

NAME: NDIFE NZUBECHUKWU KINGSEY

MATRIC: 151EN051014

DEPARTMENT: MECHATRONICS ENGINEERING

ASSIGNMENT 1

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

Solution

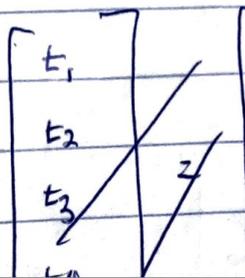
(1) Gauss Elimination method manually

A						T	B
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	1	3	T_5	16
4	3	1	-6	-3	-2	T_6	-27

Step (1)

A

1	1	-2	1	3	-1	1
$2 - \left(\frac{2}{1} \times 1\right)$	$-1 - \left(\frac{2}{1} \times 1\right)$	$1 - \left(\frac{2}{1} \times -2\right)$	$1 - \left(\frac{2}{1} \times 1\right)$	$1 - \left(\frac{2}{1} \times 3\right)$	$-3 - \left(\frac{2}{1} \times -1\right)$	
$1 - \left(\frac{1}{1} \times 1\right)$	$3 - \left(\frac{1}{1} \times 1\right)$	$-3 - \left(\frac{1}{1} \times -2\right)$	$-1 - \left(\frac{1}{1} \times 1\right)$	$2 - \left(\frac{1}{1} \times 3\right)$	$1 - \left(\frac{1}{1} \times -1\right)$	
$5 - \left(\frac{5}{1} \times 1\right)$	$2 - \left(\frac{5}{1} \times 1\right)$	$1 - \left(\frac{5}{1} \times -2\right)$	$-1 - \left(\frac{5}{1} \times 1\right)$	$2 - \left(\frac{5}{1} \times 3\right)$	$1 - \left(\frac{5}{1} \times -1\right)$	
$-3 - \left(\frac{-3}{1} \times 1\right)$	$-1 - \left(\frac{-3}{1} \times 1\right)$	$2 - \left(\frac{-3}{1} \times -2\right)$	$3 - \left(\frac{-3}{1} \times 1\right)$	$1 - \left(\frac{-3}{1} \times 3\right)$	$3 - \left(\frac{-3}{1} \times -1\right)$	
$4 - \left(\frac{4}{1} \times 1\right)$	$3 - \left(\frac{4}{1} \times 1\right)$	$1 - \left(\frac{4}{1} \times -2\right)$	$-6 - \left(\frac{4}{1} \times 1\right)$	$-3 - \left(\frac{4}{1} \times 3\right)$	$-2 - \left(\frac{4}{1} \times -1\right)$	



$$\begin{matrix} b \\ \left[\begin{matrix} t_1 \\ t_2 \\ t_3 \\ t_4 \\ t_5 \\ t_6 \end{matrix} \right] \end{matrix} = \begin{bmatrix} 4 \\ 20 - \left(\frac{2}{7} \times 4\right) \\ -15 - \left(\frac{1}{7} \times 4\right) \\ -3 - \left(\frac{5}{7} \times 4\right) \\ -16 - \left(\frac{-3}{7} \times 4\right) \\ 27 - \left(\frac{1}{7} \times 4\right) \end{bmatrix}$$

$$\Rightarrow \begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 2 & -1 & -2 & -1 & 2 \\ 0 & -3 & 9 & -6 & -13 & 6 \\ 0 & 4 & -4 & 6 & 10 & 0 \\ 0 & -1 & 9 & -10 & -15 & 2 \end{bmatrix} \begin{matrix} t_1 \\ t_2 \\ t_3 \\ t_4 \\ t_5 \\ t_6 \end{matrix} = \begin{bmatrix} 4 \\ 12 \\ -19 \\ -23 \\ 28 \\ -40 \end{bmatrix}$$

Step 2:

$$\begin{matrix} A \\ \left[\begin{matrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 2 & -1 & -2 & -1 & 2 \\ 0 & -3 & 9 & -6 & -13 & 6 \\ 0 & 4 & -4 & 6 & 10 & 0 \\ 0 & -1 & 9 & -10 & -15 & 2 \end{matrix} \right] \begin{matrix} t_1 \\ t_2 \\ t_3 \\ t_4 \\ t_5 \\ t_6 \end{matrix} = \begin{bmatrix} 4 \\ 12 \\ -19 \\ -23 \\ 28 \\ -40 \end{bmatrix} \end{matrix}$$

Keeping Row 1 and Row 2 constant]

where R_i represents the whole of Row i .

$$\begin{matrix} R_1 \\ \left[\begin{matrix} 0 & -5 & 5 & 0 & -5 & -1 \\ 0 & 2 - \left(\frac{2}{-3} \times 5\right) & -1 - \left(\frac{2}{-3} \times 5\right) & -2 - \left(\frac{2}{-3} \times 0\right) & -1 - \left(\frac{2}{-3} \times -5\right) & 2 - \left(\frac{2}{-3} \times -1\right) \\ 0 & -3 - \left(\frac{3}{-3} \times 3\right) & 9 - \left(\frac{3}{-3} \times 5\right) & -6 - \left(\frac{3}{-3} \times 0\right) & -15 - \left(\frac{3}{-3} \times -5\right) & 6 - \left(\frac{3}{-3} \times -1\right) \\ 0 & 4 - \left(\frac{4}{-3} \times 3\right) & -4 - \left(\frac{4}{-3} \times 5\right) & 6 - \left(\frac{4}{-3} \times 0\right) & 10 - \left(\frac{4}{-3} \times -5\right) & 0 - \left(\frac{4}{-3} \times -1\right) \\ 0 & -1 - \left(\frac{-1}{-3} \times 3\right) & 9 - \left(\frac{-1}{-3} \times 5\right) & -10 - \left(\frac{-1}{-3} \times 0\right) & -15 - \left(\frac{-1}{-3} \times -5\right) & 2 - \left(\frac{-1}{-3} \times -1\right) \end{matrix} \right] \end{matrix}$$

$$\left[\begin{array}{cccccc|c} 1 & 1 & -2 & 1 & 3 & 1 & E_1 & 4 \\ 0 & -3 & 5 & 0 & -5 & -1 & E_2 & 12 \\ 0 & 0 & 7/3 & -2 & -13/3 & 4/3 & E_3 & -19 - (2/3 \times 12) = -19 - 8 = -27 \\ 0 & 0 & 4 & -6 & -8 & 7 & E_4 & -23 - (-3/8 \times 12) = -23 + 4.5 = -18.5 \\ 0 & 0 & 7/3 & 6 & 10/3 & -4/3 & E_5 & 248 - (4/3 \times 12) = 248 - 16 = 232 \\ 0 & 0 & 22/3 & -10 & -40/3 & 7/3 & E_6 & -43 - (1/3 \times 12) = -43 - 4 = -47 \end{array} \right]$$

Step 3

keeping the R_3 as rows 1, 2, 3 constant and using row 3 as the pivot row

R_1

R_2

$$\begin{array}{cccccc|c} 0 & 0 & 7/3 & -2 & -13/3 & 4/3 & 1 \\ 0 & 0 & 4 - \left(\frac{12}{7} \times \frac{7}{3}\right) & -6 - \left(\frac{12}{7} \times -2\right) & -8 - \left(\frac{12}{7} \times \frac{-13}{3}\right) & 7 - \left(\frac{12}{7} \times \frac{4}{3}\right) \end{array}$$

$$\begin{array}{cccccc|c} 0 & 0 & \frac{8}{3} - \left(\frac{8}{7} \times \frac{7}{3}\right) & 6 - \left(\frac{8}{7} \times -2\right) & \frac{10}{3} - \left(\frac{8}{7} \times \frac{-13}{3}\right) & \frac{-4}{3} - \left(\frac{4}{7} \times \frac{4}{3}\right) \end{array}$$

$$\begin{array}{cccccc|c} 0 & 0 & \frac{22}{3} - \left(\frac{22}{7} \times \frac{7}{3}\right) & -10 - \left(\frac{22}{7} \times \frac{-12}{3}\right) & -\frac{40}{3} - \left(\frac{22}{7} \times \frac{-13}{3}\right) & \frac{7}{3} - \left(\frac{22}{7} \times \frac{4}{3}\right) \end{array}$$

$$\Rightarrow \left[\begin{array}{cccccc|c} 1 & 1 & -2 & 1 & 3 & 1 & E_1 & 4 \\ 0 & -3 & 5 & 0 & -5 & -1 & E_2 & 12 \\ 0 & 0 & 7/3 & -2 & -13/3 & 4/3 & E_3 & -27 \\ 0 & 0 & 0 & -18/7 & -4/7 & 33/7 & E_4 & -18.5 \\ 0 & 0 & 0 & 58/7 & 58/7 & -20/7 & E_5 & 232 \\ 0 & 0 & 0 & -26/7 & 2/7 & -13/7 & E_6 & -47 \end{array} \right]$$

4

12

$$9 - \left(\frac{2}{5} \times 12\right) = -11$$

$$5 - \left(-\frac{8}{3} \times 12\right) = -25$$

$$8 - \left(\frac{4}{3} \times 12\right) = 44$$

$$3 - \left(-\frac{1}{3} \times 12\right) = -47$$

For

$$-35 - \left(\frac{12}{7} \times -11\right) = \frac{-113}{7} = 16.143$$

$$44 - \left(\frac{8}{7} \times -11\right) = \frac{396}{7} = 56.57$$

$$-47 - \left(\frac{22}{7} \times -11\right) = \frac{-57}{7}$$

using

STEP 4
 keeping Rows 1, 2, 3, 4 constant, using Row 4 as pivot row.

R ₁								4
R ₂								12
R ₃								-11
	0	0	0	$-\frac{18}{7}$	$-\frac{4}{7}$	$\frac{33}{7}$	t ₄	$-\frac{113}{7}$
	0	0	0	$\frac{58}{7}$	$\frac{58}{7}$	$-\frac{20}{7}$	t ₅	$\frac{396}{7}$
	0	0	0	$-\frac{26}{7}$	$\frac{2}{7}$	$-\frac{13}{7}$	t ₆	$-\frac{57}{7}$

⇒ R₁

R₂

R₃

$$0 \quad 0 \quad 0 \quad -\frac{18}{7} \quad -\frac{4}{7} \quad \frac{33}{7} \quad \frac{33}{7}$$

$$0 \quad 0 \quad 0 \quad \frac{58}{7} - \left[\frac{29}{9} \times -\frac{18}{7}\right] \quad \frac{58}{7} - \left[\frac{29}{9} \times -\frac{4}{7}\right] \quad \frac{20}{7} - \left[\frac{29}{9} \times \frac{33}{7}\right]$$

$$0 \quad 0 \quad 0 \quad -\frac{26}{7} - \left[\frac{13}{9} \times -\frac{18}{7}\right] \quad \frac{2}{7} - \left[\frac{13}{9} \times -\frac{4}{7}\right] \quad -\frac{13}{7} - \left[\frac{13}{9} \times \frac{33}{7}\right]$$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & 1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 0 & 7/3 & -2 & -13/3 & 4/3 \\ 0 & 0 & 0 & -15/7 & -4/7 & 33/7 \\ 0 & 0 & 0 & 0 & 58/9 & 37/3 \\ 0 & 0 & 0 & 0 & 10/9 & -26/3 \end{bmatrix} \begin{matrix} E_1 \\ E_2 \\ E_3 \\ E_4 \\ E_5 \\ E_6 \end{matrix} = \begin{bmatrix} 4 \\ 12 \\ -11 \\ -113/7 \\ \rightarrow \frac{396}{7} - \left(\frac{-27}{7} \times \frac{-113}{7}\right) = \frac{98}{9} \\ -\frac{88}{7} + \left(\frac{13}{9} \times \frac{-113}{7}\right) = \frac{98}{9} \end{bmatrix}$$

10-keep

$$\Rightarrow \begin{bmatrix} 1 & 1 & -2 & 1 & 3 & 1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 0 & 7/3 & -2 & -13/3 & 4/3 \\ 0 & 0 & 0 & -15/7 & -4/7 & 33/7 \\ 0 & 0 & 0 & 0 & 58/9 & 37/3 \\ 0 & 0 & 0 & 0 & 10/9 & -26/3 \end{bmatrix} \begin{matrix} E_1 \\ E_2 \\ E_3 \\ E_4 \\ E_5 \\ E_6 \end{matrix} = \begin{bmatrix} 4 \\ 12 \\ -11 \\ -113/7 \\ 41/9 \text{ of } 4.50 \\ 98/9 \text{ of } 10.88 \end{bmatrix}$$

Step 5

Keeping Rows 1, 2, 3, 4, 5 constant and using
using Row 5 as the pivot row

R₁

R₂

R₃

R₄

$$0 \quad 0 \quad 0 \quad 0 \quad \frac{58}{9} \quad \frac{37}{3} \quad \frac{41}{9}$$

$$0 \quad 0 \quad 0 \quad 0 \quad \frac{10}{9} \left[\frac{5 \times 58}{29 \times 9} \right] \quad \frac{-26}{3} \left[\frac{5 \times 37}{29 \times 3} \right]$$

$$\Rightarrow \text{for } B = \frac{98}{9} - \left[\frac{5}{29} \times \frac{41}{9} \right] = \frac{293}{29}$$

$$\begin{array}{cccccc|cccc}
 & 1 & -2 & 1 & 3 & 1 & t_1 & & 4 \\
 0 & -3 & 5 & 0 & -5 & -1 & t_2 & & 12 \\
 0 & 0 & \frac{7}{3} & -2 & -\frac{13}{3} & \frac{4}{3} & t_3 & = & -11 \\
 0 & 0 & 0 & -\frac{10}{9} & -\frac{4}{9} & \frac{33}{9} & t_4 & & -\frac{113}{9} \\
 0 & 0 & 10 & 0 & \frac{58}{9} & \frac{37}{3} & t_5 & & \frac{41}{9} \\
 0 & 0 & 0 & 0 & 0 & -\frac{513}{29} & t_6 & & \frac{293}{29}
 \end{array}$$

$$t_6 = \frac{293}{29} \cdot \frac{-313}{29} = \frac{293}{29} \times \frac{29}{-313} = -0.936$$

$$t_5 = a_{55}t_5 + a_{56}t_6 = b_5$$

$$t_5 = \frac{b_5 - a_{56}t_6}{a_{55}} = \frac{\frac{41}{9} - \frac{37}{3}(-0.936)}{\frac{58}{9}}$$

$$= 2.4982$$

$$t_4 = a_{44}t_4 + a_{45}t_5 + a_{46}t_6 = b_4$$

$$t_4 = \frac{b_4 - a_{45}t_5 - a_{46}t_6}{a_{44}}$$

$$= \frac{-\frac{113}{9} - \left(-\frac{4}{9}(2.4982)\right) - \left(\frac{33}{9}(-0.936)\right)}{-\frac{18}{9}}$$

$$t_4 \Rightarrow 4.0066$$

$$E_3 = \frac{b_3 - a_{36}t_6 - a_{35}t_5 - a_{34}t_4}{a_{33}}$$

$$= \frac{-11 - \left(\frac{4}{3}(-0.936)\right) - \left(\frac{-13}{3}(2.4982)\right) - (-2(4.0066))}{\frac{7}{3}}$$

$$E_3 = \underline{\underline{3.8943}}$$

$$E_2 = \frac{b_2 - a_{23}t_3 + a_{24}t_4 + a_{25}t_5 + a_{26}t_6}{a_{22}}$$

$$= \frac{12 - 5(3.8943) + (0(4.0066)) + (-5(2.4982)) + (1(0.936))}{-5}$$

$$E_2 = \underline{\underline{-0.3620}}$$

$$E_1 = \frac{b_1 - a_{12}t_2 + a_{13}t_3 + a_{14}t_4 + a_{15}t_5 + a_{16}t_6}{a_{11}}$$

$$= \frac{4 - (1(-0.3620)) + (-2(3.8943)) + (1(4.0066)) + (3(2.4982)) + (1(0.936))}{1}$$

$$E_1 = \underline{\underline{0.71246}}$$