

SESSION 1

SOLVING ORDINARY DIFFERENTIAL EQUATIONS

1 PROBLEM 1
 $\dot{x} = \cos(t)$, and $x(t_0) = x_0$

1.1 FUNCTION

```
1 function xdot=der1(t,x)
2     xdot=cos(t)
3 endfunction
4
```

FIGURE 1. FUNCTION WRITTEN IN SCILAB

```
--> sol = ode(x_0, t_0, t, der1);
--> plot(t,sol)
--> size(sol)
ans =
    1. 1001.
--> s=sint+1;
Undefined variable: sint
--> s=sint(t)+1;
--> size(s)
ans =
    1. 1001.
--> yode(x_0, t_0, t, rtol, atol, der1);
Undefined variable: rtol
--> rtol=1e-7
rtol =
    0.0000001
--> atol=1e-7;
--> max(abs(s-y'))
Undefined variable: y
--> max(abs(s-sol));
--> max(abs(s-sol))
ans =
```

FIGURE 3. CODE WRITTEN IN SCILAB

1.2 CODE AND GRAPH

```
--> exec('C:\Users\shahil\AppData\Local\Temp\SCI_TMP_6272_26920\untitled.sce', -1)
--> t=[0:0.01:10]
t =
    column 1 to 15
    0. 0.01 0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09 0.1 0.11 0.12 0.13 0.14
    column 16 to 30
    0.15 0.16 0.17 0.18 0.19 0.2 0.21 0.22 0.23 0.24 0.25 0.26 0.27 0.28 0.29
    column 31 to 45
    0.3 0.31 0.32 0.33 0.34 0.35 0.36 0.37 0.38 0.39 0.4 0.41 0.42 0.43 0.44
    column 46 to 60
    0.45 0.46 0.47 0.48 0.49 0.5 0.51 0.52 0.53 0.54 0.55 0.56 0.57 0.58 0.59
    column 61 to 75
    0.6 0.61 0.62 0.63 0.64 0.65 0.66 0.67 0.68 0.69 0.7 0.71 0.72 0.73 0.74
    column 76 to 90
    0.75 0.76 0.77 0.78 0.79 0.8 0.81 0.82 0.83 0.84 0.85 0.86 0.87 0.88 0.89
    column 91 to 105
    0.9 0.91 0.92 0.93 0.94 0.95 0.96 0.97 0.98 0.99 1. 1.01 1.02 1.03 1.04
    column 106 to 120
    1.05 1.06 1.07 1.08 1.09 1.1 1.11 1.12 1.13 1.14 1.15 1.16 1.17 1.18 1.19
    column 121 to 135
```

FIGURE 2. CODE WRITTEN IN SCILAB

```
--> MAX(abs(s-sol))
ans =
    2.0000005
--> s=sint(t)-1;
--> yode(x_0, t_0, t, rtol, atol, der1);
--> rtol=1e-7;
--> atol=1e-7;
--> MAX(abs(s-sol));
--> MAX(abs(s-sol))
ans =
    0.0000005
--> atol=1e-10;
--> rtol=1e-10;
--> MAX(abs(s-sol))
ans =
    0.0000005
--> yode(x_0, t_0, t, rtol, atol, der1);
--> MAX(abs(s-sol))
ans =
    0.0000005
--> yode(x_0, t_0, t, rtol, atol, der1);
```

FIGURE 4. CODE WRITTEN IN SCILAB

```

--> atol=1e-10;
--> rtol=1e-10;
--> max(abs(z-sol))
ans =
    0.0000005
--> yode(x_0, t_0, t, rtol, atol, de1);
--> max(abs(z-sol))
ans =
    0.0000005
--> yode(x_0, t_0, t, rtol, atol, de1);
--> atol=1e-10;
--> rtol=1e-10;
--> max(abs(z-sol))
ans =
    0.0000005
--> plot(t,sol)
--> max(abs(x-y))
ans =
    7.603D-10
--> plot(t,sol)
*Environment saved.*
-->

```

FIGURE 5. CODE WRITTEN IN SCILAB

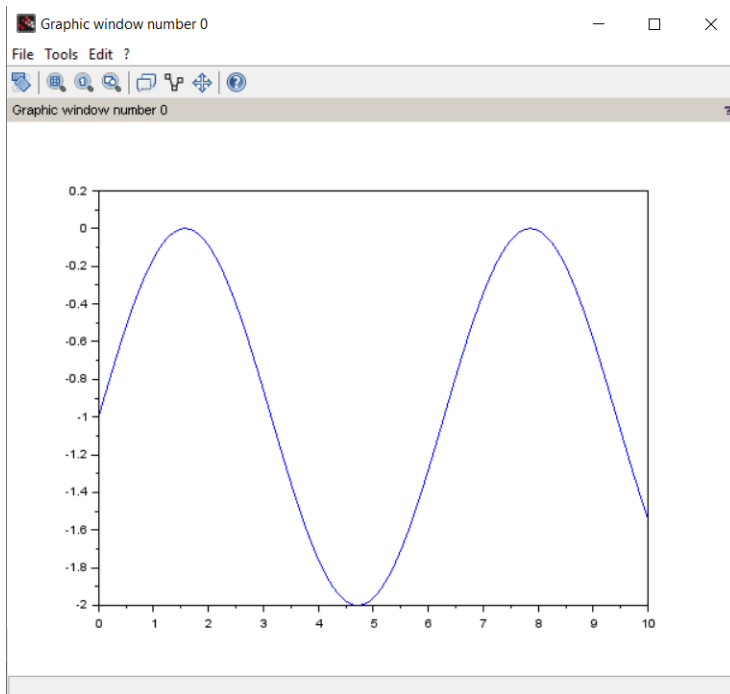


FIGURE 6. GRAPH DRAWN IN SCILAB

2 PROBLEM 2

$$\dot{x}_1 = a_{11}x_1 + a_{12}x_2$$

$$\dot{x}_2 = a_{21}x_1 + a_{22}x_2$$

```
f.sce
1 function xdot = f(t,x,A)
2     xdot=A*x
3
4 endfunction
5
```

FIGURE 7. FUNCTION WRITTEN IN SCILAB

```
--> exec('C:\Users\shahi\AppData\Local\Temp\SCI_TMP_8316_25771\f.sce', -1)
--> A=[1 2; 3 4]
A =

    1.    2.
    3.    4.

--> x0=[5; 6]
x0 =

    5.
    6.

--> t0=0
t0 =

    0.

--> t=[0:1:10]
t =

    0.    1.    2.    3.    4.    5.    6.    7.    8.    9.   10.

--> x=ode( x0, t0, t, list(f, A))
x =

column 1 to 9

    5.    708.26457    152273.42    32792467.    7.062D+09    1.521D+12    3.275D+14    7.053D+16    1.519D+19
    6.    1544.9679    332889.78    71688945.    1.544D+10    3.325D+12    7.160D+14    1.542D+17    3.321D+19

column 10 to 11

    3.271D+21    7.044D+23
    7.151D+21    1.540D+24

--> plot(t, x')
```

FIGURE 8. CODE WRITTEN IN SCILAB

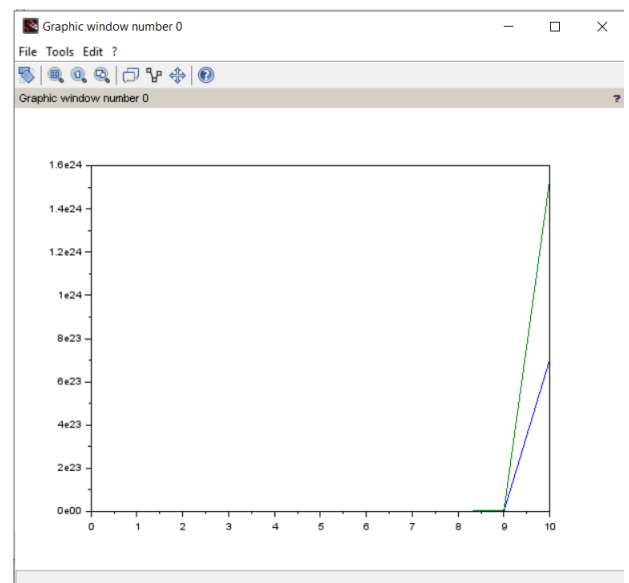


FIGURE 9. GRAPH DRAWN IN SCILAB

3 PROBLEM 3

```
f.sce x f.sci x *pendulumcode.sci x pendulum.sci x
1 function xdot = f(t, x)
2     xdot(1,1)=x(2)
3     xdot(2,1)=-m*g*sin(x(1))/l
4 endfunction
5
```

FIGURE 10. FUNCTION WRITTEN IN SCILAB

```
--> x0de(x0, t0, t, f);
--> e=(0.5*m*l^2*x(2,1)^2)+(10*m*l*(1-cos(x(1,1))))
--> error1=max(e)-min(e);
--> rtol=10^-7;atol=10^-7;
--> x0de(x0,t0,t,rtol,atol,f);
--> e=(0.5*m*l^2*x(2,1)^2)+(10*m*l*(1-cos(x(1,1))))
--> error2=max(e)-min(e);
--> rtol=10^-10;atol=10^-10;
--> x0de(x0,t0,t,rtol,atol,f);
--> e=(0.5*m*l^2*x(2,1)^2)+(10*m*l*(1-cos(x(1,1))))
--> error3=max(e)-min(e);
```

FIGURE 13. CODE WRITTEN IN SCILAB

```
--> exec('C:\Users\akshi\AppData\Local\Temp\SCI_TMP_23456_202771.f.sci', -3)
Warning: redefining function: f , Use funprot(0) to avoid this message

--> m=1
m =
1.

--> g=9.81
g =
9.81

--> l=0.5
l =
0.5

--> x0=[pi/6 ; 0]
x0 =
0.5235988
0.

--> t0=0
t0 =
0.

--> t=[0:0.01:pi];
--> x0de(x0, t0, t, f);
```

FIGURE 11. CODE WRITTEN IN SCILAB

Variable Browser					
Name	Value	Type	Visibility	Memory	
atol	1e-10	Double	local	216 B	
e	1x315	Double	local	2.7 kB	
error1	0.0127	Double	local	216 B	
error2	0.0127	Double	local	216 B	
error3	0.0127	Double	local	216 B	
g	9.81	Double	local	216 B	
l	0.5	Double	local	216 B	
m	1	Double	local	216 B	
rtol	1e-10	Double	local	216 B	
t	1x315	Double	local	2.7 kB	
t0	0	Double	local	216 B	

FIGURE 14. CODE WRITTEN IN SCILAB

```
--> plot(t,x(1,:))
```

FIGURE 12. CODE WRITTEN IN SCILAB

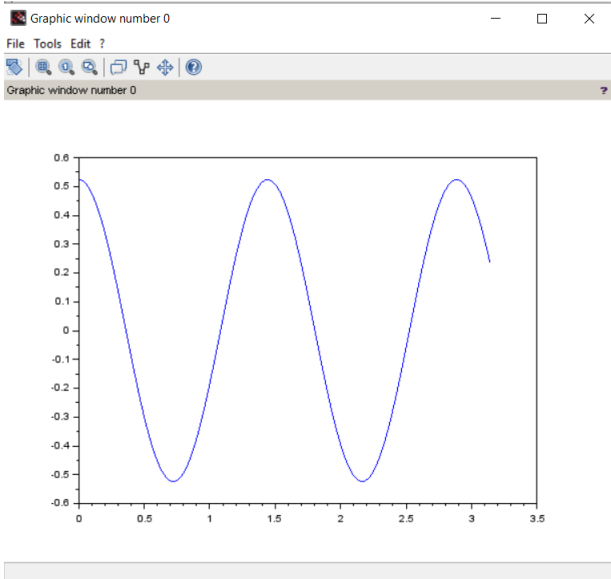


FIGURE 15. GRAPH DRAWN IN SCILAB