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18/Eng06/029

Mechanical Engineering

Question 1

a) $\frac{dy}{dt} + \frac{y}{40} = 5(1 + \sin t) - 2.5\%$ at $y(0) = 0$

b) Solve using Integrating Factor, (IF)

$$\frac{dy}{dx} + Py = Q$$

Comparing coefficients

$$P = \frac{1}{40}, Q = 5(1 + \sin t)$$

$$IF = e^{\int P dt}; \int P dt = \int \frac{1}{40} dt = \frac{t}{40}$$

$$\therefore IF = e^{\frac{t}{40}}$$

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

$$m e^{\frac{t}{40}} = \int 50 e^{\frac{t}{40}} (1 + \sin t) dt$$

Solving RHS

$$50 \int e^{\frac{t}{40}} (1 + \sin t) dt$$

$$\text{let } \frac{t}{40} = u, t = 40u$$

$$\frac{du}{dt} = \frac{1}{40}$$

$$dt = 40 du$$

Substitute for dt

$$2000 \int e^u (1 + \sin 40u) du$$

Integrating by part

$$\int u dv = uv - \int v du$$

	u	dv	
	$0.540u$	e^u	integrate
	$-40 \sin 40u$	e^u	
Differential	$-1600 \cos 40u$	e^u	

$$e^u \cos 40u - (-40 e^u \sin 40u) - \int -1600 e^u \cos 40u$$

$$e^u \cos 40u - (-40 e^u \sin 40u + 1600) e^u \cos 40u$$

Solve for $e^u \cos 40u$ again

$$40 e^u \sin 40u + e^u \cos 40u$$

1601

recall

$$\int e^u \cos 40u \cdot du = 40 e^u \sin 40u + e^u \cos 40u$$

1601

$$e^u \cos 40u \cdot du = e^u$$

$$40 \int 40 e^u \sin 40u + e^u \cos 40u$$

1601

Substitute back

$$2000 [e^u (\sin 40u + 1)] - 40 [40 e^u \sin 40u + e^u \cos 40u]$$

1601

$$2000 e^u (\sin 40u + 1) - 8000 [40 e^u \sin 40u + e^u \cos 40u]$$

1601

$$u = \frac{t}{40}$$

$$2000 e^{t/40} (\sin t + 1) - 80000 (400^{t/40} \sin t + e^{t/40} \cos t) \quad (1601)$$

$$2000 e^{t/40} (\sin t + 1) - 80000 e^{t/40} (40 \sin t + \cos t) + C \quad (1601)$$

$$2000 e^{t/40} \left[(\sin t + 1) - 40 (\cos t + \sin t) \right] + C \quad (1601)$$

$$2000 e^{t/40} \left[(\sin t + 1) - 1600 \sin t + 40 (\cos t + 1) \right] \quad (1601)$$

$$2000 e^{t/40} (1601 \sin t + 1600 \sin t + 40 (\cos t + 1601)) \quad (1601)$$

$$2000 e^{t/40} \times (\sin t - 40 (\cos t + 1601)) + C \quad (1601)$$

$$m(t) = \left(\frac{2000}{1601} (\sin t - 40 (\cos t + 1601)) - \frac{1800 \cdot 0.3}{e^{t/40}} \right) (1601)$$

```
1 - commandwindow
2 - clear
3 - clc
4 - close all
5 - syms m t
6 - solution=dsolve('Dm+0.025*m=50*(1+sin(t))', 'm(0)=150')
7 - t=0:0.5:450
8 - M=subs(solution,t)
9 - plot(t,M)
10 - grid on
11
```

```
1 - commandwindow
2 - clear
3 - clc
4 - close all
5 - syms t
6 - y = (50/0.05)+((50/1.0025)*sin(t))+(((50*(0.05))/1.0025)*cos(t))
7 - ym = 1000-(800*exp(-0.05*t))
8 - oddValues = 1:2:500
9 - evenValues = 2:2:500
10 - ym = double(subs(y, oddValues))
11 - ymm = double (subs(ym, evenValues))
12 - totTime = 1:1:500
13 - timeTrans = totTime'
14 - c = reshape([ym,ym], [],1)
15 - combVal = double(c)
16 - plot(totTime, c)
17 - grid on
18 - grid minor
19 - xlabel('T(min)'), ylabel('V(litre)')
20 - col_header = {'t(min)', 'V(Litre)'}
21 - xlswrite['odevbesdata.xlsx', col_header, 'veriler', 'A2']
22 - xlswrite['odevbesdata.xlsx', timeT, 'veriler', 'A3']
23 - xlswrite['odevbesdata.xlsx', combined, 'veriler', 'B2']
```

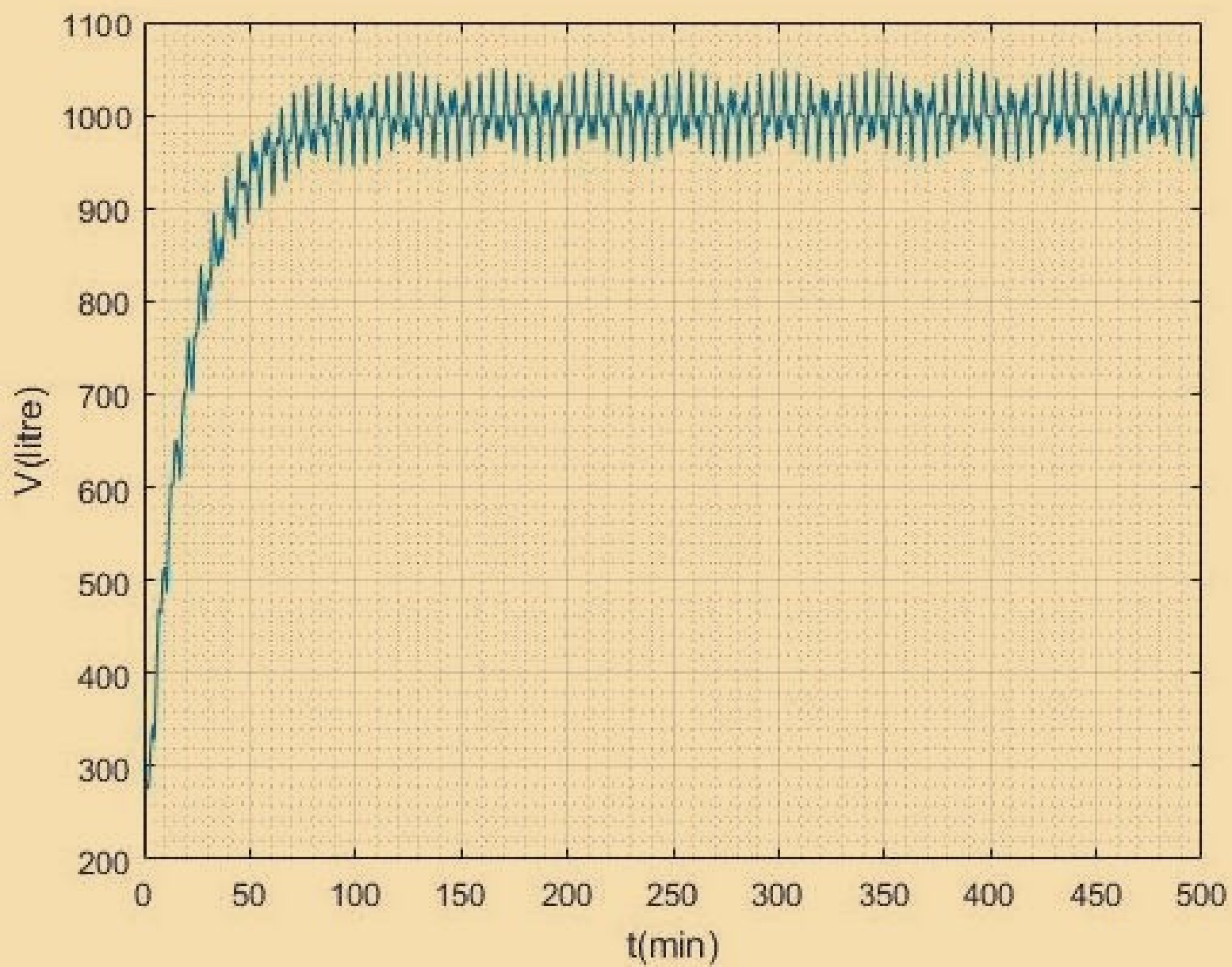
Workspace

Name	Value
c	62750x1 double
combVal	62750x1 double

script

Ln 23 Col 53

6:52 PM
5/6/2020



odevbesdata - Microsoft Excel

FILE HOME INSERT PAGE LAYOUT FORMULAS DATA REVIEW VIEW

B2 279.963914100068

	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	1	279.9639																			
3	2	318.1907																			
4	3	313.8601																			
5	4	303.601																			
6	5	327.9009																			
7	6	393.9593																			
8	7	469.1423																			
9	8	511.0566																			
10	9	506.5922																			
11	10	484.0395																			
12	11	487.1398																			
13	12	534.9268																			
14	13	604.2824																			
15	14	651.2431																			
16	15	651.4694																			
17	16	622.6706																			
18	17	608.3676																			
19	18	637.9229																			
20	19	699.585																			
21	20	751.3315																			
22	21	759.541																			
23	22	729.9392																			
24	23	702.3679																			
25	24	714.1865																			
26	25	765.9535																			
27	26	820.9421																			
28	27	838.9333																			
29	28	813.2194																			
30	29	776.7953																			

veriler Sheet2

READY AVERAGE: 968.8380276 COUNT: 500 SUM: 484419.0138 100%