$$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 0 & 2.4 & -2 & -4.4 & 1.4 \\ 0 & 0 & 0 & -2.7 & -0.7 & 4.7 \\ 0 & 0 & 0 & 6.42 & 6.42 & -0.24 \\ 0 & 0 & 0 & -3.84 & 0.17 & -1.91 \end{bmatrix} \cdot \begin{bmatrix} I_1 \\ I_2 \\ I_3 \\ I_4 \\ I_5 \\ I_6 \end{bmatrix} = \begin{bmatrix} 4 \\ 12 \\ -11 \\ -16.7 \\ -0.24 \\ 10.7 \end{bmatrix} = \begin{bmatrix} 1 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix}$$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 0 & 2.4 & -2 & -4.4 & 1.4 \\ 0 & 0 & 0 & -2.7 & -0.7 & 4.7 \\ 0 & 0 & 0 & 8.62\left(\frac{5.42}{-2.7}\right)-2.7 & 5.84\left(\frac{5.42}{-2.7}\right)-0.7 & -0.74-\left(\frac{5.42}{-2.7}\right)4.7 \\ 0 & 0 & 0 & -3.84\left(\frac{-3.84}{2.7}\right)2.7 & 0.17\left(\frac{-3.84}{-2.7}\right)-0.7 & -1.94-\left(\frac{-3.84}{-2.7}\right)4.7 \end{bmatrix} \cdot \begin{bmatrix} I_1 \\ I_2 \\ I_3 \\ I_4 \\ I_5 \\ I_6 \end{bmatrix} = \begin{bmatrix} 4 \\ 12 \\ -11 \\ -16.7 \\ 32.93-\left(\frac{5.42}{-2.2}\right)\cdot 16.7 \\ -13.08-\left(\frac{-3.84}{2.7}\right)(-10. \end{bmatrix}$$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & 3 & 5 & 0 & -5 & -1 \\ 0 & 0 & 2.4 & -2 & -4.4 & 1.4 \\ 0 & 0 & 0 & -2.7 & -0.7 & 4.7 \\ 0 & 0 & 0 & 0 & 4.01 & 9.2 \\ 0 & 0 & 0 & 0 & 1.16 & -8.59 \end{bmatrix} \cdot \begin{bmatrix} I_1 \\ I_2 \\ I_3 \\ I_4 \\ I_5 \\ I_6 \end{bmatrix} = \begin{bmatrix} 4 \\ 12 \\ -11 \\ -16.7 \\ -0.74 \\ 10.7 \end{bmatrix}$$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & 3 & 5 & 0 & -5 & -1 \\ 0 & 0 & 2.4 & -2 & -4.4 & 1.4 \\ 0 & 0 & 0 & -2.7 & -0.7 & 4.7 \\ 0 & 0 & 0 & 0 & 4.01 & 9.2 \\ 0 & 0 & 0 & 0 & 1.16-\left(\frac{1.16}{4.01}\right)4.01 & -8.59-\left(\frac{-8.59}{4.01}\right)9.2 \end{bmatrix} \cdot \begin{bmatrix} I_1 \\ I_2 \\ I_3 \\ I_4 \\ I_5 \\ I_6 \end{bmatrix} = \begin{bmatrix} 4 \\ 12 \\ -11 \\ -16.7 \\ -0.74 \\ 10.7-\left(\frac{1.16}{4.01}\right)-0.74 \end{bmatrix}$$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 0 & 2.4 & -2 & -4.4 & 1.4 \\ 0 & 0 & 0 & -2.7 & -0.7 & 4.7 \\ 0 & 0 & 0 & 0 & 4.01 & 9.2 \\ 0 & 0 & 0 & 0 & 0 & -11.3 \end{bmatrix} \cdot \begin{bmatrix} I_1 \\ I_2 \\ I_3 \\ I_4 \\ I_5 \\ I_6 \end{bmatrix} = \begin{bmatrix} 4 \\ 12 \\ -11 \\ -16.7 \\ -0.74 \\ 10.92 \end{bmatrix}$$

From the matrix above

$$-11.3 I_6 = 10.92$$

$$I_6 = \frac{0.92}{11.3} = -0.966$$

$$4.01 I_5 + 9.2 I_6 = -0.74$$

$$I_5 = \frac{-0.74 - 9.2(-0.966)}{4.01} = 2.031$$

$-2.7T_4 - 0.7T_5 + 4.7T_6 = -16.7$

$$T_4 = \frac{-16.7 - 4.7(0.966) + 0.7(2.031)}{-2.7} = 3.977$$

$2.4T_3 - 2T_4 - 4.4T_5 + 1.4T_6 = -11$

$$T_3 = \frac{-11 - 1.4(0.966) + 4.4(2.031) + 2(3.977)}{2.4} = 3.017$$

$-3T_2 + 6T_3 + 0T_4 - 5T_5 - 1T_6 = 12$

$$T_2 = \frac{12 + (0.966) + 5(2.031) - 5(3.017)}{-3} = -2.034$$

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

$T_1 = 4 + (0.966 - 3(2.031) - 3.977 + 2(3.017) + 2.034 = 1.032$

$\therefore$ $T_1 = 1.032°C$

$T_2 = -2.034°C$

$T_3 = 3.017°C$

$T_4 = 3.972°C$

$T_5 = 2.031°C$

$T_6 = -0.966°C$