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16/ENG06/057.
Mechanical Engr.
Eng 382

Assignment (3)

Estimate the value of temp. Using Gauss elimination method.

$$T_1 + T_2 - 2T_3 + T_4 + 3T_5 - T_6 = 4.$$
$$2T_1 - T_2 + T_3 + 2T_4 + T_5 - 3T_6 = 20.$$
$$T_1 + 3T_2 - 3T_3 - T_4 + 2T_5 + T_6 = -15.$$
$$5T_1 + 2T_2 - T_3 - T_4 + 2T_5 + T_6 = -3.$$
$$-3T_1 - T_2 + 2T_3 + 3T_4 + T_5 + 3T_6 = 16.$$
$$4T_1 + 3T_2 + T_3 - 6T_4 - 3T_5 - 2T_6 = -27.$$

In Matrix form;

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

Using Gauss elimination Method.

Pivot row = row 1, Pivot element first element in row 1

$\therefore f_1 = 2/1$, $f_2 = 1/1$, $f_3 = 5/1$, $f_4 = -3/1$

$f_5 = 4/1$.

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 \\ 2-(2(1)) & -1-(2(1)) & 1-(2(-2)) & 2-(2(1)) & 1-(2(3)) \\ 1-(1(1)) & 3-(1(1)) & -3-(1(-2)) & -1-(1(1)) & 2-(1(3)) \\ 5-(5(1)) & 2-(5(1)) & -1-(5(-2)) & -1-(5(1)) & 2-(5(3)) \\ -3-(-3(1)) & -1-(-3(1)) & 2-(-3(-2)) & 3-(-3(1)) & 1-(-3(3)) \\ 4-(4(1)) & 3-(4(1)) & 1-(4(-2)) & 6-(4(1)) & 3-(4(3)) \end{bmatrix}$$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 2-2(1) & -1-2(1) & 1-2(-2) & 1-2(3) & 1-2(3) & -3-2(-1) \\ 1-4(1) & 3-1(1) & -3-1(-2) & -1-1(3) & 2-1(3) & 1-1(-1) \\ 5-5(1) & 2-5(1) & -1-5(-2) & -1-5(3) & 2-5(3) & 1-5(-1) \\ -3-(-3)(1) & -1-(-3)(1) & 2-(-3)(-2) & 3-(-3)(3) & 1-(-3)(3) & 3-(-3)(-1) \\ 4-4(1) & 3-4(1) & 1-4(-2) & -6-4(3) & -3-4(3) & -2-4(-1) \end{bmatrix} \begin{bmatrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{bmatrix} = \begin{bmatrix} 4 \\ 20-2(4) \\ -15-1(4) \\ -3-5(4) \\ 16-3(4) \\ -22-4(4) \end{bmatrix}$$

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

Pivot row is row 2, Pivot element is 2nd element in row 2

$f_1 = 2/-3$, $F_2 = -3/-3 = 1$, $f_3 = 2/-3$, $f_4 = -1/-3 = 1/3$.

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 0 & 7/3 & -2 & -13/3 & 4/3 \\ 0 & 0 & 4 & -6 & -8 & 7 \\ 0 & 0 & -2/3 & 6 & 20/3 & -2/3 \\ 0 & 0 & 22/3 & -10 & -40/3 & 2/3 \end{bmatrix} = \begin{bmatrix} 4 \\ 12 \\ -11 \\ -35 \\ 36 \\ 47 \end{bmatrix}$$

Row 3; $f_1 = 4/(7/3) = 12/7$, $f_2 = -2/3 \div (-4/3) = 2/4$, $f_3 = 22/7$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 0 & 7/3 & -2 & -13/3 & 4/3 \\ 0 & 0 & 4-\left[\frac{12}{7}\left(\frac{4}{3}\right)\right] & -6-\left(\frac{12}{7}(-2)\right) & -8-\left(\frac{12}{7}\left(\frac{-13}{3}\right)\right) & 7-\frac{12}{7}\left(\frac{4}{3}\right) \\ 0 & 0 & -2/3+\left[\frac{2}{3}\left[\frac{7}{3}\right]\right] & 6+\left(\frac{2}{4}(-2)\right) & 20/3+3/2\left(\frac{-13}{3}\right) & -2/3+\frac{2}{2}\left(\frac{4}{3}\right) \\ 0 & 0 & 22/3-22/7\left(\frac{7}{3}\right) & -10-\left(\frac{22}{4}(-2)\right) & -40/3-22/7\left(\frac{-13}{5}\right) & 2/3-\frac{22}{7}\left(\frac{4}{7}\right) \end{bmatrix} \begin{bmatrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{bmatrix} = \begin{bmatrix} 4 \\ 12 \\ -11 \\ -35-\frac{12}{4}(-11) \\ \\ -42-22\left(\frac{4}{7}\right) \end{bmatrix}$$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 0 & 7/3 & -2 & -13/3 & 4/3 \\ 0 & 0 & 0 & -18/7 & -4/7 & 33/7 \\ 0 & 0 & 0 & 38/7 & 38/7 & 2/7 \\ 0 & 0 & 0 & -26/7 & -26/7 & -13/7 \end{bmatrix} \begin{bmatrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{bmatrix} = \begin{bmatrix} 4 \\ 12 \\ -11 \\ -113/7 \\ 238/7 \\ -87/7 \end{bmatrix}$$

First row is row 4.

Pivot element is fourth element on row 4

$f_1 = 38/7 \div (-18/7) \Rightarrow -38/18 = -19/9.$

$f_2 = -26/7 \div (-18/7) = 26/18 = 13/9.$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 0 & 2/3 & -2 & -15/3 & 4/3 \\ 0 & 0 & 0 & -18/7 & -4/7 & 33/7 \\ 0 & 0 & 0 & 38/7 + (19/9 \times -18/7) & 38/7 - (19/9 \times 4/7) & -2/7 + (19/9 \times 33/7) \\ 0 & 0 & 0 & -28/7 + (13/9 \times 18/7) & 2/7 - (13/9 \times -4/7) & 13/7 - (13/9 \times 33/7) \end{bmatrix} \begin{bmatrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{bmatrix} = \begin{bmatrix} 4 \\ 12 \\ -11 \\ -113/7 \\ 230/7 - \left(\frac{-113}{7} \times \frac{13}{7}\right) \\ -82/7 - \left(\frac{-113}{7} \times \frac{13}{9}\right) \end{bmatrix}$$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 0 & 2/3 & -2 & -13/3 & 4/3 \\ 0 & 0 & 0 & -18/7 & -4/7 & 33/7 \\ 0 & 0 & 0 & 0 & 38/9 & 29/3 \\ 0 & 0 & 0 & 0 & 10/9 & -26/3 \end{bmatrix} \begin{bmatrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{bmatrix} = \begin{bmatrix} 4 \\ 12 \\ -11 \\ -113/7 \\ -11/9 \\ 98/7 \end{bmatrix}$$

Fifth row is row 5.

$f_1 = 10/9 \div 38/9 = 10/38,$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 0 & 2/3 & -2 & -13/3 & 4/3 \\ 0 & 0 & 0 & -18/7 & -4/7 & 33/7 \\ 0 & 0 & 0 & 0 & 38/9 & 29/3 \\ 0 & 0 & 0 & 0 & 10/9 - (10/38 \times 38/9) & -26/3 - (10/38 \times 29/3) \end{bmatrix} \begin{bmatrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{bmatrix} = \begin{bmatrix} 4 \\ 12 \\ -11 \\ -113/7 \\ -11/9 \\ 98/7 - \left(\frac{-10}{38} \times 11/9\right) \end{bmatrix}$$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & 3 & 5 & 0 & -5 & -1 \\ 0 & 0 & 2/3 & -2 & -13/3 & 4/3 \\ 0 & 0 & 0 & -18/7 & -4/7 & 33/7 \\ 0 & 0 & 0 & 0 & 38/9 & 29/3 \\ 0 & 0 & 0 & 0 & 0 & -213/19 \end{bmatrix} \begin{bmatrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{bmatrix} = \begin{bmatrix} 4 \\ 12 \\ -11 \\ -113/7 \\ -11/9 \\ 213/19 \end{bmatrix}$$

Multiplying the matrix.

$$0 + 0 + 0 + 0 + 0 + \left(\frac{-213}{19}\right) T_6 = \frac{213}{19}$$

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

$$\therefore T_6 = 1$$

$$\boxed{T_6 = -1}$$

Also, $0 + 0 + 0 + 0 + \frac{38}{9} T_5 + \frac{29}{3} T_6 = -\frac{11}{9}$

at $T_6 = -1$

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

$$T_5 = \frac{76}{9} \div \left(\frac{38}{9}\right)$$

$\hookrightarrow 2.$ $\boxed{T_5 = 2}$

$$-\frac{18}{7} T_4 - \frac{4}{7} T_5 + \frac{33}{7} T_6 = -\frac{113}{7}$$

where $T_6 = -1$, $T_5 = 2$.

$$-\frac{18}{7} T_4 - \frac{4}{7}(2) + \frac{33}{7}(-1) = -\frac{113}{7}$$

$$T_4 = -\frac{77}{7} \times \frac{2}{18}$$

$$\boxed{T_4 = 4}$$

To get T_3

$$\frac{2}{3}T_3 - 2T_4 - \frac{13}{3}T_5 + \frac{4}{3}T_6 = -11$$

$$-\frac{7}{3}T_3 - 18 = -11$$

$$\frac{7}{3}T_3 = -11 + 18$$

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

$$\boxed{T_3 = 3}$$ //

To get T_2

$$3T_2 + 5T_3 - 5T_5 - T_6 = 12$$

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

$$-3T_2 + 6 = 12$$

$$\boxed{T_2 = -2}$$ //

To get T_1

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

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

$$T_1 = 4 - 3$$

$$\boxed{T_1 = 1}$$ //

Therefore;

$$\begin{matrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{matrix} \begin{bmatrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{bmatrix} = \begin{bmatrix} 1 \\ -2 \\ 3 \\ 4 \\ 2 \\ -1 \end{bmatrix}$$ //