Bullem Florence Ilueh-Ochuwuh

16/ENG01/005

Chemical Engineering

ENG 382 - Engineering Mathematics IV

Solution

$$10m_1 - 2m_2 + m_3 = 9$$
$$-2m_1 + 10m_2 - 2m_3 = 12$$
$$-2m_1 - 5m_2 + 10m_3 = 18$$

$$m = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$$\begin{bmatrix} 10 & -2 & 1 \\ -2 & 10 & -2 \\ -2 & -5 & 10 \end{bmatrix} \begin{bmatrix} m_1 \\ m_2 \\ m_3 \end{bmatrix} = \begin{bmatrix} 9 \\ 12 \\ 18 \end{bmatrix}$$

$$\begin{bmatrix} m_1 \\ m_2 \\ m_3 \end{bmatrix} = \begin{bmatrix} 0 & \frac{-a_{12}}{a_{11}} & \frac{-a_{13}}{a_{11}} \\ \frac{-a_{21}}{a_{22}} & 0 & \frac{-a_{23}}{a_{22}} \\ \frac{-a_{31}}{a_{32}} & \frac{-a_{32}}{a_{33}} & 0 \end{bmatrix} \begin{bmatrix} m_1 \\ m_2 \\ m_3 \end{bmatrix} + \begin{bmatrix} \frac{b_1}{a_{11}} \\ \frac{b_2}{a_{22}} \\ \frac{b_3}{a_{33}} \end{bmatrix}$$

First Iteration

$$\begin{bmatrix} m_1 \\ m_2 \\ m_3 \end{bmatrix} = \begin{bmatrix} 0 & 0.2 & -0.1 \\ 0.2 & 0 & 0.2 \\ 0.2 & 0.5 & 0 \end{bmatrix} \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix} + \begin{bmatrix} 0.9 \\ 1.2 \\ 1.8 \end{bmatrix}$$

$$\begin{bmatrix} m_1 \\ m_2 \\ m_3 \end{bmatrix} = \begin{bmatrix} (0\times0) + (0.2\times0) + (-0.1\times0) + 0.9 \\ (0.2\times0) + (0\times0) + (0.2\times0) + 1.2 \\ (0.2\times0) + (0.5\times0) + (0\times0) + 1.8 \end{bmatrix}$$

$$\begin{bmatrix} m_1 \\ m_2 \\ m_3 \end{bmatrix} = \begin{bmatrix} 0.9 \\ 1.2 \\ 1.8 \end{bmatrix}$$

Second Iteration

$$\begin{bmatrix} m_1 \\ m_2 \\ m_3 \end{bmatrix} = \begin{bmatrix} 0 & 0.2 & -0.1 \\ 0.2 & 0 & 0.2 \\ 0.2 & 0.5 & 0 \end{bmatrix} \begin{bmatrix} 0.9 \\ 1.2 \\ 1.8 \end{bmatrix} + \begin{bmatrix} 0.9 \\ 1.2 \\ 1.8 \end{bmatrix}$$

$$\begin{bmatrix} m_1 \\ m_2 \\ m_3 \end{bmatrix} = \begin{bmatrix} (0 \times 0.9) + (0.2 \times 1.2) + (-0.1 \times 1.8) + 0.9 \\ (0.2 \times 0.9) + (0 \times 1.2) + (0.2 \times 1.8) + 1.2 \\ (0.2 \times 0.9) + (0.5 \times 1.2) + (0 \times 1.8) + 1.8 \end{bmatrix}$$

$$\begin{bmatrix} m_1 \\ m_2 \\ m_3 \end{bmatrix} = \begin{bmatrix} 0.96 \\ 1.74 \\ 2.58 \end{bmatrix}$$

Third iteration

$$\begin{bmatrix} m_1 \\ m_2 \\ m_3 \end{bmatrix} = \begin{bmatrix} 0 & 0.2 & -0.1 \\ 0.2 & 0 & 0.2 \\ 0.2 & 0.5 & 0 \end{bmatrix} \begin{bmatrix} 0.96 \\ 1.74 \\ 2.58 \end{bmatrix} + \begin{bmatrix} 0.9 \\ 1.2 \\ 1.8 \end{bmatrix}$$

$$\begin{bmatrix} m_1 \\ m_2 \\ m_3 \end{bmatrix} = \begin{bmatrix} (0 \times 0.96) + (0.2 \times 1.74) + (-0.1 \times 2.58) + 0.9 \\ (0.2 \times 0.96) + (0 \times 1.74) + (0.2 \times 2.58) + 1.2 \\ (0.2 \times 0.96) + (0.5 \times 1.74) + (0 \times 2.58) + 1.8 \end{bmatrix}$$

$$\begin{bmatrix} m_1 \\ m_2 \\ m_3 \end{bmatrix} = \begin{bmatrix} 0.99 \\ 1.908 \\ 2.862 \end{bmatrix}$$

BULLEM, FLORENCE ILUEH-OCHUWEH

16/ENG01/005

CHEMICAL ENGINEERING

ASSIGNMENT 4

SOLUTION

```
commandwindow
clear
clc
format short g
syms m1 m2 m3
A = [10 -2 1
     -2 10 -2
     -2 -5  10]
 x = [m1; m2; m3]
 B = [9; 12; 18]
 C = [ 0 -A(1,2)/A(1,1) -A(1,3)/A(1,1)
       -A(2,1)/A(2,2) 0 -A(2,3)/A(2,2)
       -A(3,1)/A(3,3) -A(3,2)/A(3,3) 0]
D = [B(1,1)/A(1,1); B(2,1)/A(2,2); B(3,1)/A(3,3)]
x = [0; 0; 0]
A =


    10    -2     1
    -2    10    -2
    -2    -5    10


x =


 m1
 m2
 m3


B =


     9
    12
    18
```

```
C =

         0         0.2        -0.1
       0.2           0         0.2
       0.2         0.5           0


D =

       0.9
       1.2
       1.8


x =

     0
     0
     0

x = (C*x)+ D
x = (C*x)+ D
x = (C*x)+ D
x = (C*x)+ D
x = (C*x)+ D
x = (C*x)+ D
x = (C*x)+ D
x = (C*x)+ D
x = (C*x)+ D
x = (C*x)+ D
x = (C*x)+ D

x =

       0.9
       1.2
       1.8

x =

      0.96
      1.74
      2.58
```

```
x =

    0.99
   1.908
   2.862

x =

  0.9954
  1.9704
   2.952

x =

 0.99888
  1.9895
  2.9843

x =

 0.99947
  1.9966
  2.9945

x =

 0.99987
  1.9988
  2.9982

x =

 0.99994
  1.9996
  2.9994

x =

 0.99999
  1.9999
  2.9998

x =

 0.99999
       2
  2.9999
```

```
x =
            1
            2
            3
x =

            1
            2
            3
```

```
for i = 1:inf
    normB = norm(x)
    x = (C*x)+ D
     normA = norm(x)
     error = abs(normA - normB)
     if error <= 1E-15
         break
     end
end
i'
x'
error'
tableau = table(i',x',error')
```

```
normB =
     0
x =
          0.9
          1.2
          1.8
normA =
       2.3431
error =
       2.3431
normB =
       2.3431
x =

         0.96
```

```
         1.74
         2.58
normA =
       3.2566
error =
      0.91355
normB =
       3.2566
x =
         0.99
        1.908
        2.862
normA =
       3.5793
error =
      0.32271
normB =
       3.5793
x =
       0.9954
       1.9704
        2.952
normA =
       3.6861
error =
      0.10681
normB =
       3.6861
x =
      0.99888
       1.9895
       2.9843
normA =
       3.7231
```

```
error =
     0.036997
normB =
       3.7231
x =
      0.99947
       1.9966
       2.9945
normA =
       3.7353
error =
     0.012185
normB =
       3.7353
x =
      0.99987
       1.9988
       2.9982
normA =
       3.7395
error =
    0.0042271
normB =
       3.7395
x =

      0.99994
       1.9996
       2.9994
normA =

       3.7409
```

```
error =
    0.0013884
normB =
       3.7409
x =
      0.99999
       1.9999
       2.9998
normA =
       3.7414
error =
    0.0004829
normB =
       3.7414
x =
      0.99999
            2
       2.9999
normA =
       3.7416
error =
   0.00015816
normB =
       3.7416
x =
           1
           2
           3
normA =
       3.7416
error =
   5.5172e-05
normB =
       3.7416
```

```
x =
            1
            2
            3
normA =
       3.7416
error =
   1.8013e-05
normB =
       3.7416
x =
            1
            2
            3
normA =
       3.7417
error =
   6.3043e-06
normB =
       3.7417
x =
            1
            2
            3
normA =
       3.7417
error =
   2.0512e-06
normB =
       3.7417
x =
            1
            2
            3
```

```
normA =
       3.7417
error =
   7.2049e-07
normB =
       3.7417
x =
            1
            2
            3
normA =
       3.7417
error =
   2.3354e-07
normB =
       3.7417
x =
            1
            2
            3
normA =
       3.7417
error =
   8.2356e-08
normB =
       3.7417
x =

            1
            2
            3
```

```
normA =
       3.7417
error =
   2.6584e-08
normB =
       3.7417
x =
            1
            2
            3
normA =
       3.7417
error =
   9.4157e-09
normB =
       3.7417
x =
            1
            2
            3
normA =
       3.7417
error =
   3.0253e-09
normB =
       3.7417
x =
            1
            2
            3
normA =
       3.7417
error =

   1.0767e-09
```

```
normB =
       3.7417
x =
            1
            2
            3
normA =
       3.7417
error =
   3.4421e-10
normB =
       3.7417
x =
            1
            2
            3
normA =
       3.7417
error =
   1.2315e-10
normB =
       3.7417
x =
            1
            2
            3
normA =
       3.7417
error =
   3.9152e-11
normB =
       3.7417
```

```
x =
           1
           2
           3
normA =
       3.7417
error =
    1.409e-11
normB =
       3.7417
x =
           1
           2
           3
normA =
       3.7417
error =
   4.4516e-12
normB =
       3.7417
x =
           1
           2
           3
normA =
       3.7417
error =
   1.6125e-12
normB =
       3.7417
x =

           1
           2
           3
```

```
normA =
       3.7417
error =
   5.0626e-13
normB =
       3.7417
x =
            1
            2
            3
normA =
       3.7417
error =
    1.843e-13
normB =
       3.7417
x =
            1
            2
            3
normA =
       3.7417
error =
   5.7732e-14
normB =
       3.7417
x =
            1
            2
            3
normA =

       3.7417
```

```
error =
   2.1316e-14
normB =
       3.7417
x =
            1
            2
            3
normA =
       3.7417
error =
   6.2172e-15
normB =
       3.7417
x =
            1
            2
            3
normA =
       3.7417
error =
   2.6645e-15
normB =
       3.7417
x =
            1
            2
            3
normA =

       3.7417
error =

   8.8818e-16
```

```
ans =
    34
ans =
            1            2            3
ans =

   8.8818e-16


tableau =

  1×3 table

    Var1       Var2           Var3
    ____    ___________    _________

     34     1    2    3    8.8818e-16
```