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 MATRIC NO: 181EAG011012
 DEPT: CHEMICAL ENGINEERING
 COURSE CODE: ENG 282 COURSE TITLE: ENG MATHS II
 ASSIGNMENT 5

1. Accumulation rate = Input rate - Output rate

Amount of salt present in the tank at any time $t = y$.

Its rate of change = $\frac{dy}{dt}$

$$\frac{dy}{dt} = y_{in} - y_{out}$$

$$y_{in} = \text{Input rate} = \frac{50 \text{ gal}}{\text{min}} \times (1 + \sin t) \frac{\text{lb}}{\text{gal}} = \frac{50(1 + \sin t) \text{ lb}}{\text{min}}$$

Then:

$$y_{out} = \text{Output rate} = \frac{30 \text{ gal}}{1200 \text{ gal}} \times 100 = 2.5 \text{ gal } y$$

$$\text{And } 2.5\% \text{ of } y = \frac{0.025y}{1}$$

$$\frac{dy}{dt} = 50(1 + \sin t) - 0.025y$$

$$\frac{dy}{dt} + 0.025y = 50(1 + \sin t)$$

Using/ solving using integrating factor: $\frac{dy}{dt} + Py = Q$

here, $x = t$, $P = 0.025$, $Q = 50(1 + \sin t)$.

$$IF = e^{\int P dt} = e^{0.025t}$$

$$\int P dt = \int 0.025 dt = 0.025t$$

$$IF = e^{0.025t}$$

$$y \cdot IF = \int IF \cdot Q dt$$

$$y \cdot e^{0.025t} = \int e^{0.025t} \cdot 50(1 + \sin t) dt$$

$$\int e^{0.025t} \cdot 50(1 + \sin t) dt = 50 \left[\int e^{0.025t} (1 + \sin t) dt \right]$$

So simplifying,

$$\int e^{0.025t} \cdot 50(1 + \sin t) dt = 50 \left[\int e^{0.025t} (1 + \sin t) dt \right]$$

$$= 50 \left[\int e^{0.025t} dt + \int e^{0.025t} \sin t dt \right]$$

$$= 50 \left[\int e^{0.025t} dt + \int e^{0.025t} \sin t dt \right]$$

$$= 50 \left[\int e^{0.025t} dt + \int e^{0.025t} \sin t dt \right]$$

$$= 50 \left[\frac{e^{0.025t}}{0.025} + \int e^{0.025t} \sin t dt \right] \quad (c)$$

And $\int e^{0.025t} \sin t dt$ will be integrated by part $\int u dv = uv - \int v du$

$$\int e^{0.025t} \sin t dt = e^{0.025t} \int \sin t dt + \int e^{0.025t} \cos t dt$$

$$\text{where } u = e^{0.025t} \quad ; \quad du = 0.025e^{0.025t} dt \quad ; \quad v = -\cos t \quad ; \quad dv = \sin t$$

$$\int e^{0.025t} \sin t dt = (e^{0.025t} \cos t) - \int -\cos t \cdot 0.025e^{0.025t} dt$$

$$= -e^{0.025t} \cos t - 0.025 \int \cos t e^{0.025t} dt \quad \dots (d)$$

$$= -e^{0.025t} \cos t + 0.025 \int \cos t e^{0.025t} dt$$

integrating $\int \cos t e^{0.025t} dt$ by part again.

$$\text{Then } u = e^{0.025t} \quad ; \quad du = 0.025e^{0.025t} dt \quad ; \quad v = \sin t \quad ; \quad dv = \cos t$$

$$\text{so } \int \cos t e^{0.025t} dt = e^{0.025t} \sin t - \int \sin t \cdot 0.025e^{0.025t} dt$$

$$= e^{0.025t} \sin t - 0.025 \int \sin t e^{0.025t} dt \quad \dots (eq e)$$

let $I = \int \sin t e^{0.025t} dt$ so substitute into eq e

$$= e^{0.025t} \sin t - 0.025 I \quad \dots (eq f)$$

so put back into eq d.

$$= -e^{0.025t} \cos t + 0.025 \left[e^{0.025t} \sin t - 0.025 I \right]$$

$$= -e^{0.025t} \cos t + 0.025 e^{0.025t} \sin t - 6.25 \times 10^{-4} I$$

From eq d

$$\int e^{0.025t} \sin t dt = -e^{0.025t} \cos t + 0.025 e^{0.025t} \sin t - 6.25 \times 10^{-4} I$$

$$\text{and } I = \int \sin t e^{0.025t} dt$$

$$I = -e^{0.025t} \cos t + 0.025 e^{0.025t} \sin t - 6.25 \times 10^{-4} I$$

$$I + 6.25 \times 10^{-4} I = -e^{0.025t} \cos t + 0.025 e^{0.025t} \sin t$$

$$1.000625 I = e^{0.025t} (0.025 \sin t - \cos t)$$

$$I = \frac{1}{1.000625} e^{0.025t} (0.025 \sin t - \cos t) + C_1 \quad \dots (f)$$

Putting eq f into c.

$$y = e^{0.025t} = 50 \left[\frac{e^{0.025t} (0.025 \sin t - \cos t)}{0.025} + I \right] + C_2$$

$$\text{And } I = e^{0.025t} (0.025 \sin t - \cos t) + C_1$$

$$y \cdot e^{0.025t} = 50 \left[\frac{e^{0.025t}}{0.025} + e^{0.025t} (0.025 \sin t - \cos t) \right] + C_1$$

$$y \cdot e^{0.025t} = 50 e^{0.025t} \left[\frac{1}{0.025} + (0.025 \sin t - \cos t) \right] + \frac{C_1}{e^{0.025t}}$$

$$y = \frac{50 e^{0.025t}}{e^{0.025t}} \left[\frac{1}{0.025} + (0.025 \sin t - \cos t) \right] + \frac{C_1}{e^{0.025t}}$$

$$y = 50 \left[\frac{1}{0.025} + (0.025 \sin t - \cos t) \right] + \frac{C_1}{e^{0.025t}}$$

And when $t=0$, $y=150$.

$$150 = 50 \left[\frac{1}{0.025} + (0.025 \sin 0 - \cos 0) \right] + \frac{C_1}{e^{0.025 \times 0}}$$

$$150 = 50 \left[\frac{1}{0.025} + (0 - 1) \right] + C_1$$

$$3 = 40 - 1 + C_1$$

$$3 = 39 + C_1$$

$$3 - 39 = C_1 \quad \therefore C_1 = -36$$

$$\therefore y = 50 \left[\frac{1}{0.025} + (0.025 \sin t - \cos t) \right] - \frac{36}{e^{0.025t}}$$

$$y = 2000 + 50(0.025 \sin t - \cos t) - \frac{1806}{e^{0.025t}}$$

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Details

Workspace

Name	Value
col_header	1x2 cell
G	501x1 double
H	501x1 double
t	1x501 double
t1	1x250 double
T1	250x1 double
t2	1x251 double
T2	251x1 double
y	1x250 double

```

1 - commandwindow
2 - clc
3 - close all
4 - syms y
5 - y=dsolve('Dy=(50*(1+sin(t))-(0.025*y))','y(0)=150')
6 - pretty(y)
7 - t=0:0.5:450
8 - yn=subs(y,t)
9 - plot(t,yn,'red')
10 - grid on
11 - grid minor
12
13
14
15
16
17
    
```

Command Window

New to MATLAB? See resources for [Getting Started.](#)

```

col_header =
    1x2 cell array
    {'t (min)'}    {'V (litre)'}
    
```

script Ln 9 Col 17

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Workspace:

Name	Value
Cond	1x1 sym
Q	1x1 symfun
t	1x901 double
y	1x1 sym
yn	1x901 sym
Ysol	1x1 symfun

Figure 1

Command Window

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```

yn =
[ 150, 2000 - (2000*1601^(1/2))*cos(atan(1/40) + 1/2))/1601 - (2881850*exp(-1/80))/1601, 2000 - (2000*1601^(1/2))*cos(atan(1
fx >>

```

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Details

Workspace

Name	Value
i	251
j	251
t	1x500 double
t1	1x250 double
T1	250x1 double
t2	1x251 double
T2	251x1 double
values	500x1 double
y	1x250 double
v	250x1 double

```

Editor - C:\Users\ITUA\Documents\MATLAB\assignment5number1.m
blossomassignment.m x amainopractice.m x assignment2practice5.m x assignment2new.m x char.m x assignment5number1.m x +
1 - commandwindow
2 - clc
3 - clear all
4 - close all
5 - t=0:1:499
6 - t1=1:2:499
7 - t2=0:2:500
8 - y= (50/0.05)+((50/1.0025)*sin(t1))+((50*0.05)/1.0025)*cos(t1)-(802.4*exp(-0.05*t1))
9 - ym= 1000-(800*exp(-0.05*t2))
10 - T1=t1'
11 - T2=t2'
12 - Y=y'
13 - YM=ym'
14 - values=[]
15 - A=[y']
16 - B=[ym']
17 - i=1
    
```

Command Window

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```

col_header =
    1x2 cell array

    {'t (min)'}    {'V(litre)'}

fx >>
    
```

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```

Editor - C:\Users\ITUA\Documents\MATLAB\assignment5number1.m
+16 blossomassignment.m x amainopractice.m x assignment2practice5.m x assignment2new.m x char.m x assignment5number1.m x
14 - values=[]
15 - A=[y']
16 - B=[ym']
17 - i=1
18 - j=1
19 - while (i<=250 && j<=250)
20 -     Bn=B(j)
21 -     values=[values;Bn]
22 -     An=A(i)
23 -     values=[values;An]
24 -     i=i+1;
25 -     j=j+1;
26 - end
27 - plot(t,values,'black')
28 - grid on
29 - grid minor
30 - xlabel('t(min)')
    
```

Command Window

New to MATLAB? See resources for [Getting Started.](#)

```

col_header =
1x2 cell array
    {'t (min)'}    {'V(litre)'}
fx >>
    
```

script Ln 13 Col 7

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```

Editor - C:\Users\ITUA\Documents\MATLAB\assignment5number1.m
+16 blossomassignment.m x amainopractice.m x assignment2practice5.m x assignment2new.m x char.m x assignment5number1.m x
22 -     An=A(i)
23 -     values=[values;An]
24 -     i=i+1;
25 -     j=j+1;
26 - end
27 - plot(t,values,'black')
28 - grid on
29 - grid minor
30 - xlabel('t(min)')
31 - ylabel('V(litres)')
32 - grid on
33 - grid minor
34 - col_header={'t(min) ','V(litre)'}
35 - xlsxwrite('odevbesdata.xlsx',[t(:),values(:)],'veriler','A2')
36 - xlsxwrite('odevbesdata.xlsx',col_header,'veriler','A1')
37
38

```

Command Window

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```

col_header =
1x2 cell array
    {'t(min)'}    {'V(litre)'}
fx >>

```

script Ln 13 Col 7

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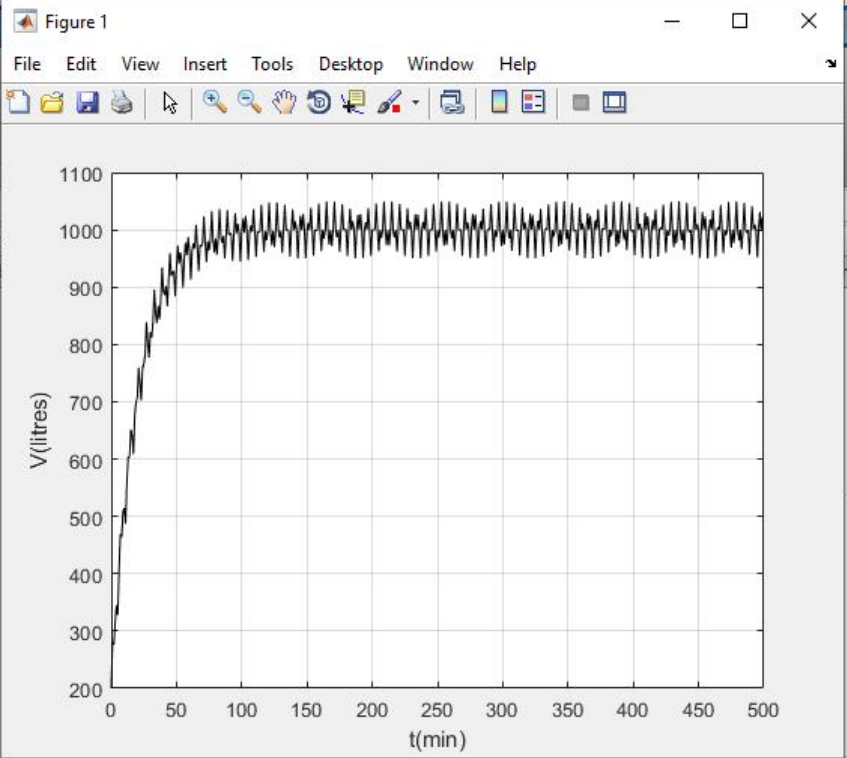
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T1	250x1 double
t2	1x251 double
T2	251x1 double
values	500x1 double
y	1x250 double
v	250x1 double



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char.m assignment5number1.m

```
4*exp(-0.05*t1)
```

Command Window

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```
col_header =
1x2 cell array
{'t (min)'} {'V (litre)'}
```

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A1 t(min)

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
1	t(min)	V(litre)																			
2		0	200																		
3		1	280.0495																		
4		2	276.1301																		
5		3	313.9375																		
6		4	345.0154																		
7		5	327.971																		
8		6	407.3454																		
9		7	469.2057																		
10		8	463.744																		
11		9	506.6496																		
12		10	514.7755																		
13		11	487.1917																		
14		12	560.9507																		
15		13	604.3294																		
16		14	602.7318																		
17		15	651.5119																		
18		16	640.5368																		
19		17	608.4061																		
20		18	674.7443																		
21		19	699.6198																		
22		20	705.6964																		
23		21	759.5725																		

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Styles: Conditional Formatting, Format as Table, Cell Styles
Cells: Insert, Delete, Format
Editing: AutoSum, Fill, Clear, Sort & Filter, Find & Select

A1 t(min)

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
22	20	705.6964																			
23	21	759.5725																			
24	22	733.7031																			
25	23	702.3964																			
26	24	759.0446																			
27	25	765.9793																			
28	26	781.9746																			
29	27	838.9566																			
30	28	802.7224																			
31	29	776.8164																			
32	30	821.4959																			
33	31	811.8219																			
34	32	838.4828																			
35	33	895.737																			
36	34	853.8532																			
37	35	836.9544																			
38	36	867.7609																			
39	37	843.645																			
40	38	880.3451																			
41	39	934.5738																			
42	40	891.7318																			
43	41	886.3296																			
44	42	902.0349																			

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B44 902.034857397614

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
44	42	902.0349																			
45	43	866.4324																			
46	44	911.3575																			
47	45	959.1768																			
48	46	919.7929																			
49	47	927.1644																			
50	48	927.4256																			
51	49	883.9389																			
52	50	934.332																			
53	51	972.6259																			
54	52	940.5811																			
55	53	960.7664																			
56	54	946.2356																			
57	55	898.8964																			
58	56	951.3519																			
59	57	977.5836																			
60	58	955.9814																			
61	59	987.8372																			
62	60	960.1703																			
63	61	913.1701																			
64	62	963.9606																			
65	63	976.421																			
66	64	967.3902																			

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	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
482	480	1000																			
483	481	981.1861																			
484	482	1000																			
485	483	965.767																			
486	484	1000																			
487	485	1047.306																			
488	486	1000																			
489	487	994.8607																			
490	488	1000																			
491	489	956.9717																			
492	490	1000																			
493	491	1040.952																			
494	492	1000																			
495	493	1008.945																			
496	494	1000																			
497	495	951.6039																			
498	496	1000																			
499	497	1031.335																			
500	498	1000																			
501	499	1022.316																			
502	500	1000																			
503																					
504																					