

BULLEM, FLORENCE ILUEH-OCHUWEH

16/ENG01/005

CHEMICAL ENGINEERING

ENG 382- ENGINEERING MATHEMATICS IV

MID-SEMESTER TEST

QUESTION 4A

FIXED-POINT ITERATION METHOD

```
commandwindow
clear
clc
format long g
p=0.35;
g = 9.81;
m = 68.1;
t = 10;
v = 40;
for i=1:inf;
    iter(i+1) = i;
    p(i+1)=(g*m)/v*(1- exp((-p(i)*t)/m));
    Ea(i+1)=abs((p(i+1)-p(i))/p(i+1))*100);
    if Ea(i+1) <= 1E-11
        break
    end
end
p';
iter';
Ea';
table=[iter',p',Ea']
```

SOLUTION

ans =

0

1

2

3

4

5

6

7

8

9

10

11

12

13

14

15

16

17

18

19

20

21

22

23

24

25

26

27

28

29

ans =

0

58.1684968584692

56.669170693217

53.1717510236431

45.6425646403538

32.3839488151734

16.8088340221021

6.32456769857547

1.96466586886192

0.566465947309014

0.159564313514515

0.0446451872560936

0.0124678002591076
0.00347996226683956
0.000971169120216692
0.000271017433573531
7.56300831260318e-05
2.11052513095223e-05
5.88960389572715e-06
1.64354478048921e-06
4.58645315383666e-07
1.27988917260608e-07
3.57164100223082e-08
9.9669733513094e-09
2.78135729191509e-09
7.76172357999009e-10
2.16590888698186e-10
6.04395032683219e-11
1.68620933463022e-11
4.71658554099392e-12

table =

0	0.35	0
1	0.836689991310678	58.1684968584692
2	1.93093463636917	56.669170693217

3	4.12343975821962	53.1717510236431
4	7.58578790728007	45.6425646403538
5	11.2189158851417	32.3839488151734
6	13.4857057877063	16.8088340221021
7	14.3962034189633	6.32456769857547
8	14.6847088823159	1.96466586886192
9	14.7683666503639	0.566465947309014
10	14.79196935472	0.159564313514515
11	14.7985762067788	0.0446451872560936
12	14.8004214937681	0.0124678002591076
13	14.8009365607756	0.00347996226683956
14	14.801080304297	0.000971169120216692
15	14.8011204179137	0.000271017433573531
16	14.8011316120218	7.56300831260318e-05
17	14.8011347358385	2.11052513095223e-05
18	14.8011356075668	5.88960389572715e-06
19	14.80113585083	1.64354478048921e-06
20	14.8011359187148	4.58645315383666e-07
21	14.8011359376586	1.27988917260608e-07
22	14.801135942945	3.57164100223082e-08
23	14.8011359444202	9.9669733513094e-09
24	14.8011359448319	2.78135729191509e-09
25	14.8011359449468	7.76172357999009e-10
26	14.8011359449788	2.16590888698186e-10
27	14.8011359449878	6.04395032683219e-11

28	14.8011359449903	1.68620933463022e-11
29	14.801135944991	4.71658554099392e-12

NEWTON-RAPHSON METHOD

```

Commandwindow
Clear
Clc
Format long g
syms p
g = 9.81;
v = 40;
t = 10;
m = 68.1;
a =v - (((g*m)/p)*(1- exp((-p*t)/m)))
pretty(a)
q = diff(a)
pretty(q)
p = 0.35;
for i= 1:10;
    iter(i+1) = I;
    pf(i) = p;
    p = double(subs(p - (a/q)));
    pf(i+1) = p;
    Ea(i+1) = abs(((pf(i+1)-pf(i))/pf(i+1))*100);
    if Ea(i+1) <= 1E-11
        break
    end
end
iter'
pf'
Ea'
table(iter',pf',Ea')

```

RESULTS

a =

$$(2938163350254649 * (\exp(-(100*p)/681) - 1)) / (4398046511104*p) + 40$$

$$\frac{\exp\left(-\frac{100p}{681}\right) - 1}{4398046511104p} + 40$$

q =

$$-(73454083756366225 * \exp(-(100*p)/681)) / (748767418515456*p) - (2938163350254649 * (\exp(-(100*p)/681) - 1)) / (4398046511104*p^2)$$

$$-\frac{73454083756366225 \exp\left(-\frac{100p}{681}\right) + 2938163350254649}{748767418515456p^2}$$

$$4398046511104p$$

ans =

0

1

2

3

4

5

6

7

ans =

0.35

8.34099580691024

13.3210094965819

14.7172021430025

14.8008605185077

14.8011359420219

14.8011359449913

14.8011359449913

ans =

```
0
95.8038583389523
37.3846568531425
9.48680756609994
0.565226429913042
0.00186082686707078
2.00616185516846e-08
0
```

ans =

8×3 table

Var1	Var2	Var3
0	0.35	0
1	8.34099580691024	95.8038583389523
2	13.3210094965819	37.3846568531425
3	14.7172021430025	9.48680756609994
4	14.8008605185077	0.565226429913042

5	14.8011359420219	0.00186082686707078
6	14.8011359449913	2.00616185516846e-08
7	14.8011359449913	0

COMMENT ON RESULTS

When using newton-raphson method, the values converged faster than when the fixed-point iteration method was used. Hence, the newton-raphson method is employed more often in iteration.

QUESTION 4B

EXCEL FUNCTION

$$=C2+I^2*(2*B2-C2)$$

$$=C2+I^2*(2*B3-C3)$$

$$=C2+I^2*(2*B4-C4)$$

$$=C2+I^2*(2*B5-C5)$$

$$=C2+I^2*(2*B6-C6)$$

$$=C2+I^2*(2*B7-C7)$$

$$=C2+I^2*(2*B8-C8)$$

$$=C2+I^2*(2*B9-C9)$$

$$=C2+I^2*(2*B10-C10)$$

$$=C2+I^2*(2*B11-C11)$$

$$=C2+I^2*(2*B12-C12)$$

$$=C2+I^2*(2*13-C13)$$

$$=C2+I^2*(2*B14-C14)$$

$$=C2+\$I\$2*(2*B15-C15)$$

$$=C2+\$I\$2*(2*B16-C16)$$

$$\$I\$2 = 0.1$$

iter	x	y
0	0	1
1	0.1	0.9
2	0.2	0.83
3	0.3	0.787
4	0.4	0.7683
5	0.5	0.77147
6	0.6	0.794323
7	0.7	0.834891
8	0.8	0.891402
9	0.9	0.962261
10	1	1.046035
11	1.1	1.141432
12	1.2	1.247289
13	1.3	1.36256
14	1.4	1.486304
15	1.5	1.617673

MIDSEMESTERTEST_1.xlsx (Last saved by user) - Microsoft Excel

FILE HOME INSERT PAGE LAYOUT FORMULAS DATA REVIEW VIEW

Clipboard Font Alignment Number Styles Cells Editing

Document Recovery

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Available Files

- MIDSEMESTERTEST_1.xlsx
Version created last time t...

Which file do I want to save?

Close

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	iter	x	y						h								
2	0	0	1					0.1									
3	1	0.1	0.9														
4	2	0.2	0.83														
5	3	0.3	0.787														
6	4	0.4	0.7683														
7	5	0.5	0.77147														
8	6	0.6	0.794323														
9	7	0.7	0.834891														
10	8	0.8	0.891402														
11	9	0.9	0.962261														
12	10	1	1.046035														
13	11	1.1	1.141432														
14	12	1.2	1.247289														
15	13	1.3	1.36256														
16	14	1.4	1.486304														
17	15	1.5	1.617673														
18																	
19																	
20																	
21																	
22																	
23																	

Sheet3 Sheet4 Sheet5

READY 8:21 PM 14/04/2019

QUESTION 4C

EXCEL FUNCTION

tidal rise (z)	wind speed (w)	relative humidity (x)	Precipitation (y)	zsim	zsimerror	zmerror
0.5	4.5	84	74.8	0.502017	0.03535036	0.033333333
0.4	3.9	82	34	0.342651	-0.124015334	-0.066666667
0.3	3.3	74	32.8	0.484779	0.018112735	-0.166666667
0.4	5.2	81	64	0.4757	0.009033169	-0.066666667
0.5	6.1	76	48.9	0.45436	-0.012306556	0.033333333
0.7	3.2	74	43.1	0.540492	0.073825626	0.233333333

zmean	sumzsimerror	sumzmerror
0.466666667	0.022640795	0.093333333

R	Rsquare
0.492524054	0.24258

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Document Recovery

Excel has recovered the following files. Save the ones you wish to keep.

Available Files

- MIDSEMERTEST_1.xlsx
Version created last time t...

Which file do I want to save?

Close

	A	B	C	D	E	F	G	H	I	J	K	L
1	tidal rise(z)	wind speed(w)	relative humidity (x)	precipitation(y)	zsim	zsimerror	zmerror					
2		0.5	4.5	84	74.8	0.502017	0.03535036	0.033333333				
3		0.4	3.9	82	34	0.342651	-0.124015334	-0.066666667				
4		0.3	3.3	74	32.8	0.484779	0.018112735	-0.166666667				
5		0.4	5.2	81	64	0.4757	0.009033169	-0.066666667				
6		0.5	6.1	76	48.9	0.45436	-0.012306556	0.033333333				
7		0.7	3.2	74	43.1	0.540492	0.073825626	0.233333333				
8												
9						sumzsimerror	sumzmerror					
10	zmean					0.022640795	0.093333333					
11	0.466666667											
12												
13				R	Rsquare							
14				0.492524054	0.24258							
15												
16												
17												
18												
19												
20												
21												
22												
23												

SUMMARY OUTPUT

<i>Regression Statistics</i>	
Multiple R	0.492524
R Square	0.24258
Adjusted R Square	-0.89355
Standard Error	0.188006
Observations	6

<i>ANOVA</i>					
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	3	0.022641	0.007547	0.213514	0.880524
Residual	2	0.070693	0.035346		
Total	5	0.093333			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95.0%</i>	<i>Upper 95.0%</i>
Intercept	1.623638	1.76937	0.917636	0.45568	-5.98935	9.236624	-5.98935	9.236624
wind speed(w)	-0.02866	0.085235	-0.33626	0.768674	-0.3954	0.338076	-0.3954	0.338076
relative humidity (x)	-0.01639	0.024472	-0.66957	0.572081	-0.12168	0.08891	-0.12168	0.08891
precipitation(y)	0.005131	0.007027	0.730102	0.541265	-0.02511	0.035367	-0.02511	0.035367

COMMENT

The correlation coefficient (R square) value is less than 0.8, hence the model is inefficient. It shows that tidal rise is not a function of wind speed, relative humidity and precipitation.

MATLAB CODES

```
commandwindow
clear
clc
format long g
osarrrr = xlsread('MIDSEMESTERTEST_X')
z = osarrrr(:,1);
w = osarrrr(:,2)
x = osarrrr(:,3)
y = osarrrr(:,4)
[xr xc] = size(w)
x0 = ones(xr,1)
x1 = [x0 w x y]
wuchi = regress(z,x1)
a0 = wuchi(1)
a1 = wuchi(2)
a2 = wuchi(3)
a3 = wuchi(4)
zsim = a0 + a1*w + a2*x + a3*y
Rvalue = corr(z,zsim)
Rsquare = Rvalue^2
```


SOLUTIONS

osarrrrr =

0.5	4.5	84	74.8
0.4	3.9	82	34
0.3	3.3	74	32.8
0.4	5.2	81	64
0.5	6.1	76	48.9
0.7	3.2	74	43.1

z =

0.5
0.4
0.3
0.4
0.5
0.7

w =

4.5
3.9
3.3
5.2
6.1
3.2

x =

84
82
74

81
76
74

y =

74.8
34
32.8
64
48.9
43.1

xr =

6

xc =

1

x0 =

1
1
1
1
1
1
1

x1 =

1

4.5

84

74.8

1	3.9	82	34
1	3.3	74	32.8
1	5.2	81	64
1	6.1	76	48.9
1	3.2	74	43.1

wuchi =

1.62363822964517
-0.0286615619104322
-0.0163860041346794
0.00513075097989349

a0 =

1.62363822964517

a1 =

-0.0286615619104322

a2 =

-0.0163860041346794

a3 =

0.00513075097989349

zsim =

0.502017027031188
0.342651332467152
0.484779401514974
0.475699835515074
0.45436011067269
0.54049229279892

Rvalue =
0.492524054436865

Rsquare =
0.242579944198928

QUESTION 4D

EXCEL FUNCTION

=2*(E11^3) (the formula was dragged throughout the first row as given by the boundary conditions)

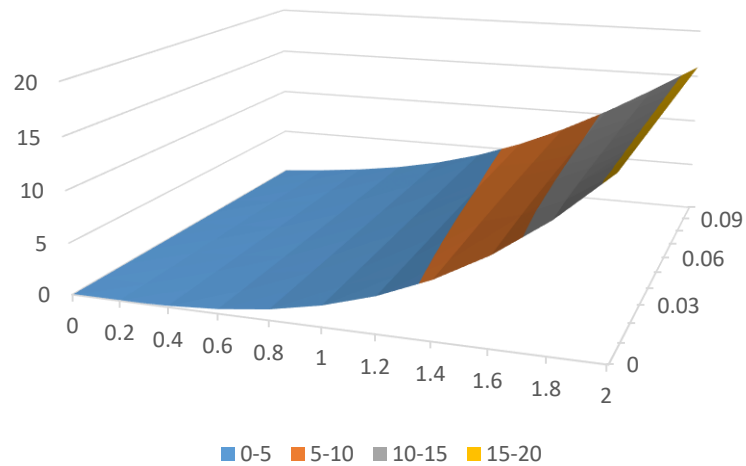
=(B\$8*D12)+(1-(2*B\$8))*E12+(B\$8*F12) (the formula was dragged to the rest of the columns)

tf 0.1
zf 2
n 11
m 11
dt 0.01
dz 0.2
A 1.79
r 0.4475

z		0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2
t	0	0	0.02	0.13	0.43	1.02	2.00	3.46	5.49	8.19	11.66	16
	0.01	0	0.06	0.21	0.56	1.20	2.21	3.71	5.79	8.54	12.05	16
	0.02	0	0.10	0.30	0.69	1.37	2.43	3.97	6.09	8.88	12.25	16
	0.03	0	0.14	0.39	0.82	1.54	2.64	4.23	6.39	9.14	12.42	16

0.04	0	0.19	0.47	0.95	1.71	2.86	4.49	6.65	9.38	12.55	16
0.05	0	0.23	0.56	1.08	1.88	3.07	4.73	6.90	9.58	12.67	16
0.06	0	0.27	0.64	1.21	2.06	3.28	4.96	7.13	9.77	12.78	16
0.07	0	0.32	0.73	1.33	2.22	3.48	5.18	7.34	9.93	12.87	16
0.08	0	0.36	0.82	1.46	2.39	3.68	5.39	7.53	10.09	12.96	16
0.09	0	0.40	0.90	1.59	2.55	3.87	5.58	7.72	10.23	13.03	16
0.1	0	0.45	0.99	1.71	2.71	4.05	5.77	7.89	10.36	13.11	16

3-D PLOT SHOWING OBTAINED RESULTS



MATLAB CODES

```
commandwindow
clear
clc
format long g
t0 = 0;
z0 = 0;
tf = 0.10;
zf = 2;
dz = 0.2;
dt = 0.01;
c = 1.79;
r = c*(dt/(dz^2));
t = [t0:dt:tf]';
z = [z0:dz:zf]
n = (zf-z0)/dz
m = (tf-t0)/dt
```

```
T(1:m+1,1) = zeros(m+1,1);
T(1:m+1,n+1) = 16;
T(1,1:n+1) = 2*(z.^3);
for j = 1:m
    for i = 2:n
        T(j+1,i) = r*T(j,i-1) + (1-(2*r))*T(j,i) + r*T(j,i+1);
    end
end
T
Round(T,2)
mesh(z,t,T)
```

RESULTS

t =

0
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
0.1

z =

0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2

n =

10

m =

10

T =

Columns 1 through 4

0	0.016	0.128	0.432
0	0.05896	0.21392	0.56088
0	0.10192	0.29984	0.68976
0	0.14488	0.38576	0.81864
0	0.18784	0.47168	0.94752
0	0.2308	0.5576	1.0764
0	0.27376	0.64352	1.20528
0	0.31672	0.72944	1.33416
0	0.35968	0.81536	1.46149611285807
0	0.40264	0.900589110503988	1.58769746866683
0	0.445290826950534	0.985237873831325	1.71125801516862

Columns 5 through 8

1.024	2	3.456	5.488
1.19584	2.2148	3.71376	5.78872
1.36768	2.4296	3.97152	6.08944
1.53952	2.6444	4.22928	6.39016
1.71136	2.8592	4.48704	6.6523815369625
1.8832	3.074	4.72757193779072	6.90247605806819

2.05504	3.28109044216135	4.96086808945354	7.12689523232798
2.2234299728672	3.4841333664574	5.1784647387266	7.33872618515917
2.38964642864074	3.67818188691625	5.38696844691471	7.53276705664664
2.55091877990629	3.86624425493727	5.58253133917044	7.71564769479202
2.708485393203	4.04567457505525	5.76906243811675	7.88538387001003

Columns 9 through 11

8.192	11.664	16
8.53568	12.05064	16
8.87936	12.245034	16
9.137009915	12.41924217	16
9.37659351215	12.5528323648125	16
9.57887553982006	12.6740729949924	16
9.76628763292574	12.7773244685437	16
9.93259851759727	12.8720327849314	16
10.0872374834632	12.9564012790426	16
10.2280627659846	13.0344609081493	16
10.3596201902446	13.1056764831338	16

ans =

Columns 1 through 4

0	0.02	0.13	0.43
0	0.06	0.21	0.56
0	0.1	0.3	0.69
0	0.14	0.39	0.82
0	0.19	0.47	0.95
0	0.23	0.56	1.08
0	0.27	0.64	1.21
0	0.32	0.73	1.33
0	0.36	0.82	1.46
0	0.4	0.9	1.59
0	0.45	0.99	1.71

Columns 5 through 8

1.02	2	3.46	5.49
1.2	2.21	3.71	5.79
1.37	2.43	3.97	6.09
1.54	2.64	4.23	6.39
1.71	2.86	4.49	6.65
1.88	3.07	4.73	6.9
2.06	3.28	4.96	7.13
2.22	3.48	5.18	7.34
2.39	3.68	5.39	7.53
2.55	3.87	5.58	7.72
2.71	4.05	5.77	7.89

Columns 9 through 11

8.19	11.66	16
8.54	12.05	16
8.88	12.25	16
9.14	12.42	16
9.38	12.55	16
9.58	12.67	16
9.77	12.78	16
9.93	12.87	16
10.09	12.96	16
10.23	13.03	16
10.36	13.11	16

