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**MATRIC NUMBER: 16/ENG01/020**

**DEPARTMENT: CHEMICAL ENGINEERING**

**QUESTION 4a**

**i. Fixed Point**

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']

**COMMAND WINDOW**

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

58.168

56.669

53.172

45.643

32.384

16.809

6.3246

1.9647

0.56647

0.15956

0.044645

0.012468

0.00348

0.00097117

0.00027102

7.563e-05

2.1105e-05

5.8896e-06

1.6435e-06

4.5865e-07

1.2799e-07

3.5716e-08

9.967e-09

2.7814e-09

7.7617e-10

2.1659e-10

6.044e-11

1.6862e-11

4.7166e-12

table =

0 0.35 0

1 0.83669 58.168

2 1.9309 56.669

3 4.1234 53.172

4 7.5858 45.643

5 11.219 32.384

6 13.486 16.809

7 14.396 6.3246

8 14.685 1.9647

9 14.768 0.56647

10 14.792 0.15956

11 14.799 0.044645

12 14.8 0.012468

13 14.801 0.00348

14 14.801 0.00097117

15 14.801 0.00027102

16 14.801 7.563e-05

17 14.801 2.1105e-05

18 14.801 5.8896e-06

19 14.801 1.6435e-06

20 14.801 4.5865e-07

21 14.801 1.2799e-07

22 14.801 3.5716e-08

23 14.801 9.967e-09

24 14.801 2.7814e-09

25 14.801 7.7617e-10

26 14.801 2.1659e-10

27 14.801 6.044e-11

28 14.801 1.6862e-11

29 14.801 4.7166e-12

**ii. Newton Raphson**

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;

% p = double(subs(p - (a/q)))

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')

a =

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

/ / 100 p \ \

| exp| - ----- | - 1 | 2938163350254649

\ \ 681 / /

--------------------------------------- + 40

4398046511104 p

q =

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

/ 100 p \ / / 100 p \ \

exp| - ----- | 73454083756366225 | exp| - ----- | - 1 | 2938163350254649

\ 681 / \ \ 681 / /

- -------------------------------- - ---------------------------------------

748767418515456 p 2

4398046511104 p

**COMMAND WINDOW**

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

**COMPARING RESULTS**

**It can be seen that the values obtained from Newton Raphson converges faster than of fixed point iteration.**

**QUESTION 4B**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| x | y | dy |  | h | y0 |
| 0 | 1 | -1 |  | 0.1 | 1 |
| 0.1 | 0.9 | -0.7 |  |  |  |
| 0.2 | 0.83 | -0.43 |  |  |  |
| 0.3 | 0.787 | -0.187 |  |  |  |
| 0.4 | 0.7683 | 0.0317 |  |  |  |
| 0.5 | 0.77147 | 0.22853 |  |  |  |
| 0.6 | 0.794323 | 0.405677 |  |  |  |
| 0.7 | 0.834891 | 0.565109 |  |  |  |
| 0.8 | 0.891402 | 0.708598 |  |  |  |
| 0.9 | 0.962261 | 0.837739 |  |  |  |
| 1 | 1.046035 | 0.953965 |  |  |  |
| 1.1 | 1.141432 | 1.058568 |  |  |  |
| 1.2 | 1.247289 | 1.152711 |  |  |  |
| 1.3 | 1.36256 | 1.23744 |  |  |  |
| 1.4 | 1.486304 | 1.313696 |  |  |  |
| 1.5 | 1.617673 | 1.382327 |  |  |  |

y Dy

1 =((2\*A2)-B2)

= B2+($E$2\*C2) =((2\*A3)-B3)

=B3+($E$2\*C3) =((2\*A4)-B4)

=B4+($E$2\*C4) =((2\*A5)-B5

=B5+($E$2\*C5) =((2\*A6)-B6)

=B6+($E$2\*C6) =((2\*A7)-B7)

=B7+($E$2\*C7) =((2\*A8)-B8)

=B8+($E$2\*C8) =((2\*A9)-B9)

=B9+($E$2\*C9) =((2\*A10)-B10)

=B10+($E$2\*C10) =((2\*A11)-B11)

=B11+($E$2\*C11) =((2\*A12)-B12)

=B12+($E$2\*C12) =((2\*A13)-B13)

=B13+($E$2\*C13) =((2\*A14)-B14)

=B14+($E$2\*C14) =((2\*A15)-B15)

=B15+($E$2\*C15) =((2\*A16)-B16)

=B16+($E$2\*C16) =((2\*A17)-B17)

=B17+($E$2\*C17) =((2\*A18)-B18)

**QUESTION 4 C**

**EXCEL**

|  |  |  |  |
| --- | --- | --- | --- |
| y | x | z | l |
| 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 |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| SUMMARY OUTPUT | |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| *Regression Statistics* | |  |  |  |  |  |  |  |
| Multiple R | 0.492524 |  |  |  |  |  |  |  |
| R Square | 0.24258 |  |  |  |  |  |  |  |
| Adjusted R Square | -0.89355 |  |  |  |  |  |  |  |
| Standard Error | 0.188006 |  |  |  |  |  |  |  |
| Observations | 6 |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| ANOVA |  |  |  |  |  |  |  |  |
|  | *df* | *SS* | *MS* | *F* | *Significance F* |  |  |  |
| Regression | 3 | 0.022641 | 0.007547 | 0.213514 | 0.880524 |  |  |  |
| Residual | 2 | 0.070693 | 0.035346 |  |  |  |  |  |
| Total | 5 | 0.093333 |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
|  | *Coefficients* | *Standard Error* | *t Stat* | *P-value* | *Lower 95%* | *Upper 95%* | *Lower 95.0%* | *Upper 95.0%* |
| Intercept | 1.623638 | 1.76937 | 0.917636 | 0.45568 | -5.98935 | 9.236624 | -5.98935 | 9.236624 |
| X Variable 1 | -0.02866 | 0.085235 | -0.33626 | 0.768674 | -0.3954 | 0.338076 | -0.3954 | 0.338076 |
| X Variable 2 | -0.01639 | 0.024472 | -0.66957 | 0.572081 | -0.12168 | 0.08891 | -0.12168 | 0.08891 |
| X Variable 3 | 0.005131 | 0.007027 | 0.730102 | 0.541265 | -0.02511 | 0.035367 | -0.02511 | 0.035367 |

**COMMENT**

**The value of R^2 is very far from 1 , hence the model is not suitable to represent the system**

**MATLAB**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| y | x | z | l | c |
| 0.5 | 4.5 | 84 | 74.8 | 1 |
| 0.4 | 3.9 | 82 | 34 | 1 |
| 0.3 | 3.3 | 74 | 32.8 | 1 |
| 0.4 | 5.2 | 81 | 64 | 1 |
| 0.5 | 6.1 | 76 | 48.9 | 1 |
| 0.7 | 3.2 | 74 | 43.1 | 1 |

commandwindow

clear

clc

format short g

greg = xlsread('testmultiple')

y = greg(:,1)

x1 = greg(:,2)

x0 = greg(:,5)

x2 = greg(:,3)

x3 = greg(:,4)

x = [x0,x1,x2,x3]

beed =regress(y,x)

a0 = beed(1)

a1 = beed(2)

a2 = beed(3)

a3 = beed(4)

ysim = a0 + a1\*x1 + a2\*x2 + a3\*x3

Rvalue = corr(y,ysim)

Rsquare = Rvalue^2

**COMMAND WINDOW**

greg =

0.5 4.5 84 74.8 1

0.4 3.9 82 34 1

0.3 3.3 74 32.8 1

0.4 5.2 81 64 1

0.5 6.1 76 48.9 1

0.7 3.2 74 43.1 1

y =

0.5

0.4

0.3

0.4

0.5

0.7

x1 =

4.5

3.9

3.3

5.2

6.1

3.2

x0 =

1

1

1

1

1

1

x2 =

84

82

74

81

76

74

x3 =

74.8

34

32.8

64

48.9

43.1

x =

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

beed =

1.6236

-0.028662

-0.016386

0.0051308

a0 =

1.6236

a1 =

-0.028662

a2 =

-0.016386

a3 =

0.0051308

ysim =

0.50202

0.34265

0.48478

0.4757

0.45436

0.54049

Rvalue =

0.49252

Rsquare =

0.24258

**QUESTION 4 d**

**Microsoft Excel**

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

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  | x | 0 | 1 | 2 | 3 |
| t |  |  | 0 | 0.2 | 0.4 | 0.6 |
|  | 0 | 0 | 0 | 0.016 | 0.128 | 0.432 |
|  | 1 | 0.01 | 0 | 0.05896 | 0.21392 | 0.56088 |
|  | 2 | 0.02 | 0 | 0.10192 | 0.29984 | 0.68976 |
|  | 3 | 0.03 | 0 | 0.14488 | 0.38576 | 0.81864 |
|  | 4 | 0.04 | 0 | 0.18784 | 0.47168 | 0.94752 |
|  | 5 | 0.05 | 0 | 0.2308 | 0.5576 | 1.0764 |
|  | 6 | 0.06 | 0 | 0.27376 | 0.64352 | 1.20528 |
|  | 7 | 0.07 | 0 | 0.31672 | 0.72944 | 1.33416 |
|  | 8 | 0.08 | 0 | 0.35968 | 0.81536 | 1.461496 |
|  | 9 | 0.09 | 0 | 0.40264 | 0.900589 | 1.587697 |
|  | 10 | 0.1 | 0 | 0.445291 | 0.985238 | 1.711258 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 0.8 | 1 | 1.2 | 1.4 | 1.6 | 1.8 | 2 |
| 1.024 | 2 | 3.456 | 5.488 | 8.192 | 11.664 | 16 |
| 1.19584 | 2.2148 | 3.71376 | 5.78872 | 8.53568 | 12.05064 | 16 |
| 1.36768 | 2.4296 | 3.97152 | 6.08944 | 8.87936 | 12.24503 | 16 |
| 1.53952 | 2.6444 | 4.22928 | 6.39016 | 9.13701 | 12.41924 | 16 |
| 1.71136 | 2.8592 | 4.48704 | 6.652382 | 9.376594 | 12.55283 | 16 |
| 1.8832 | 3.074 | 4.727572 | 6.902476 | 9.578876 | 12.67407 | 16 |
| 2.05504 | 3.28109 | 4.960868 | 7.126895 | 9.766288 | 12.77732 | 16 |
| 2.22343 | 3.484133 | 5.178465 | 7.338726 | 9.932599 | 12.87203 | 16 |
| 2.389646 | 3.678182 | 5.386968 | 7.532767 | 10.08724 | 12.9564 | 16 |
| 2.550919 | 3.866244 | 5.582531 | 7.715648 | 10.22806 | 13.03446 | 16 |
| 2.708485 | 4.045675 | 5.769062 | 7.885384 | 10.35962 | 13.10568 | 16 |

=2\*(G12^3)-------(drag down)

=($E$8\*F13)+(1-(2\*$E$8))\*G13+($E$8\*H13)

**MATLAB**

commandwindow

clear

clc

format short 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

mesh(z,t,T)

COMMANDWINDOW

T =

0 0.016 0.128 0.432 1.024 2 3.456 5.488 8.192 11.664 16

0 0.05896 0.21392 0.56088 1.1958 2.2148 3.7138 5.7887 8.5357 12.051 16

0 0.10192 0.29984 0.68976 1.3677 2.4296 3.9715 6.0894 8.8794 12.245 16

0 0.14488 0.38576 0.81864 1.5395 2.6444 4.2293 6.3902 9.137 12.419 16

0 0.18784 0.47168 0.94752 1.7114 2.8592 4.487 6.6524 9.3766 12.553 16

0 0.2308 0.5576 1.0764 1.8832 3.074 4.7276 6.9025 9.5789 12.674 16

0 0.27376 0.64352 1.2053 2.055 3.2811 4.9609 7.1269 9.7663 12.777 16

0 0.31672 0.72944 1.3342 2.2234 3.4841 5.1785 7.3387 9.9326 12.872 16

0 0.35968 0.81536 1.4615 2.3896 3.6782 5.387 7.5328 10.087 12.956 16

0 0.40264 0.90059 1.5877 2.5509 3.8662 5.5825 7.7156 10.228 13.034 16

0 0.44529 0.98524 1.7113 2.7085 4.0457 5.7691 7.8854 10.36 13.106 16

