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CHEMICAL ENGINEERING
17/ENG01/034

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CHEMICAL ENG
ENG382 ASSIGNMENT 2

Soln

$f(x) = e^{-(0.5)x}(4-x)-2$

$f'(x) = -e^{-0.5x} - 0.5xe^{-0.5x}(4-x)$

$f'(x) = -e^{-0.5x} - 2e^{-0.5x} + 0.5xe^{-0.5x}$

$f'(x) = -3e^{-0.5x} + 0.5xe$

$$\frac{f(x)}{f'(x)} = \frac{e^{-0.5x}(4-x)-2}{0.5xe^{-0.5x} - 3e^{-0.5x}}$$

$$x_{i+1} = x_i - \frac{f(x)}{f'(x)}$$

when $x = 0.5$

$$x_1 = 0.5 - \left[\frac{e^{-0.5(0.5)}(4-0.5)-2}{(0.5\times0.5e^{-0.5\times0.5}) - (3e^{-0.5\times0.5})}\right]$$

$x_1 = 0.838890606$

when $x = 0.838890606$

$$x_2 = 0.838890606 - \left[\frac{e^{-0.5\times0.838890606}(4-0.838890606)-2}{(0.5\times0.838890606e^{-0.5\times0.838890606}) - (3e^{-0.5\times0.838890606})}\right]$$

$x_2 = 0.884956003$

when $x = 0.884956003$

$$x_3 = x_2 - \left[\frac{e^{-0.5\times x_2}(4-x_2)-2}{(0.5\times x_2e^{-0.5\times x_2}) - (3e^{-0.5\times x_2})}\right]$$

$x_3 = 0.885708605$

when $x_3 = 0.885708605$

$$x_4 = x_3 - \left[\frac{e^{-0.5\times x_3}(4-x_3)-2}{(0.5\times x_3e^{-0.5\times x_3}) - (3e^{-0.5\times x_3})}\right]$$

$x_4 = 0.885708802$

When $x = 0.885708802$

$$x_5 = 0.885708802 - \left[\frac{e^{-0.5 \times 0.885708802}(4 - 0.885708802) - 2}{(0.5 \times 0.885708802 e^{-0.5 \times 0.885708802}) - (3e^{-0.5 \times 0.885}}\right]$$

$x_5 = 0.885708802$

For Absolute Error

$$E_a = \left|\frac{x_{i+1} - x_i}{x_{i+1}}\right| \times 100$$

$$E_{a1} = \frac{0.838870606 - 0.5}{0.838870606} \times 100$$

$$= 40.397472\%$$

$$E_{a2} = \frac{0.884956003 - 0.838870606}{0.884956003} \times 100$$

$$= 5.205388\%$$

$$E_{a3} = \frac{0.885708005 - 0.884956003}{0.885708005} \times 100$$

$$E_{a3} = 0.084972\%$$

i	x	E_a %
0	0.5	40.397
1	0.838870606	5.2053
2	0.884956003	0.0849
3	0.885708005	2.22×10^{-5}

Code on matlab:

```
commandwindow
clear
clc
format short g
syms x
f(x)= (exp(-0.5*x)*((4-x)))-2
g(x)= diff (f(x))
x=0.5
xf=x
for i= 1:20
   iter(i+1)=i
   x = double(subs(x-(f(x)/g(x))))
   xf(i+1)=x
   ea(i+1)= abs((xf(i+1)-xf(i))/xf(i+1))*100
   if ea>=1E-9
      break
   end
end
tab=[iter' xf' ea']
```

Output:

f(x) =

$$-\exp(-x/2)*(x - 4) - 2$$

g(x) =

$$(\exp(-x/2)*(x - 4))/2 - \exp(-x/2)$$

x =

0.5

xf =

0.5

iter =

0 1

x =

0.83889

xf =

0.5 0.83889

ea =

0 40.397

iter =

0 1 2

x =

0.88496

xf =

0.5 0.83889 0.88496

ea =

0 40.397 5.2054

iter =

0 1 2 3

x =

0.88571

xf =

```
       0.5     0.83889     0.88496     0.88571

ea =

         0      40.397      5.2054     0.084972

iter =

    0    1    2    3    4

x =

     0.88571

xf =

       0.5     0.83889     0.88496     0.88571     0.88571

ea =

         0      40.397      5.2054     0.084972   2.2247e-05

iter =
```

```
   0    1    2    3    4    5

x =

    0.88571

xf =

       0.5     0.83889     0.88496     0.88571     0.88571     0.88571

ea =

         0      40.397      5.2054    0.084972   2.2247e-05   1.5293e-12

iter =

   0    1    2    3    4    5    6

x =

    0.88571
```

xf =

0.5 0.83889 0.88496 0.88571 0.88571 0.88571 0.88571

ea =

0 40.397 5.2054 0.084972 2.2247e-05 1.5293e-12 0

iter =

0 1 2 3 4 5 6 7

x =

0.88571

xf =

0.5 0.83889 0.88496 0.88571 0.88571 0.88571 0.88571 0.88571

ea =

0 40.397 5.2054 0.084972 2.2247e-05 1.5293e-12 0 0

```
iter =

   0   1   2   3   4   5   6   7   8

x =

    0.88571

xf =

      0.5    0.83889    0.88496    0.88571    0.88571    0.88571    0.88571    0.88571    0.88571

ea =

        0     40.397     5.2054    0.084972  2.2247e-05  1.5293e-12          0          0          0

iter =

   0   1   2   3   4   5   6   7   8   9

x =

    0.88571
```

xf =

Columns 1 through 9

0.5 0.83889 0.88496 0.88571 0.88571 0.88571 0.88571 0.88571 0.88571

Column 10

0.88571

ea =

Columns 1 through 9

0 40.397 5.2054 0.084972 2.2247e-05 1.5293e-12 0 0 0

Column 10

0

iter =

0 1 2 3 4 5 6 7 8 9 10

x =

0.88571

xf =

Columns 1 through 9

0.5 0.83889 0.88496 0.88571 0.88571 0.88571 0.88571 0.88571 0.88571

Columns 10 through 11

0.88571 0.88571

ea =

Columns 1 through 9

0 40.397 5.2054 0.084972 2.2247e-05 1.5293e-12 0 0 0

Columns 10 through 11

0 0

iter =

```
   0    1    2    3    4    5    6    7    8    9   10   11
```

x =

```
    0.88571
```

xf =

```
  Columns 1 through 9

       0.5     0.83889     0.88496     0.88571     0.88571     0.88571     0.88571     0.88571     0.88571

  Columns 10 through 12

    0.88571     0.88571     0.88571
```

ea =

```
  Columns 1 through 9

         0      40.397      5.2054     0.084972   2.2247e-05   1.5293e-12           0           0           0

  Columns 10 through 12

         0           0           0
```

iter =

0 1 2 3 4 5 6 7 8 9 10 11 12

x =

0.88571

xf =

Columns 1 through 9

0.5 0.83889 0.88496 0.88571 0.88571 0.88571 0.88571 0.88571 0.88571

Columns 10 through 13

0.88571 0.88571 0.88571 0.88571

ea =

Columns 1 through 9

0 40.397 5.2054 0.084972 2.2247e-05 1.5293e-12 0 0 0

Columns 10 through 13

0 0 0 0

iter =

0 1 2 3 4 5 6 7 8 9 10 11 12 13

x =

0.88571

xf =

Columns 1 through 9

0.5 0.83889 0.88496 0.88571 0.88571 0.88571 0.88571 0.88571 0.88571

Columns 10 through 14

0.88571 0.88571 0.88571 0.88571 0.88571

ea =

Columns 1 through 9

0 40.397 5.2054 0.084972 2.2247e-05 1.5293e-12 0 0 0

Columns 10 through 14

0 0 0 0 0

iter =

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14

x =

0.88571

xf =

Columns 1 through 9

0.5 0.83889 0.88496 0.88571 0.88571 0.88571 0.88571 0.88571 0.88571

Columns 10 through 15

0.88571 0.88571 0.88571 0.88571 0.88571 0.88571

ea =

Columns 1 through 9

0 40.397 5.2054 0.084972 2.2247e-05 1.5293e-12 0 0 0

Columns 10 through 15

0 0 0 0 0 0

iter =

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

x =

0.88571

xf =

Columns 1 through 9

0.5 0.83889 0.88496 0.88571 0.88571 0.88571 0.88571 0.88571 0.88571

Columns 10 through 16

0.88571 0.88571 0.88571 0.88571 0.88571 0.88571 0.88571

ea =

Columns 1 through 9

0 40.397 5.2054 0.084972 2.2247e-05 1.5293e-12 0 0 0

Columns 10 through 16

0 0 0 0 0 0 0

iter =

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

x =

0.88571

xf =

Columns 1 through 9

0.5 0.83889 0.88496 0.88571 0.88571 0.88571 0.88571 0.88571 0.88571

Columns 10 through 17

0.88571 0.88571 0.88571 0.88571 0.88571 0.88571 0.88571 0.88571

ea =

Columns 1 through 9

0 40.397 5.2054 0.084972 2.2247e-05 1.5293e-12 0 0 0

Columns 10 through 17

0 0 0 0 0 0 0 0

iter =

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17

x =

0.88571

xf =

Columns 1 through 9

0.5 0.83889 0.88496 0.88571 0.88571 0.88571 0.88571 0.88571 0.88571

Columns 10 through 18

0.88571 0.88571 0.88571 0.88571 0.88571 0.88571 0.88571 0.88571 0.88571

ea =

Columns 1 through 9

0 40.397 5.2054 0.084972 2.2247e-05 1.5293e-12 0 0 0

Columns 10 through 18

0 0 0 0 0 0 0 0 0

iter =

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

x =

0.88571

xf =

Columns 1 through 9

0.5 0.83889 0.88496 0.88571 0.88571 0.88571 0.88571 0.88571 0.88571

Columns 10 through 18

0.88571 0.88571 0.88571 0.88571 0.88571 0.88571 0.88571 0.88571 0.88571

Column 19

0.88571

ea =

Columns 1 through 9

0 40.397 5.2054 0.084972 2.2247e-05 1.5293e-12 0 0 0

Columns 10 through 18

0 0 0 0 0 0 0 0 0

Column 19

0

```
iter =

  Columns 1 through 19

    0    1    2    3    4    5    6    7    8    9   10   11   12   13   14   15   16   17   18

  Column 20

    19


x =

      0.88571


xf =

  Columns 1 through 9

         0.5      0.83889      0.88496      0.88571      0.88571      0.88571      0.88571      0.88571      0.88571

  Columns 10 through 18

      0.88571      0.88571      0.88571      0.88571      0.88571      0.88571      0.88571      0.88571      0.88571

  Columns 19 through 20
```

0.88571 0.88571

ea =

Columns 1 through 9

0 40.397 5.2054 0.084972 2.2247e-05 1.5293e-12 0 0 0

Columns 10 through 18

0 0 0 0 0 0 0 0 0

Columns 19 through 20

0 0

iter =

Columns 1 through 19

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

Columns 20 through 21

19 20

x =

0.88571

xf =

Columns 1 through 9

0.5 0.83889 0.88496 0.88571 0.88571 0.88571 0.88571 0.88571 0.88571

Columns 10 through 18

0.88571 0.88571 0.88571 0.88571 0.88571 0.88571 0.88571 0.88571 0.88571

Columns 19 through 21

0.88571 0.88571 0.88571

ea =

Columns 1 through 9

0 40.397 5.2054 0.084972 2.2247e-05 1.5293e-12 0 0 0

Columns 10 through 18

0 0 0 0 0 0 0 0 0

Columns 19 through 21

0 0 0

tab =

0	0.5	0
1	0.83889	40.397
2	0.88496	5.2054
3	0.88571	0.084972
4	0.88571	2.2247e-05
5	0.88571	1.5293e-12
6	0.88571	0
7	0.88571	0
8	0.88571	0
9	0.88571	0
10	0.88571	0
11	0.88571	0
12	0.88571	0
13	0.88571	0
14	0.88571	0
15	0.88571	0
16	0.88571	0
17	0.88571	0
18	0.88571	0
19	0.88571	0
20	0.88571	0