

DOUMU TARIERE JESSICA

CHEMICAL ENGINEERING

17/ENG01/034

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17/ENG07/034

CHEMICAL ENGINEERING

ASSIGNMENT 3

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

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

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

$$5T_1 + 2T_2 - T_3 - T_4 + 2T_5 + T_6 = -8$$

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

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

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

$$F_{21} = a_{21}/a_{11} = 2/1 = 2$$

$$F_{41}^* = a_{41}/a_{11} = 5/1 = 5$$

$$F_{61} = a_{61}/a_{11} = 4/1 = 4$$

$$F_{31} = a_{31}/a_{11} = 1/1 = 1$$

$$F_{51} = a_{51}/a_{11} = -3/1 = -3$$

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

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 2 & -1 & -2 & -1 & 2 \\ 0 & -3 & 9 & -6 & -13 & 6 \\ 0 & 2 & -4 & 6 & 10 & 0 \\ 0 & -1 & 9 & -10 & -15 & 2 \end{bmatrix} \begin{bmatrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{bmatrix} = \begin{bmatrix} 4 \\ 12 \\ -14 \\ -23 \\ 28 \\ -45 \end{bmatrix}$$

$$F_{32} = a_{32}'/a_{22}' = 2/-3 = -2/3$$

$$F_{52} = a_{52}'/a_{22}' = -2/3$$

$$F_{42} = a_{42}'/a_{22}' = -3/-3 = 1$$

$$F_{62} = a_{62}'/a_{22}' = -1/3 = -1/3$$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 0 & 7/3 & -2 & -13/3 & 4/3 \\ 0 & 0 & 4 & -6 & -8 & 7 \\ 0 & 0 & -2/3 & 6 & 20/3 & -2/3 \\ 0 & 0 & 22/3 & -10 & -40/3 & 7/3 \end{bmatrix} \begin{matrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{matrix}$$

$$\begin{bmatrix} 4 \\ 12 \\ -11 - (-2/3 \times 12) \\ -35 - (1 \times 12) \\ 36 - (-2/3 \times 12) \\ 47 - (22/3 \times 12) \end{bmatrix} \begin{matrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{matrix}$$

$$F_{43}'' = a_{43}'' / a_{33}'' = \frac{4/7}{-2/3} = -12/7$$

$$F_{63}'' = a_{63}'' / a_{33}'' = \frac{22/3}{-2/3} = -11$$

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

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

$$F_{54}''' = a_{54}''' / a_{44}''' = \frac{38/7}{-18/7} = -19/9$$

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

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

$$F_{65}'' = \begin{bmatrix} 1 & 1 \\ 0 & -3 \\ 0 & 0 \\ 0 & 0 \\ 0 & 0 \end{bmatrix}$$

$$\begin{bmatrix} 1 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix}$$

$$\frac{38}{9}$$

$$\therefore T_5 = -1$$

$$T_4$$

$$\therefore T_4$$

$$7/3 T_3$$

$$T_3$$

$$\therefore T_3$$

$$+65 = \frac{-105}{0.55} \omega = \frac{104}{38/9} = 5/19$$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 0 & 7/3 & -2 & -13/3 & 4/3 \\ 0 & 0 & 0 & -18/7 & -4/7 & 33/7 \\ 0 & 0 & 0 & 0 & 38/9 & 24/3 \\ 0 & 0 & 0 & 0 & 10/9 - (5/9 \times 38/9) & -24/3 - (5/9 \times 24/3) \end{bmatrix} \begin{bmatrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{bmatrix} = \begin{bmatrix} 4 \\ 12 \\ -11 \\ -113/7 \\ -11/9 \\ 95/9 - (5/9 \times 11/9) \end{bmatrix}$$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 0 & 7/3 & -2 & -13/3 & 4/3 \\ 0 & 0 & 0 & -18/7 & -4/7 & 33/7 \\ 0 & 0 & 0 & 0 & 38/9 & 24/3 \\ 0 & 0 & 0 & 0 & 0 & -213/19 \end{bmatrix} \begin{bmatrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{bmatrix} = \begin{bmatrix} 4 \\ 12 \\ -11 \\ -113/7 \\ -11/9 \\ 213/19 \end{bmatrix}$$

$$\begin{aligned} 4 \\ 12 \\ -11 \\ -35 - (12/7 \times -11) \\ -38 - (2/7 \times -11) \\ -47 - (23/7 \times -11) \end{aligned}$$

$$-213/19 T_6 = 213/19$$

$$T_6 = 213/19 \times -19/213 \therefore T_6 = -1$$

$$\frac{38 T_5 + 29 T_6}{9} = \frac{-11}{9} \quad T_5 = \frac{-11}{9} - \frac{29}{3} (-1) = \frac{76}{9} \times \frac{9}{38}$$

$$\therefore T_5 = 2$$

$$-18/7 T_4 - 4/7 T_5 + 33/7 T_6 = -113/7$$

$$T_4 = -113/7 + 4/7 (2) - 33/7 (-1)$$

$$\therefore T_4 = 4$$

$$7/3 T_3 - 2 T_4 - 13/3 T_5 + 4/3 T_6 = -11$$

$$T_3 = -11 + 2(4) + 13/3 (2) - 4/3 (-1)$$

$$\therefore T_3 = 3$$

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

$$T_2 = \frac{12 - 5(3) + 5(2) + 6(-1)}{-3}$$

$$\therefore T_2 = -2$$

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

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

$$\therefore T_1 = 1$$

1. Code on matlab:

```
function[x]=mygausclass(A,b)
A=[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]
b=[4; 20; -15; -3; 16; -27]
Aug=[A,b]
[m,n]=size(Aug)
for k=1:n-1
    for i=k+1:n-1
        if Aug(i,k)~=0
            q=Aug(i,k)/Aug(k,k)
            Aug(i,k:n)=Aug(i,k:n)-q*Aug(k,k:n)
        end
    end
end
X=zeros(m,1)
X(m)=Aug(m,n)/Aug(m,m)
for k=m-1:-1:1
    X(k)= (Aug(k,n)-(Aug(k,k+1:m)*X(k+1:m))/Aug(k,k)))
end
x=X
```

Output:

A =

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

b =

4
20
-15
-3
16
-27

Aug =

1	1	-2	1	3	-1	4
2	-1	1	2	1	-3	20
1	3	-3	-1	2	1	-15
5	2	-1	-1	2	1	-3
-3	-1	2	3	1	3	16
4	3	1	-6	-3	-2	-27

m =

6

n =

7

q =

2

Aug =

1	1	-2	1	3	-1	4
0	-3	5	0	-5	-1	12
1	3	-3	-1	2	1	-15
5	2	-1	-1	2	1	-3
-3	-1	2	3	1	3	16
4	3	1	-6	-3	-2	-27

q =

1

Aug =

1	1	-2	1	3	-1	4
0	-3	5	0	-5	-1	12
0	2	-1	-2	-1	2	-19
5	2	-1	-1	2	1	-3
-3	-1	2	3	1	3	16
4	3	1	-6	-3	-2	-27

q =

5

Aug =

1	1	-2	1	3	-1	4
0	-3	5	0	-5	-1	12
0	2	-1	-2	-1	2	-19
0	-3	9	-6	-13	6	-23
-3	-1	2	3	1	3	16
4	3	1	-6	-3	-2	-27

q =

-3

Aug =

1	1	-2	1	3	-1	4
0	-3	5	0	-5	-1	12
0	2	-1	-2	-1	2	-19
0	-3	9	-6	-13	6	-23
0	2	-4	6	10	0	28
4	3	1	-6	-3	-2	-27

q =

4

Aug =

1	1	-2	1	3	-1	4
0	-3	5	0	-5	-1	12
0	2	-1	-2	-1	2	-19
0	-3	9	-6	-13	6	-23
0	2	-4	6	10	0	28
0	-1	9	-10	-15	2	-43

q =

-0.66667

Aug =

Columns 1 through 6

1	1	-2	1	3	-1
0	-3	5	0	-5	-1
0	0	2.3333	-2	-4.3333	1.3333
0	-3	9	-6	-13	6
0	2	-4	6	10	0
0	-1	9	-10	-15	2

Column 7

4
12
-11
-23
28
-43

q =

1

Aug =

Columns 1 through 6

1	1	-2	1	3	-1
0	-3	5	0	-5	-1
0	0	2.3333	-2	-4.3333	1.3333
0	0	4	-6	-8	7
0	2	-4	6	10	0
0	-1	9	-10	-15	2

Column 7

4
12
-11
-35
28
-43

q =

-0.66667

Aug =

Columns 1 through 6

1	1	-2	1	3	-1
0	-3	5	0	-5	-1
0	0	2.3333	-2	-4.3333	1.3333
0	0	4	-6	-8	7
0	0	-0.66667	6	6.6667	-0.66667
0	-1	9	-10	-15	2

Column 7

4

12
-11
-35
36
-43

q =

0.33333

Aug =

Columns 1 through 6

1	1	-2	1	3	-1
0	-3	5	0	-5	-1
0	0	2.3333	-2	-4.3333	1.3333
0	0	4	-6	-8	7
0	0	-0.66667	6	6.6667	-0.66667
0	0	7.3333	-10	-13.333	2.3333

Column 7

4
12
-11
-35
36
-47

q =

1.7143

Aug =

Columns 1 through 6

1	1	-2	1	3	-1
0	-3	5	0	-5	-1
0	0	2.3333	-2	-4.3333	1.3333
0	0	0	-2.5714	-0.57143	4.7143
0	0	-0.66667	6	6.6667	-0.66667
0	0	7.3333	-10	-13.333	2.3333

Column 7

4
12
-11
-16.143
36
-47

q =

-0.28571

Aug =

Columns 1 through 6

1	1	-2	1	3	-1
0	-3	5	0	-5	-1
0	0	2.3333	-2	-4.3333	1.3333
0	0	0	-2.5714	-0.57143	4.7143
0	0	0	5.4286	5.4286	-0.28571
0	0	7.3333	-10	-13.333	2.3333

Column 7

4
12
-11
-16.143
32.857
-47

q =

3.1429

Aug =

Columns 1 through 6

1	1	-2	1	3	-1
0	-3	5	0	-5	-1
0	0	2.3333	-2	-4.3333	1.3333
0	0	0	-2.5714	-0.57143	4.7143
0	0	0	5.4286	5.4286	-0.28571
0	0	0	-3.7143	0.28571	-1.8571

Column 7

4
12
-11
-16.143
32.857
-12.429

q =

-2.1111

Aug =

Columns 1 through 6

1	1	-2	1	3	-1
0	-3	5	0	-5	-1
0	0	2.3333	-2	-4.3333	1.3333
0	0	0	-2.5714	-0.57143	4.7143
0	0	0	0	4.2222	9.6667
0	0	0	-3.7143	0.28571	-1.8571

Column 7

4
12
-11
-16.143
-1.2222
-12.429

q =

1.4444

Aug =

Columns 1 through 6

1	1	-2	1	3	-1
0	-3	5	0	-5	-1
0	0	2.3333	-2	-4.3333	1.3333
0	0	0	-2.5714	-0.57143	4.7143
0	0	0	0	4.2222	9.6667
0	0	0	0	1.1111	-8.6667

Column 7

4
12
-11
-16.143
-1.2222
10.889

q =

0.26316

Aug =

Columns 1 through 6

1	1	-2	1	3	-1
0	-3	5	0	-5	-1
0	0	2.3333	-2	-4.3333	1.3333
0	0	0	-2.5714	-0.57143	4.7143
0	0	0	0	4.2222	9.6667
0	0	0	0	0	-11.211

Column 7

4
12
-11
-16.143
-1.2222
11.211

X =

0
0
0
0
0
0
0

X =

0
0
0
0
0
-1

X =

0
0
0
0
2
-1

X =

0
0
0
4
2
-1

X =

0
0
3
4
2
-1

X =

0
-2
3
4
2
-1

X =

1

-2
3
4
2
-1

ans =

1
-2
3
4
2
-1

2. Code for matlab:

```
commandwindow  
clear  
clc  
A=[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]  
b=[4; 20; -15; -3; 16; -27]  
x=(inv(A))*b
```

Output:

A =

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

b =

4
20
-15
-3

16
-27

x =

1
-2
3
4
2
-1