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15/Eng02/024

Computer Engineering

Maths Assignment 3

Assignment 3

1)
$$\begin{cases} T_1 + T_2 - T_3 + T_4 + 6T_5 - T_6 = 4 \\ 2T_1 - T_2 + T_3 + 4T_4 + T_5 - 3T_6 = 20 \\ T_1 + 3T_2 - 3T_3 - T_4 + 2T_5 + T_6 = -15 \\ 5T_1 + T_2 - T_3 - T_4 + 2T_5 + T_6 = -3 \\ -8T_1 - T_2 + 2T_3 + 3T_4 + T_5 + 3T_6 = 16 \\ 4T_1 + 3T_2 + T_3 - 6T_4 - 3T_5 - 2T_6 = -27 \end{cases}$$

The Augmented Matrix

$$\begin{array}{cccccc|c} 1 & 1 & -2 & 1 & 3 & -1 & T_1 & 4 \\ 2 & -1 & 1 & 2 & 1 & -3 & T_2 & 20 \\ 1 & 3 & -3 & -1 & 2 & 1 & T_3 & -15 \\ 5 & 1 & -1 & -1 & 2 & 1 & T_4 & -3 \\ -8 & -1 & 2 & 3 & 1 & 3 & T_5 & 16 \\ 4 & 3 & 1 & -6 & -3 & -2 & T_6 & -27 \end{array}$$

$$\begin{array}{l} T_1 = 4 \\ T_2 = 20 \\ T_3 = -15 \\ T_4 = -3 \\ T_5 = 16 \\ T_6 = -27 \end{array}$$

$$\begin{array}{cccccc|c} 1 & 1 & -2 & 1 & 3 & -1 & T_1 & 4 \\ 2 - (1/1) & -1 - (1/1) & 1 - (-2/1) & 2 - (1/1) & 1 - (3/1) & -3 - (-1/1) & T_2 & 20 - (1/1)4 \\ 1 - (1/1) & 3 - (1/1) & -3 - (-2/1) & -1 - (1/1) & 2 - (3/1) & 1 - (-1/1) & T_3 & -15 - (1/1)4 \\ 5 - (1/1) & 1 - (1/1) & -1 - (-2/1) & -1 - (1/1) & 2 - (3/1) & 1 - (-1/1) & T_4 & -3 - (1/1)4 \\ -8 - (1/1) & -1 - (1/1) & 2 - (-2/1) & 3 - (1/1) & 1 - (3/1) & 3 - (-1/1) & T_5 & 16 - (1/1)4 \\ 4 - (1/1) & 3 - (1/1) & 1 - (-2/1) & -6 - (1/1) & -3 - (3/1) & -2 - (-1/1) & T_6 & -27 - (1/1)4 \end{array}$$

$$\Downarrow$$

$$\begin{array}{cccccc|c} 1 & 1 & -2 & 1 & 3 & -1 & T_1 & 4 \\ 0 & -3 & 5 & 0 & -5 & -1 & T_2 & 12 \\ 0 & 2 & -1 & -2 & -1 & 2 & T_3 & -19 \\ 0 & 3 & 9 & -6 & -13 & 6 & T_4 & -25 \\ 0 & 2 & 4 & 6 & 10 & 0 & T_5 & 28 \\ 0 & -1 & 9 & -10 & -15 & 2 & T_6 & 143 \end{array}$$

$$\begin{array}{cccccc|c}
 1 & 1 & -2 & 1 & 3 & -1 & T_1 \\
 0 & -3 & 5 & 0 & -5 & -1 & T_2 \\
 0 & 2 - \left(\frac{1}{3}\right) \cdot 3 & -1 - \left(-\frac{1}{3}\right) \cdot 5 & -2 - \left(-\frac{1}{3}\right) \cdot 0 & -1 - \left(-\frac{1}{3}\right) \cdot (-5) & 2 - \left(\frac{1}{3}\right) \cdot (-1) & T_3 \\
 0 & -3 - \left(\frac{1}{3}\right) \cdot 3 & 7 - \left(\frac{1}{3}\right) \cdot 5 & -6 - \left(-\frac{1}{3}\right) \cdot 0 & -13 - \left(\frac{1}{3}\right) \cdot (-5) & 6 - \left(-\frac{1}{3}\right) \cdot (-1) & T_4 \\
 0 & 2 - \left(\frac{1}{3}\right) \cdot 3 & -4 - \left(-\frac{1}{3}\right) \cdot 5 & 6 - \left(-\frac{1}{3}\right) \cdot 0 & 6 - \left(\frac{1}{3}\right) \cdot (-5) & 0 - \left(\frac{1}{3}\right) \cdot (-1) & T_5 \\
 0 & -1 - \left(-\frac{1}{3}\right) \cdot 3 & 7 - \left(-\frac{1}{3}\right) \cdot 5 & -10 - \left(-\frac{1}{3}\right) \cdot 0 & -15 - \left(-\frac{1}{3}\right) \cdot (-5) & 2 - \left(\frac{1}{3}\right) \cdot (-1) & T_6
 \end{array}$$

$$= \begin{bmatrix} 4 \\ 12 \\ -19 - \left(-\frac{1}{3}\right) \cdot 12 \\ -13 - \left(-\frac{1}{3}\right) \cdot 12 \\ 28 - \left(\frac{1}{3}\right) \cdot 12 \\ -43 - \left(-\frac{1}{3}\right) \cdot 12 \end{bmatrix}$$

$$\begin{array}{c|c}
 T_1 & 4 \\
 T_2 & 12 \\
 T_3 & -11 \\
 T_4 & -16.7 \\
 T_5 & 32.77 - \left(\frac{15.43}{-2.7}\right) (-16) \\
 T_6 & -13.08 - \left(\frac{-3.77}{-2.7}\right) (-16)
 \end{array}$$

$$\begin{array}{cccccc|c|c}
 1 & 1 & -2 & 1 & 3 & -1 & T_1 & 4 \\
 0 & -3 & 5 & 0 & -5 & -1 & T_2 & 12 \\
 0 & 0 & 2.4 & -2 & -4.4 & 1.4 & T_3 & -11 \\
 0 & 0 & 0 & -6 & -8 & 7 & T_4 & -35 \\
 0 & 0 & 0 & 6.7 & -0.7 & & T_5 & 36 \\
 0 & 0 & 0 & -13.4 & 2.4 & & T_6 & -47
 \end{array}$$

$$\begin{array}{cccc|c}
 1 & 1 & -2 & 1 & 3 \\
 0 & -3 & 5 & 0 & -5 \\
 0 & 0 & 2.4 & -2 & -4.4 \\
 0 & 0 & 0 & -2.7 & -1 \\
 0 & 0 & 0 & 0 & 1
 \end{array}$$

$$\begin{array}{cccccc|c}
 1 & 1 & -2 & 1 & 3 & -1 & T_1 \\
 0 & -3 & 5 & 0 & -5 & -1 & T_2 \\
 0 & 0 & 2.4 & -2 & -4.4 & 1.4 & T_3 \\
 0 & 0 & 4 - \left(\frac{1}{2.4}\right) \cdot 2.4 & -6 - \left(\frac{1}{2.4}\right) \cdot (-2) & -8 - \left(\frac{1}{2.4}\right) \cdot (-4.4) & 7 - \left(\frac{1}{2.4}\right) \cdot 1.4 & T_4 \\
 0 & 0 & -0.7 - \left(-\frac{1}{2.4}\right) \cdot 2.4 & 6 - \left(-\frac{1}{2.4}\right) \cdot (-2) & 6.7 - \left(-\frac{1}{2.4}\right) \cdot (-4.4) & -0.7 - \left(-\frac{1}{2.4}\right) \cdot 1.4 & T_5 \\
 0 & 0 & 7.4 - \left(\frac{1}{2.4}\right) \cdot 2.4 & -10 - \left(\frac{1}{2.4}\right) \cdot (-2) & -13.4 - \left(\frac{1}{2.4}\right) \cdot (-4.4) & 2.4 - \left(\frac{1}{2.4}\right) \cdot 1.4 & T_6
 \end{array}$$

$$\begin{array}{c|c}
 T_1 & 4 \\
 T_2 & 12 \\
 T_3 & -11 \\
 T_4 & -35 - \left(\frac{1}{2.4}\right) (-11) \\
 T_5 & 36 - \left(-\frac{1}{2.4}\right) (-11) \\
 T_6 & -47 - \left(\frac{1}{2.4}\right) (-11)
 \end{array}$$

$$\begin{array}{cccc|c}
 1 & 1 & -2 & 1 & 3 \\
 0 & -3 & 5 & 0 & -5 \\
 0 & 0 & 2.4 & -2 & -4.4 \\
 0 & 0 & 0 & -2.7 & -1 \\
 0 & 0 & 0 & 0 & 1
 \end{array}$$

$$\begin{bmatrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \end{bmatrix} = \begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 0 & 2.4 & -2 & -4.4 & 1.4 \\ 0 & 0 & 0 & -2.7 & -0.7 & 4.7 \\ 0 & 0 & 0 & 0 & 4.01 & 7.2 \end{bmatrix}$$

$$\begin{bmatrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{bmatrix} = \begin{bmatrix} 4 \\ 12 \\ -11 \\ -16.7 \\ 52.79 - \left(\frac{15.41}{-2.7}\right)(-16.7) \\ -13.08 - \left(\frac{-3.99}{-2.7}\right)(-16.7) \end{bmatrix}$$

$$\Downarrow$$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 0 & 2.4 & -2 & -4.4 & 1.4 \\ 0 & 0 & 0 & -2.7 & -0.7 & 4.7 \\ 0 & 0 & 0 & 0 & 4.01 & 7.2 \\ 0 & 0 & 0 & 0 & 1.16 & -8.59 \end{bmatrix} \quad \begin{bmatrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{bmatrix} = \begin{bmatrix} 4 \\ 12 \\ -11 \\ -16.7 \\ -0.74 \\ 10.7 \end{bmatrix}$$

$$\Downarrow$$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 0 & 2.4 & -2 & -4.4 & 1.4 \\ 0 & 0 & 0 & -2.7 & -0.7 & 4.7 \\ 0 & 0 & 0 & 0 & 4.01 & 7.2 \\ 0 & 0 & 0 & 0 & 1.16 & -8.59 \end{bmatrix} \quad \begin{bmatrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{bmatrix}$$

$$= \begin{bmatrix} 4 \\ 12 \\ -11 \\ -16.7 \\ -0.74 \\ 10.7 - (1.44 \times 4.01)(-0.74) \end{bmatrix}$$

The final matrix will be:

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 0 & 2.4 & -2 & -4.4 & 1.4 \\ 0 & 0 & 0 & -2.7 & -0.7 & 4.7 \\ 0 & 0 & 0 & 0 & 4.01 & 9.2 \\ 0 & 0 & 0 & 0 & 0 & -11.3 \end{bmatrix} \begin{bmatrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{bmatrix} = \begin{bmatrix} 4 \\ 12 \\ -11 \\ -16.7 \\ -0.74 \\ 10.92 \end{bmatrix}$$

From the above matrix we can solve for the temperatures $T_1, T_2, T_3, T_4, T_5,$ & T_6 respectively.

$$-11.3 T_6 = 10.92$$

$$T_6 = \frac{-10.92}{11.3}$$

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

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

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

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

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

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

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

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

$$-2.7 T_4 = -10.7381$$

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

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

$$2.4 T_3 - 2(3.977) - 4.4(2.031) + 1.4(-0.966) = -11$$

$$24T_3 = -11 + 18.2428$$

$$T_3 = \frac{7.2428}{2.4}$$

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

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

$$-3T_2 + 5(3.017) + 0.5(2.031) - 1(-0.966) = 12$$

$$-3T_2 + 15.085 - 1.0155 + 0.966 = 12$$

$$-3T_2 = 6.104$$

$$T_2 = -6.104/3$$

$$T_2 = -2.034 \text{ --- (5)}$$

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

$$T_1 + (-2.034) - 2(3.017) + 3.777 + 3(2.031) + 0.966 = 4$$

$$T_1 - 2.034 - 6.034 + 3.777 + 6.073 + 0.966 =$$

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

from eqn (1) - to eqn (6) respectively

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

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

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

$$T_4 = 3.777^\circ\text{C}$$

$$T_5 = 2.031^\circ\text{C}$$

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