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16 ENG05017

Mechatronics Engr

Engineering Mathematics

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Assignment 3

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

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

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

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

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

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

Solution

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

$$F_1 = 2$$

$$F_2 = 1$$

$$F_3 = 5$$

$$F_4 = -3$$

$$F_5 = 4$$

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

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & 0 & -5 & -1 \\ 0 & 2 & -1 & -2 & -2 & -1 & 2 \\ 0 & -3 & 9 & -6 & -6 & -13 & 6 \\ 0 & 2 & -4 & 6 & 6 & 10 & 0 \\ 0 & -1 & 9 & 10 & 10 & 15 & 2 \end{bmatrix} \begin{bmatrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{bmatrix} = \begin{bmatrix} 4 \\ 12 \\ -19 \\ -23 \\ 128 \\ -43 \end{bmatrix}$$

$$F_1 = -\frac{2}{3}$$

$$F_2 = -1$$

$$F_3 = -\frac{2}{3}$$

$$F_4 = \frac{1}{3}$$

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

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 0 & \frac{1}{3} & -2 & -\frac{13}{3} & \frac{4}{3} \\ 0 & 0 & 4 & -6 & -9 & 7 \\ 0 & 0 & -\frac{2}{3} & 8 & \frac{20}{3} & \frac{2}{3} \\ 0 & 0 & \frac{2}{3} & -10 & -\frac{40}{3} & \frac{7}{3} \end{bmatrix} \begin{bmatrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{bmatrix} = \begin{bmatrix} 4 \\ 12 \\ -11 \\ -35 \\ -36 \\ 47 \end{bmatrix}$$

$$F_1 = \frac{12}{7}$$

$$F_2 = -\frac{2}{7}$$

$$F_3 = \frac{22}{7}$$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 0 & 7/3 & -2 & -13/3 & 4/3 \\ 0 & 0 & 4 - \frac{12}{7}(\frac{7}{3}) & -6 + \frac{12}{7}(-2) & -8 - \frac{12}{7}(\frac{-13}{3}) & 7 - \frac{12}{7}(\frac{4}{3}) \\ 0 & 0 & -\frac{7}{3} + \frac{2}{7}(\frac{7}{3}) & 6 + \frac{2}{7}(-2) & \frac{20}{3} + \frac{2}{7}(\frac{-13}{3}) & -\frac{2}{3} + \frac{2}{7}(\frac{4}{3}) \\ 0 & 0 & \frac{22}{3} - \frac{22}{7}(\frac{7}{3}) & -10 - \frac{22}{7}(-2) & -\frac{40}{3} - \frac{22}{7}(\frac{-13}{3}) & \frac{7}{3} - \frac{22}{7}(\frac{4}{3}) \end{bmatrix} \begin{matrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{matrix} = \begin{bmatrix} 4 \\ 12 \\ -11 \\ -35 - \frac{12}{7}(-11) \\ 36 + \frac{2}{7}(-11) \\ 47 - \frac{22}{7}(-11) \end{bmatrix}$$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 0 & 7/3 & -2 & -13/3 & 4/3 \\ 0 & 0 & 0 & -18/7 & -4/7 & 33/7 \\ 0 & 0 & 0 & 28/7 & 38/7 & -2/7 \\ 0 & 0 & 0 & 26/7 & 2/7 & -13/7 \end{bmatrix} \begin{matrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{matrix} = \begin{bmatrix} 4 \\ 12 \\ -11 \\ -113/7 \\ 230/7 \\ -87/7 \end{bmatrix}$$

$$F_1 = \frac{-19}{99}$$

$$F_2 = \frac{13}{9}$$

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

$$F_1 = \frac{5}{9}$$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 0 & 7/3 & -2 & -13/3 & 4/3 \\ 0 & 0 & 0 & -18/7 & -4/7 & 33/7 \\ 0 & 0 & 0 & 0 & \frac{38}{9} & \frac{29}{3} \\ 0 & 0 & 0 & 6 & \frac{10}{9} - \frac{5}{19}(\frac{38}{9}) & -\frac{26}{3} - \frac{5}{19}(\frac{29}{3}) \end{bmatrix} \begin{matrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{matrix} = \begin{bmatrix} 4 \\ 12 \\ -11 \\ -113/9 \\ -11/9 \\ \frac{98}{9} - \frac{5}{19}(-11) \end{bmatrix}$$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 0 & \frac{7}{3} & -2 & -\frac{13}{3} & \frac{4}{3} \\ 0 & 0 & 0 & -\frac{18}{7} & -\frac{4}{7} & \frac{83}{7} \\ 0 & 0 & 0 & 0 & \frac{38}{9} & \frac{29}{3} \\ 0 & 0 & 0 & 0 & 0 & -\frac{213}{19} \end{bmatrix} \begin{bmatrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{bmatrix} = \begin{bmatrix} 4 \\ 12 \\ -11 \\ -\frac{113}{7} \\ -\frac{11}{9} \\ -\frac{213}{19} \end{bmatrix}$$

Solving for T_6, T_5, T_4, T_3, T_2 & T_1

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

$$T_6 = \frac{213}{19} \times \frac{19}{213} = -1$$

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

$$T_5 = \left(\frac{-11}{9} + \frac{29}{3} \right) \times \frac{9}{38} = 2$$

$$-\frac{18}{7} T_4 - \frac{4}{7} T_5 + \frac{33}{7} T_6 = -11$$

$$T_4 = \left(\frac{-113}{7} + \frac{8}{7} + \frac{33}{7} \right) \times \frac{-7}{18} = 4$$

$$T_3 = (-11 + 8 + \frac{26}{3} + \frac{4}{3}) \times \frac{3}{7} = 3$$

$$T_2 (12 - 15 + 10 - 1) \times -\frac{1}{3} = -2$$

$$T_1 = (4 + 2 + 6 - 4 - 6 - 1) = 1$$

$$\therefore T_1 = 1$$

$$T_2 = -2$$

$$T_3 = 3$$

$$T_4 = 4$$

$$T_5 = 2$$

$$T_6 = -1$$