

Assignment 2

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

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

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

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

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

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

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

$$f_{21} = \frac{a_{21}}{a_{11}} = \frac{2}{1} = 2$$

$$f_{41} = \frac{a_{41}}{a_{11}} = \frac{5}{1} = 5$$

$$f_{61} = \frac{a_{61}}{a_{11}} = \frac{4}{1} = 4$$

$$f_{31} = \frac{a_{31}}{a_{11}} = \frac{1}{1} = 1$$

$$f_{51} = \frac{a_{51}}{a_{11}} = \frac{-3}{1} = -3$$

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

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

$$f_{32}' = \frac{q_{32}'}{a_{22}'} = \frac{2}{-3} = -\frac{2}{3}$$

$$f_{42}' = \frac{q_{42}'}{a_{22}'} = \frac{-3}{-3} = 1$$

$$f_{52}' = \frac{q_{52}'}{a_{22}'} = \frac{-2}{3}$$

$$f_{62}' = \frac{q_{62}'}{a_{22}'} = \frac{-1}{-3} = \frac{1}{3}$$

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

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

$$f_{43}'' = \frac{q_{43}''}{q_{33}''} = \frac{4}{\frac{7}{3}} = \frac{12}{7}$$

$$f_{62}'' = \frac{q_{62}''}{q_{32}''} = \frac{22}{3} \div \frac{7}{3} = \frac{22}{7}$$

$$f_{52}'' = \frac{q_{52}''}{q_{32}''} = \frac{-2}{3} \div \frac{7}{3} = -\frac{2}{7}$$

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

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

$$f_{54}''' = \frac{a_{53}'''}{a_{44}'''} = \frac{38}{7} \div \frac{-18}{7} = -\frac{19}{9}$$

$$f_{64}''' = \frac{a_{64}'''}{a_{44}'''} = \frac{-26}{7} \div \frac{-18}{7} = \frac{13}{9}$$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 0 & \frac{7}{3} & -2 & -\frac{13}{3} & \frac{4}{3} \\ 0 & 0 & 0 & -\frac{18}{7} & -\frac{4}{7} & \frac{33}{7} \\ 0 & 0 & 0 & \frac{38}{7} - \left(\frac{-19}{9} \times \frac{-18}{7} \right) & \frac{38}{7} - \left(\frac{-19}{9} \times \frac{-4}{7} \right) & -\frac{2}{7} - \left(\frac{-19}{9} \times \frac{33}{7} \right) \\ 0 & 0 & 0 & -\frac{26}{7} - \left(\frac{13}{9} \times \frac{-18}{7} \right) & \frac{2}{7} - \left(\frac{13}{9} \times \frac{-4}{7} \right) & -\frac{13}{7} - \left(\frac{13}{9} \times \frac{33}{7} \right) \end{bmatrix} \begin{bmatrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{bmatrix} = \begin{bmatrix} 4 \\ 12 \\ -11 \\ -\frac{113}{7} \\ \frac{230}{7} - \left(\frac{-19}{9} \times \frac{-113}{7} \right) \\ -\frac{87}{7} - \left(\frac{13}{9} \times \frac{-113}{7} \right) \end{bmatrix}$$

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

$$f_{65}^{IV} = \frac{a_{65}^{IV}}{a_{55}^{IV}} = \frac{10}{9} \div \frac{38}{9} = \frac{5}{19}$$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 0 & 7/3 & -2 & -13/3 & 4/3 \\ 0 & 0 & 0 & -18/7 & -4/7 & 33/7 \\ 0 & 0 & 0 & 0 & 38/9 & 29/3 \\ 0 & 0 & 0 & 0 & \frac{10}{9} - \left(\frac{5}{19} \times \frac{28}{9}\right) & -\frac{26}{3} - \left(\frac{5}{19} \times \frac{29}{3}\right) \end{bmatrix} \begin{bmatrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{bmatrix} = \begin{bmatrix} 4 \\ 12 \\ -11 \\ -113/7 \\ -11/9 \\ \frac{98}{9} - \left(\frac{5}{19} \times \frac{-11}{9}\right) \end{bmatrix}$$

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

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

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

$$\therefore T_6 = -1$$

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

$$T_5 = \frac{\frac{-11}{9} - \frac{29}{3}(-1)}{\frac{38}{9}} = \frac{76}{9} \times \frac{9}{38}$$

$$T_5 = 2$$

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

$$T_4 = \frac{\frac{-113}{7} + \frac{4}{7}(2) - \frac{33}{7}(-1)}{\frac{-18}{7}} = \frac{-72}{7} \times \frac{7}{-18}$$

$$T_4 = 4$$

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16/11/2020

chemical engineering

ENG 382 - Engineering mathematics IV

Assignment 3

$$\frac{1}{3}T_3 - 2T_4 - \frac{13}{3}T_5 + \frac{4}{3}T_6 = -11$$

$$T_3 = \frac{-11 + 2(4) + \frac{13}{3}(2) - \frac{4}{3}(-1)}{1/3} = 7 \times \frac{3}{1}$$

$$T_3 = 3$$

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

$$T_2 = \frac{12 - 5T_3 + 5T_5 + T_6}{-3} = \frac{12 - 5(3) + 5(2) - 1}{-3}$$

$$T_2 = -2$$

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

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

$$T_1 = 1$$

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