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Computer Eng

15/ENG02/030

ENG 381

Assignment 3

$$\begin{cases} T_1 + T_2 - 2T_3 + T_4 + 3T_5 - T_6 = 4 \\ 2T_1 - T_2 + T_3 + 2T_4 + T_5 - 3T_6 = 20 \\ T_1 + 3T_2 - 3T_3 - T_4 + 2T_5 + T_6 = -15 \\ 5T_1 + 2T_2 - T_3 - T_4 + 2T_5 + T_6 = -3 \\ 3T_1 - T_2 + 2T_3 + 3T_4 + T_5 - 3T_6 = 16 \\ 4T_1 + 3T_2 + T_3 - 6T_4 - 3T_5 - 2T_6 = -27 \end{cases}$$

The augmented matrix \Rightarrow

$$\begin{array}{cccccc|c} 1 & 1 & -2 & 1 & 3 & -1 & T_1 & 4 \\ 2 & -1 & 1 & 2 & 1 & -3 & T_2 & 20 \\ 1 & 3 & -3 & -1 & 2 & 1 & T_3 & -15 \\ 5 & 2 & -1 & -1 & 2 & 1 & T_4 & -3 \\ -3 & -1 & 2 & 3 & 3 & 1 & T_5 & 16 \\ 4 & 3 & 1 & -6 & -3 & -2 & T_6 & -27 \end{array} \Rightarrow$$

$$\begin{array}{cccccc|c} 1 & 1 & -2 & 1 & 3 & -1 & T_1 & 4 \\ 2 - \left(\frac{2}{1}\right)1 & -1 - \left(\frac{2}{1}\right)1 & 1 - \left(\frac{2}{1}\right)(-2) & 2 - \left(\frac{2}{1}\right)1 & 1 - \left(\frac{2}{1}\right)3 & -3 - \left(\frac{2}{1}\right)(-1) & T_2 & 20 - \left(\frac{2}{1}\right)4 \\ 1 - \left(\frac{1}{1}\right)1 & 3 - \left(\frac{1}{1}\right)1 & -3 - \left(\frac{1}{1}\right)(-2) & -1 - \left(\frac{1}{1}\right)1 & 2 - \left(\frac{1}{1}\right)3 & 1 - \left(\frac{1}{1}\right)(-1) & T_3 & -15 - \left(\frac{1}{1}\right)4 \\ 5 - \left(\frac{5}{1}\right)1 & 2 - \left(\frac{5}{1}\right)1 & -1 - \left(\frac{5}{1}\right)(-2) & -1 - \left(\frac{5}{1}\right)1 & 2 - \left(\frac{5}{1}\right)3 & 1 - \left(\frac{5}{1}\right)(-1) & T_4 & -3 - \left(\frac{5}{1}\right)4 \\ -3 - \left(\frac{-3}{1}\right)1 & -1 - \left(\frac{-3}{1}\right)1 & 2 - \left(\frac{-3}{1}\right)(-2) & 3 - \left(\frac{-3}{1}\right)1 & 3 - \left(\frac{-3}{1}\right)3 & 1 - \left(\frac{-3}{1}\right)(-1) & T_5 & 16 - \left(\frac{-3}{1}\right)4 \\ 4 - \left(\frac{4}{1}\right)1 & 3 - \left(\frac{4}{1}\right)1 & 1 - \left(\frac{4}{1}\right)(-2) & -6 - \left(\frac{4}{1}\right)1 & -3 - \left(\frac{4}{1}\right)3 & -2 - \left(\frac{4}{1}\right)(-1) & T_6 & -27 - \left(\frac{4}{1}\right)4 \end{array}$$

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

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 2 - \left(\frac{2}{3}\right)3 & -1 - \left(\frac{2}{3}\right)5 & -2 \left(\frac{2}{3}\right)0 & -1 - \left(\frac{2}{3}\right)-5 & 2 \left(\frac{2}{3}\right)-1 \\ 0 & -3 - \left(\frac{3}{3}\right)3 & 9 - \left(\frac{3}{3}\right)5 & -6 - \left(\frac{3}{3}\right)0 & -13 - \left(\frac{3}{3}\right)-5 & 6 - \left(\frac{3}{3}\right)-1 \\ 0 & 2 - \left(\frac{2}{3}\right)3 & -4 - \left(\frac{2}{3}\right)5 & 6 \left(\frac{2}{3}\right)0 & 10 - \left(\frac{2}{3}\right)-5 & 0 - \left(\frac{2}{3}\right)-1 \\ 0 & 1 - \left(\frac{1}{3}\right)3 & 9 - \left(\frac{1}{3}\right)5 & -10 - \left(\frac{1}{3}\right)0 & -15 - \left(\frac{1}{3}\right)-5 & 2 - \left(\frac{1}{3}\right)-1 \end{bmatrix} \begin{matrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{matrix}$$

\Rightarrow

$$\begin{bmatrix} 4 \\ 12 \\ -14 - \left(\frac{2}{3}\right)12 \\ -23 - \left(\frac{3}{3}\right)12 \\ 28 - \left(\frac{2}{3}\right)12 \\ -43 - \left(\frac{1}{3}\right)12 \end{bmatrix}$$

\Rightarrow

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 0 & 2.4 & -2 & -4.4 & 1.4 \\ 0 & 0 & 0 & -6 & -8 & 7 \\ 0 & 0 & -0.7 & 6 & 6.7 & -0.7 \\ 0 & 0 & 7.4 & -10 & -13.4 & 2.4 \end{bmatrix} \begin{matrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{matrix} = \begin{bmatrix} 4 \\ 12 \\ -11 \\ -35 \\ 36 \\ -47 \end{bmatrix}$$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 0 & 2.4 & -2 & -4.4 & 1.4 \\ 0 & 0 & 4 - \left(\frac{4}{2.4}\right)2.4 & -6 - \left(\frac{4}{2.4}\right)-2 & -8 - \left(\frac{4}{2.4}\right)-4.4 & 7 - \left(\frac{4}{2.4}\right)1.4 \\ 0 & 0 & -6.7 - \left(\frac{6.7}{2.4}\right)2.4 & 6 - \left(\frac{-6.7}{2.4}\right)-2 & 6.7 - \left(\frac{6.7}{2.4}\right)-4.4 & -0.7 - \left(\frac{6.7}{2.4}\right)1.4 \\ 0 & 0 & 7.4 - \left(\frac{7.4}{2.4}\right)2.4 & -10 - \left(\frac{7.4}{2.4}\right)-2 & -13.4 - \left(\frac{7.4}{2.4}\right)-4.4 & 2.4 - \left(\frac{7.4}{2.4}\right)1.4 \end{bmatrix}$$

$$\begin{bmatrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{bmatrix} = \begin{bmatrix} 4 \\ 12 \\ -11 \\ -35 - \left(\frac{4}{2.4}\right)(-11) \\ 36 - \left(\frac{6.7}{2.4}\right)(-11) \\ -47 - \left(\frac{7.4}{2.4}\right)(-11) \end{bmatrix}$$

$$\begin{bmatrix} 1 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix} \begin{matrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{matrix}$$

=

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 0 & 2.4 & -2 & -4.4 & 1.4 \\ 0 & 0 & 6 & -2.7 & -0.7 & 4.7 \\ 0 & 0 & 0 & 5.42 & 5.42 & -6.29 \\ 0 & 0 & 0 & -3.84 & 0.17 & -1.91 \end{bmatrix} \begin{matrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{matrix} = \begin{bmatrix} 4 \\ 12 \\ -11 \\ -16.7 \\ 32.79 \\ -13.08 \end{bmatrix}$$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 0 & 2.4 & -2 & -4.4 & 1.4 \\ 0 & 0 & 0 & -2.7 & -0.7 & 4.7 \\ 0 & 0 & 6 & 5.42 \left(\frac{5.42}{2.7}\right) & -2.7 & 5.42 \left(\frac{5.42}{2.7}\right) - 0.7 - 6.29 - \left(\frac{5.42}{2.7}\right)(4.7) \\ 0 & 0 & 0 & -3.84 \left(\frac{-3.84}{-2.7}\right) & -2.7 & 0.17 - \left(\frac{-3.84}{-2.7}\right)(-0.7) - 1.91 - \left(\frac{-3.84}{-2.7}\right)(4.7) \end{bmatrix}$$

$$\begin{bmatrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{bmatrix} = \begin{bmatrix} 4 \\ 12 \\ -11 \\ -16.7 \\ 32.79 - \left(\frac{5.42}{2.7}\right)(-16.7) \\ -13.08 - \left(\frac{-3.84}{2.7}\right)(-16.7) \end{bmatrix}$$

$$= \begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & 3 & 5 & 0 & -5 & -1 \\ 0 & 0 & 2.4 & -2 & -4.4 & 1.4 \\ 0 & 0 & 6 & -2.7 & -0.7 & 4.7 \\ 0 & 0 & 0 & 0 & 4.01 & 9.2 \\ 0 & 0 & 0 & 0 & 1.16 & -8.59 \end{bmatrix} \begin{matrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{matrix} = \begin{bmatrix} 4 \\ 12 \\ -11 \\ -16.7 \\ -0.74 \\ 10.7 \end{bmatrix}$$

$$= \begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & 3 & 5 & 0 & -5 & -1 \\ 0 & 0 & 2.4 & -2 & -4.4 & 1.4 \\ 0 & 0 & 0 & -2.7 & -0.7 & 4.7 \\ 0 & 0 & 0 & 0 & 4.01 & 9.2 \\ 0 & 0 & 0 & 0 & 1.16 - \left(\frac{1.16}{4.01}\right)(4.01) - 8.59 - \left(\frac{1.16}{4.01}\right)(9.2) \end{bmatrix} \begin{matrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{matrix} = \begin{bmatrix} 4 \\ 12 \\ -11 \\ -16.7 \\ -0.74 \\ 10.7 - \left(\frac{1.16}{4.01}\right)(-0.74) \end{bmatrix}$$

2nd matrix will be \Rightarrow

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -3 & -1 \\ 0 & 0 & 2.4 & -2 & -6.4 & 1.4 \\ 0 & 0 & 0 & -2.7 & -0.7 & 4.7 \\ 0 & 0 & 0 & 0 & 4.01 & 9.2 \\ 0 & 0 & 0 & 0 & 0 & -11.3 \end{bmatrix} \begin{bmatrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{bmatrix} = \begin{bmatrix} 4 \\ 12 \\ -11 \\ -16.7 \\ -0.74 \\ 10.92 \end{bmatrix}$$

From the above matrix we can solve for the temperatures $T_1, T_2, T_3, T_4, T_5, T_6$ respectively,
 $-11.3 T_6 = 10.92$

$$T_6 = 10.92 / 11.3$$

$$T_6 = -0.966 \text{ --- (1)}$$

$$4.01 T_5 + 9.2 T_6 = -0.74$$

$$T_5 = \frac{-0.74 - 9.2(-0.966)}{4.01}$$

$$T_5 = \frac{8.1472}{4.01} = 2.031 \text{ --- (2)}$$

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

$$-2.7 T_4 - 0.7(2.031) + 4.7(-0.966) = -16.7$$

$$-2.7 T_4 - 1.4217 - 4.5402 = -16.7$$

$$-2.7 T_4 = -16.7 + 1.4217 + 4.5402$$

$$-2.7 T_4 = -10.7381$$

$$T_4 = -10.7381 / -2.7 = 3.977 \text{ --- (3)}$$

$$2.4 T_3 - 2 T_4 - 6.4 T_5 + 1.4 T_6 = -11$$

$$2.4 T_3 - 2(3.977) - 6.4(2.031) + 1.4(-0.966) = -11$$

$$2.4 T_3 - 7.954 - 8.9364 - 1.3524 = -11$$

$$2.4 T_3 = -11 + 7.954 + 8.9364 + 1.3524$$

$$T_3 = 7.2428 / 2.4$$

$$T_3 = 3.017 \text{ --- (4)}$$

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

$$-3 T_2 + 5(3.017) + 0 - 5(2.031) - (-0.966) = 12$$

$$-3 T_2 = 6.104$$

$$T_2 = 6.104 / -3 \Rightarrow T_2 = -2.034 \text{ --- (5)}$$

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~~Maths~~ Assignment contd.

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

$$T_1 = (2.034) - 2(3.627) + 3.977 + 3(2.031) + 0.966 = 4$$

$$T_1 = 2.034 - 6.634 + 3.977 + 6.043 + 0.966 = 4$$

$$T_1 = 1.032 \text{ --- } (6)$$

from eqn (1) to eqn (6)

$$T_1 = 1.032^\circ\text{C}$$

$$T_2 = -2.034^\circ\text{C}$$

$$T_3 = 3.017^\circ\text{C}$$

$$T_L = 3.972^\circ\text{C}$$

$$T_5 = 2.631^\circ \text{C}$$

$$T_6 = -0.966^\circ\text{C} //$$

