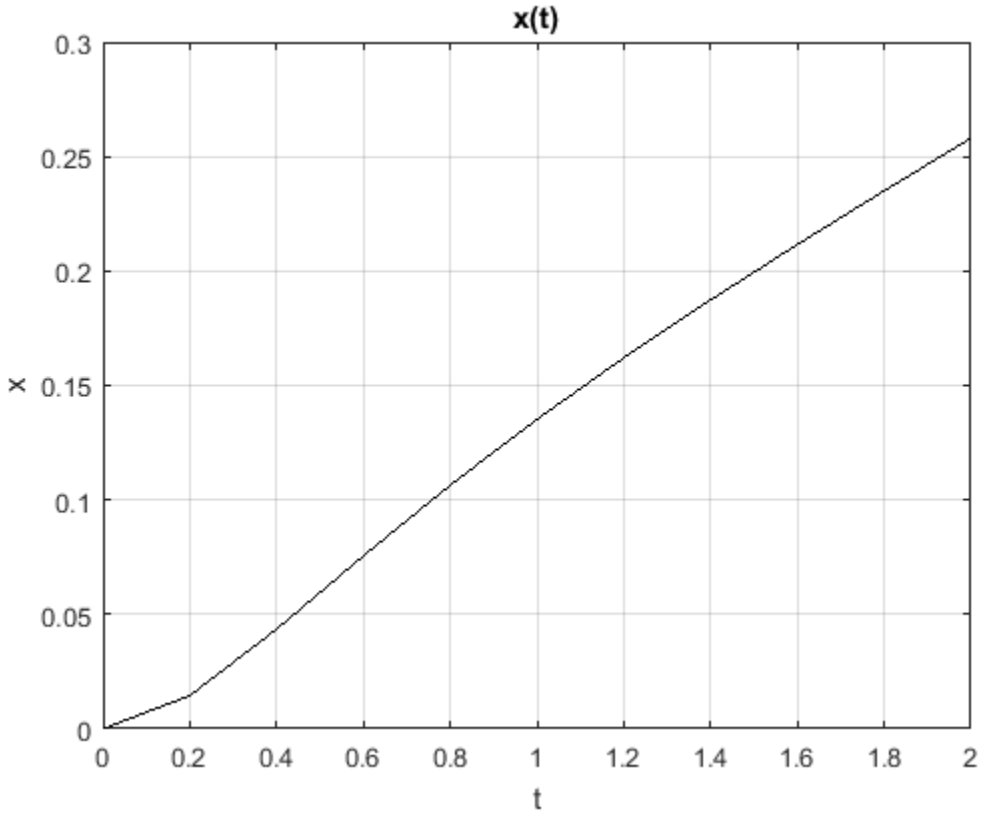
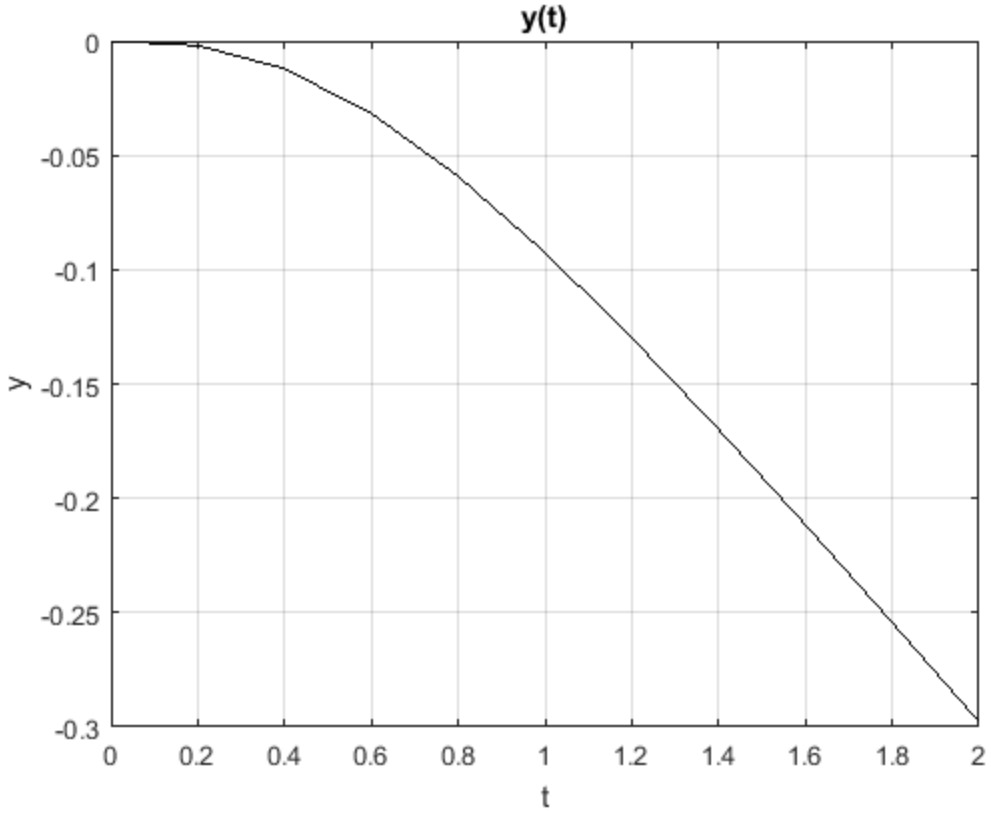
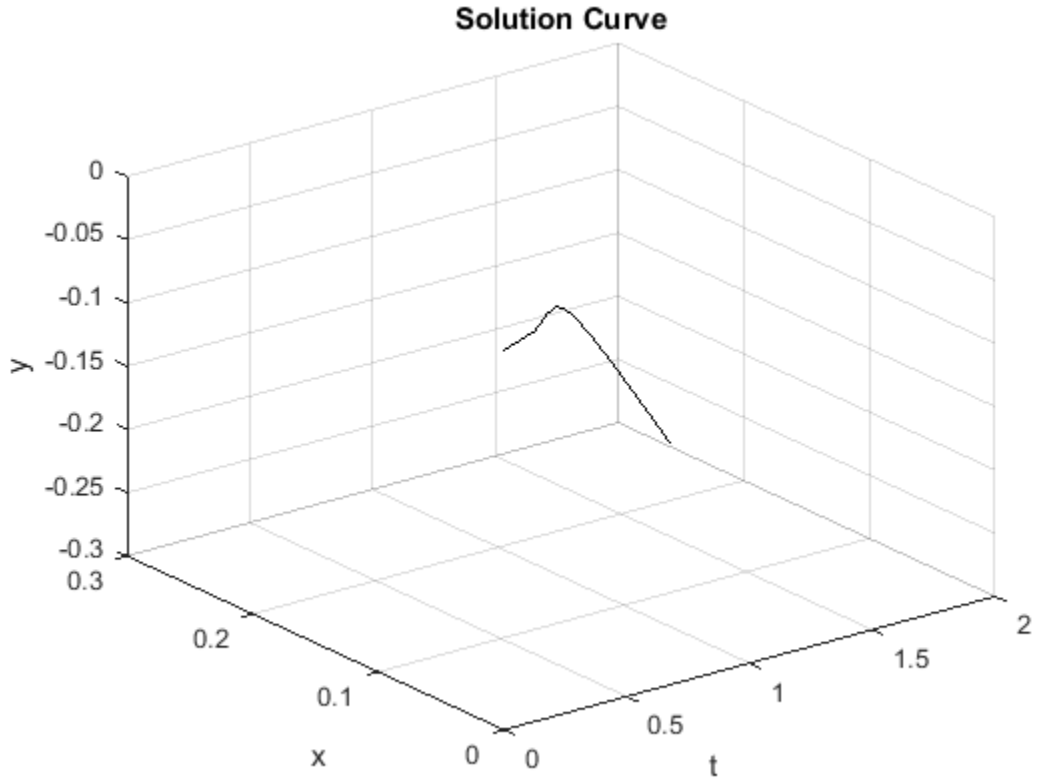
Practical 1(a)

Plotting Solution of System of ODE(1st Order)

```
% x(1)=x
% x(2)y
% x(0)=y(0)=0

f=@(t,x)[t-5*x(1)+2*x(2);-x(2)-2*x(1)];
tspan=0:0.2:2;
[t,x]=ode45(f,tspan,[0,0]);
figure(1)
plot(t,x(:,1),'-k');title('x(t)');
xlabel('t');ylabel('x');grid on;
figure(2)
plot(t,x(:,2),'-k');title('y(t)');
xlabel('t');ylabel('y');grid on;
figure(3)
plot3(t,x(:,1),x(:,2),'-k');
title('Solution Curve');xlabel('t');ylabel('x');zlabel('y');grid on;
```




y(t)
0
-0.05
-0.1
-0.15
-0.2
-0.25
-0.3
y
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
t


Solution Curve
0
-0.05
-0.1
-0.15
-0.2
-0.25
-0.3
y
0.3
0.2
0.1
0
x
0
0.5
1
1.5
2
t

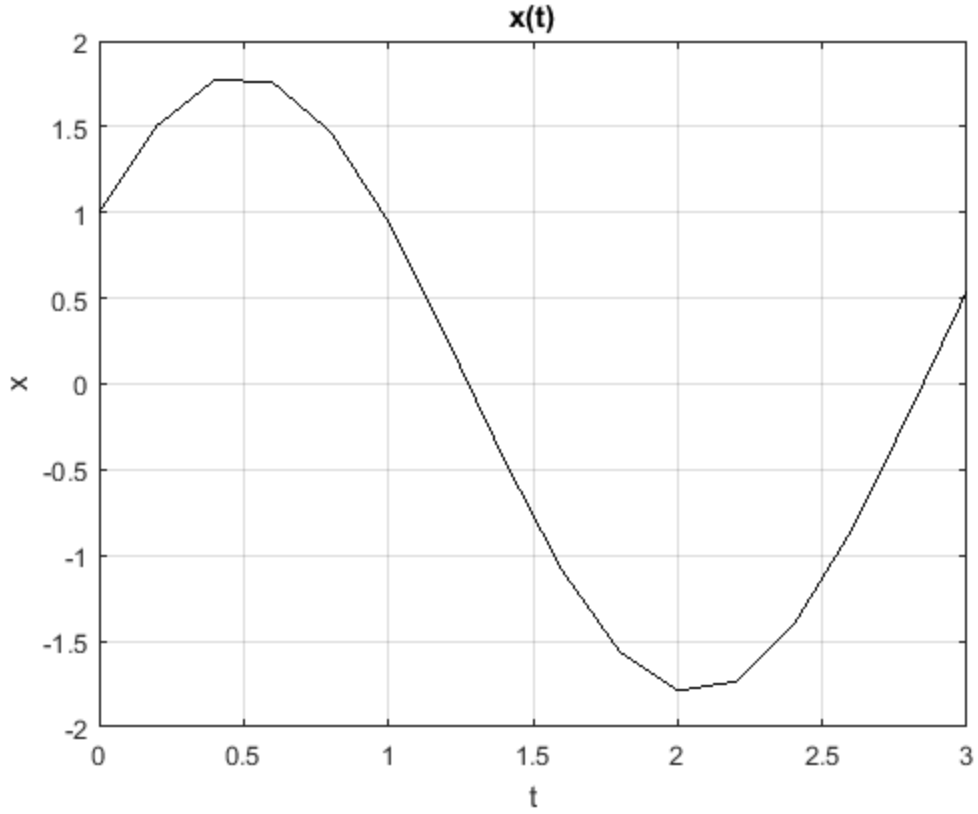
Published with MATLAB® R2015b

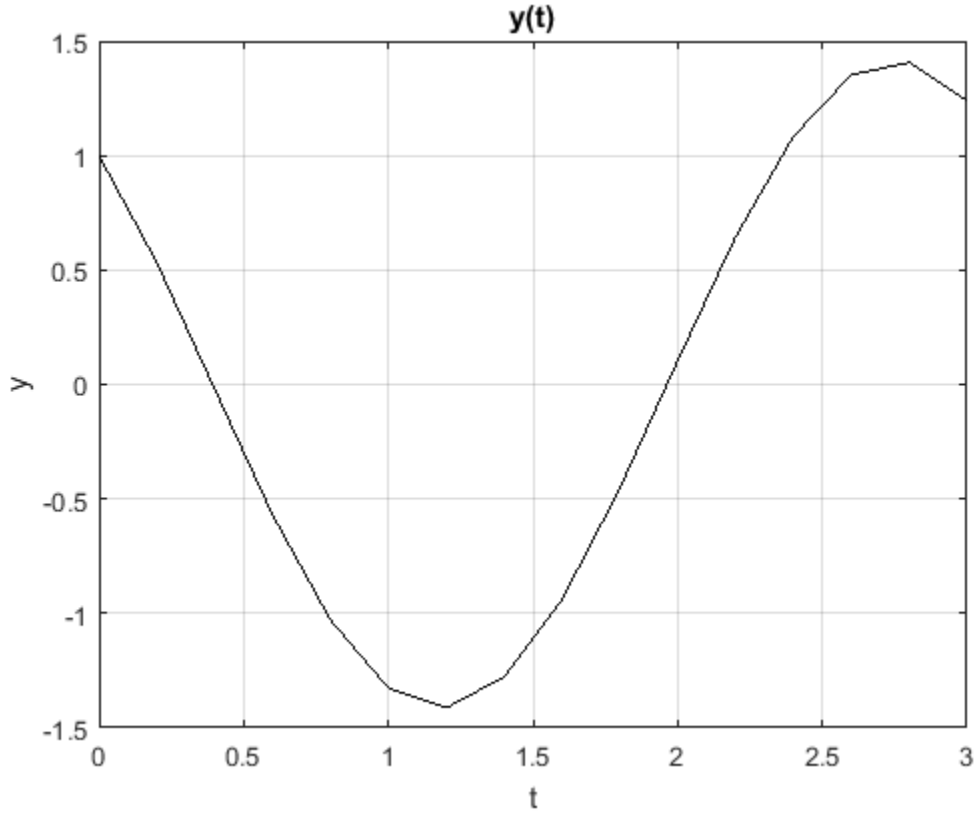
Practical 1(b)

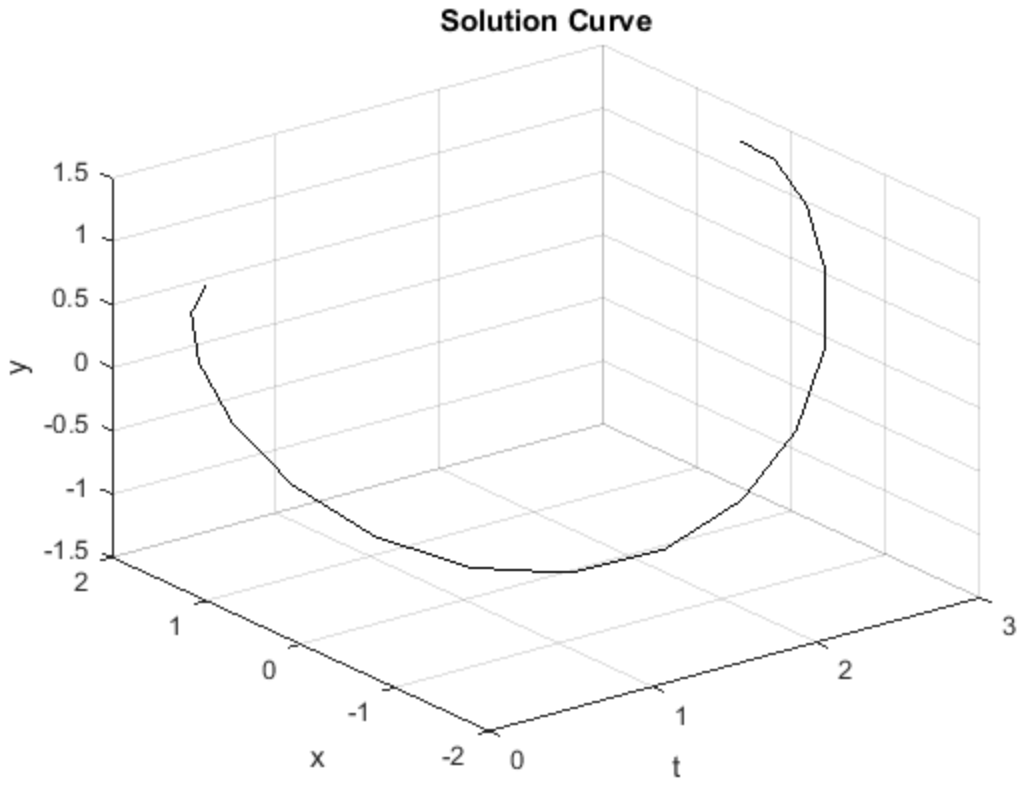
Plotting Solution of System of ODE(1st Order)

```
% x(1)=x
% x(2)y
% x(0)=y(0)=1

f=@(t,x)[cos(2*t)+2*x(2);sin(2*t)-2*x(1)];
tspan=0:0.2:pi
[t,x]=ode45(f,tspan,[1,1]);
figure(1)
plot(t,x(:,1),'-k');title('x(t)');
xlabel('t');ylabel('x');grid on;
figure(2)
plot(t,x(:,2),'-k');title('y(t)');
xlabel('t');ylabel('y');grid on;
figure(3)
plot3(t,x(:,1),x(:,2),'-k');
title('Solution Curve');xlabel('t');ylabel('x');zlabel('y');grid on;
```

```
tspan =

  Columns 1 through 7

         0    0.2000    0.4000    0.6000    0.8000    1.0000    1.2000

  Columns 8 through 14

    1.4000    1.6000    1.8000    2.0000    2.2000    2.4000    2.6000

  Columns 15 through 16

    2.8000    3.0000
```


x(t)
x
t
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
0
0.5
1
1.5
2
2.5
3


y(t)
y
t
1.5
1
0.5
0
-0.5
-1
-1.5
0
0.5
1
1.5
2
2.5
3

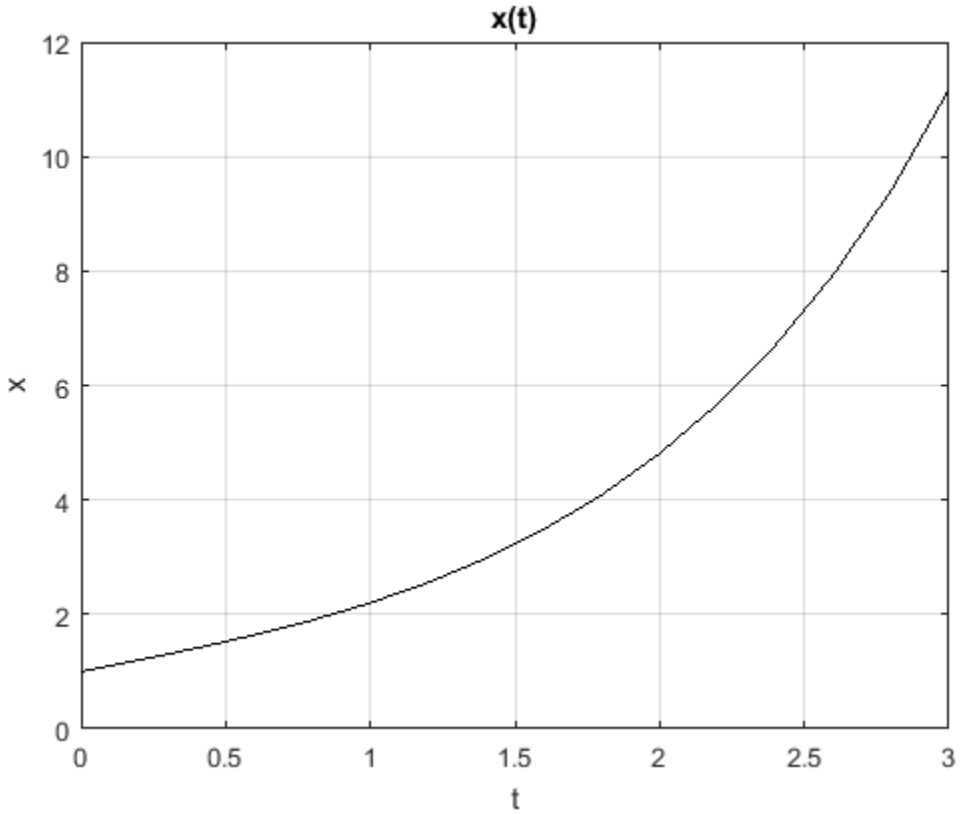


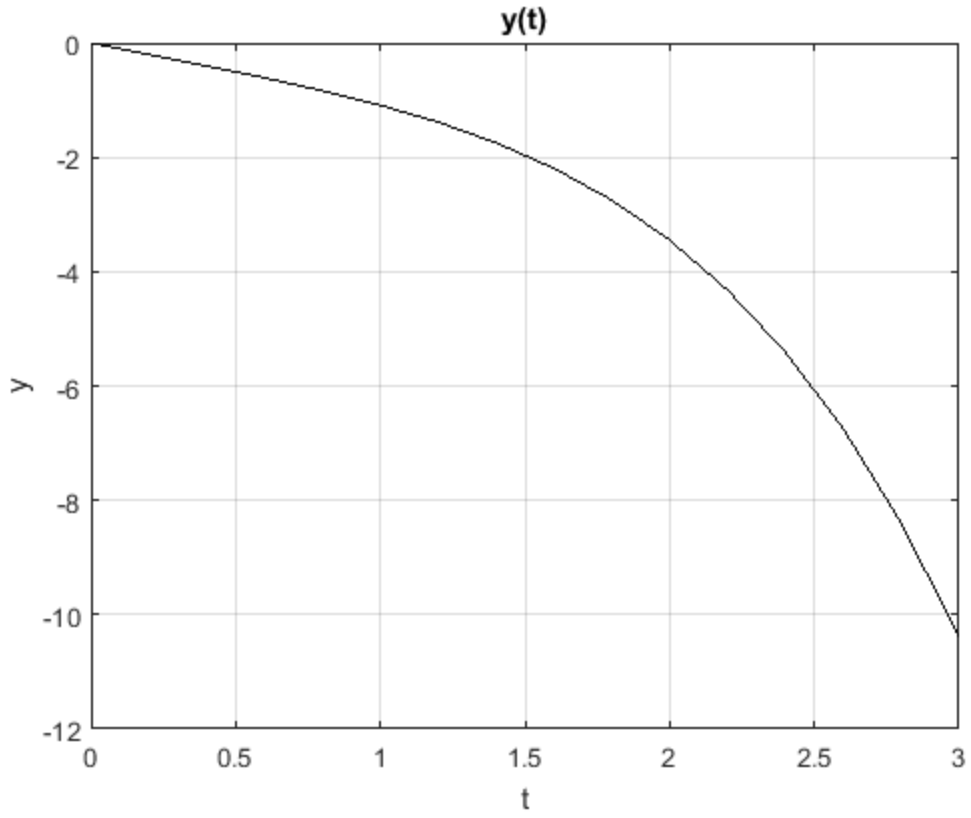
Published with MATLAB® R2015b

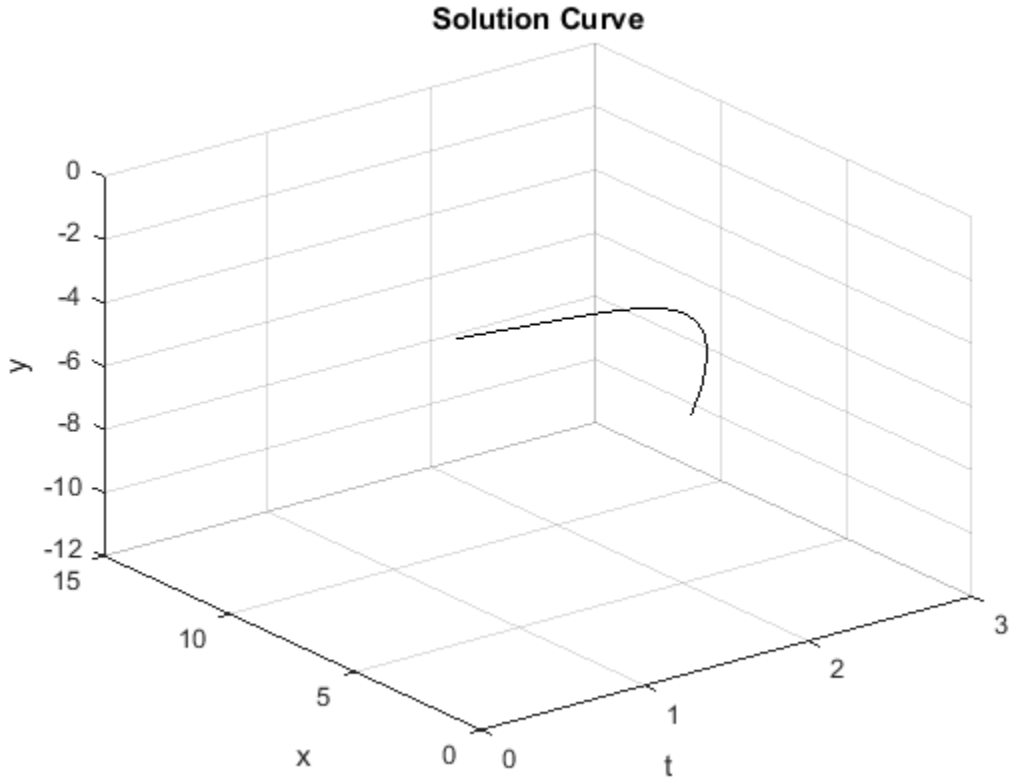
Practical 1(c)

Plotting Solution of System of ODE(1st Order)

```
% x(1)=x
% x(2)y
% x(0)=1;y(0)=0

f=@(t,x)[exp(t)+x(2);sin(1*t)-x(1)];
tspan=0:0.2:pi;
[t,x]=ode45(f,tspan,[1,0]);
figure(1)
plot(t,x(:,1),'-k');title('x(t)');
xlabel('t');ylabel('x');grid on;
figure(2)
plot(t,x(:,2),'-k');title('y(t)');
xlabel('t');ylabel('y');grid on;
figure(3)
plot3(t,x(:,1),x(:,2),'-k');
title('Solution Curve');xlabel('t');ylabel('x');zlabel('y');grid on;
```




y(t)
0
-2
-4
-6
-8
-10
-12
y
0
0.5
1
1.5
2
2.5
3
t


Solution Curve
0
-2
-4
-6
-8
-10
-12
y
15
10
5
0
x
0
1
2
3
t

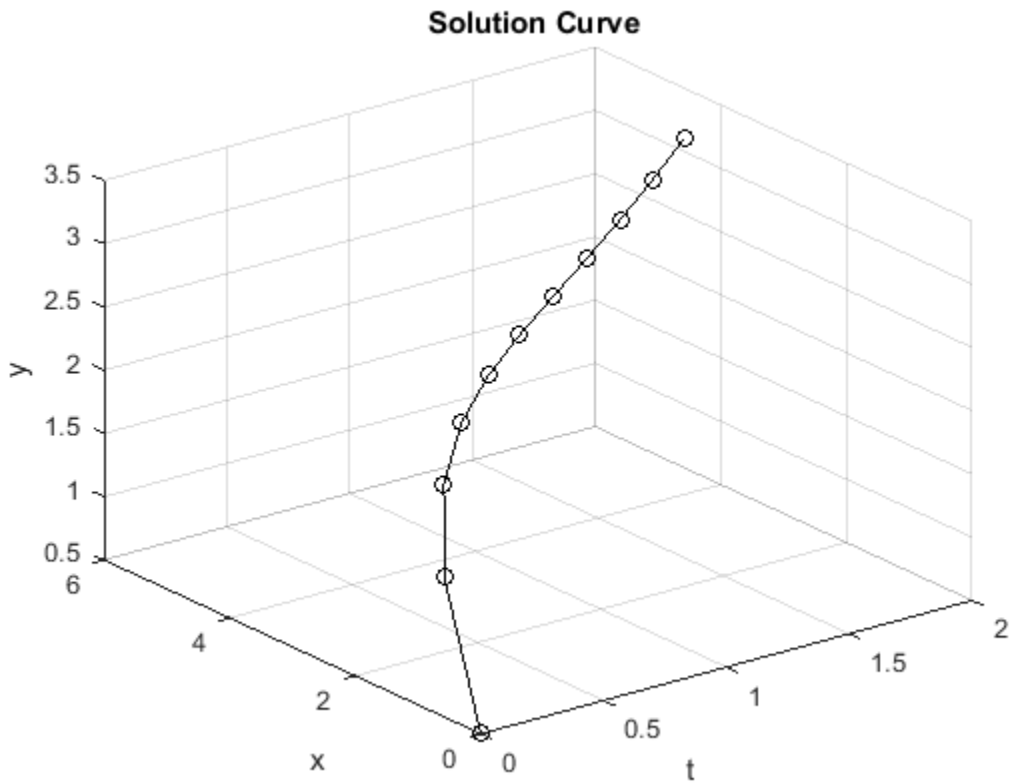
Published with MATLAB® R2015b

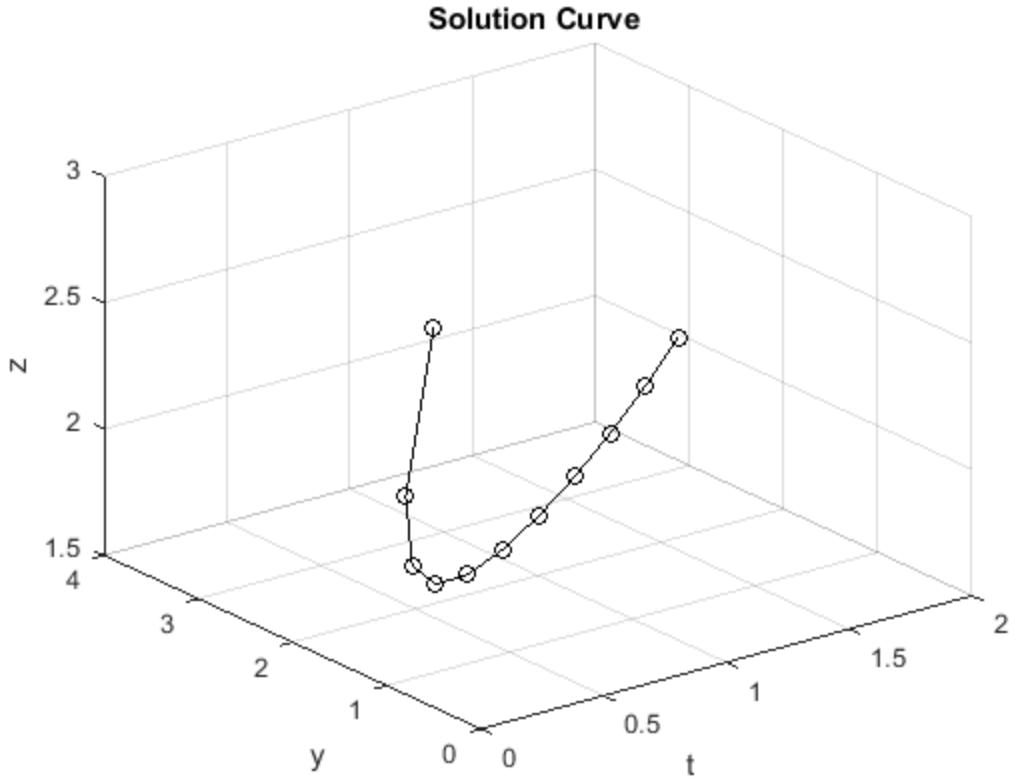
Practical 2(a)

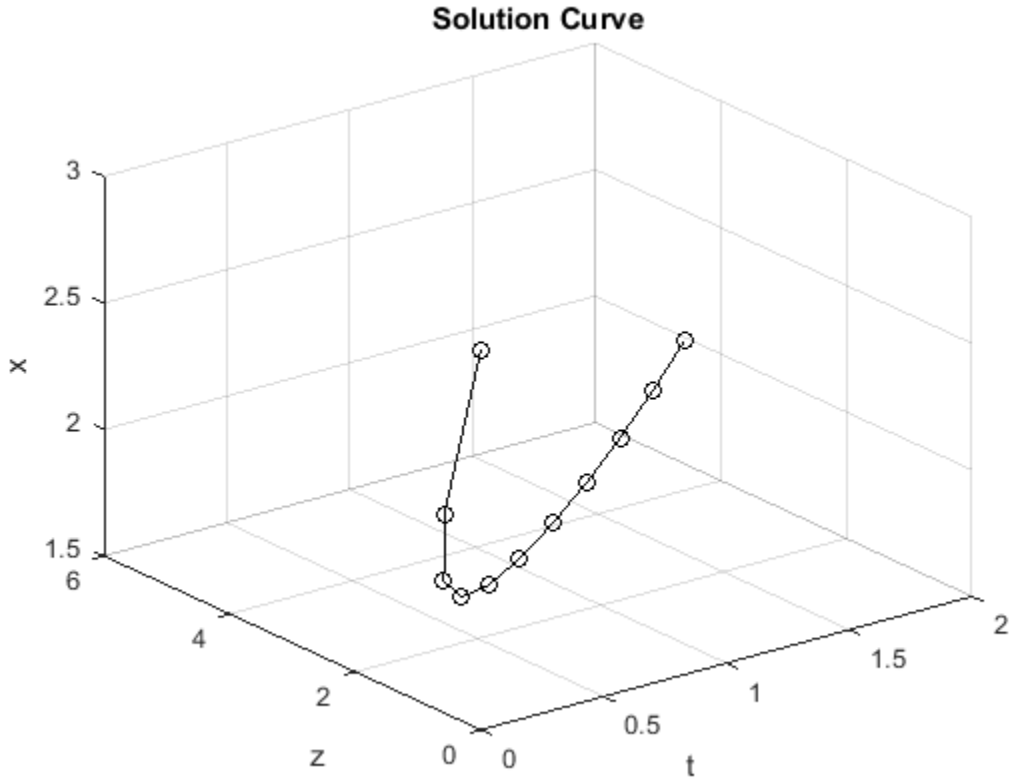
Plotting Solution of System of ODE(1st Order)

Shelly x(1)=x x(2)=y x(3)=z

```
f=@(t,x)[3*x(3)-x(1);2*x(3)-x(2);-2*x(3)+x(1)];
tspan=0:0.2:2;
[t,x]=ode45(f,tspan,[0,1/2,3]);
figure(1)
plot3(t,x(:,1),x(:,2)','-ok');
title('Solution Curve ');
xlabel('t');ylabel('x');zlabel('y');grid on;
figure(2)
plot3(t,x(:,2),x(:,3)','-ok');
title('Solution Curve ');
xlabel('t');ylabel('y');zlabel('z');grid on;
figure(3)
plot3(t,x(:,1),x(:,3),'-ok');
title('Solution Curve');
xlabel('t');ylabel('z');zlabel('x');grid on;
```




Solution Curve
z
3
2.5
2
1.5
4
3
2
1
y
0
0
0.5
1
1.5
2
t


Solution Curve
x
3
2.5
2
1.5
6
4
2
z
0
0
0.5
1
1.5
2
t

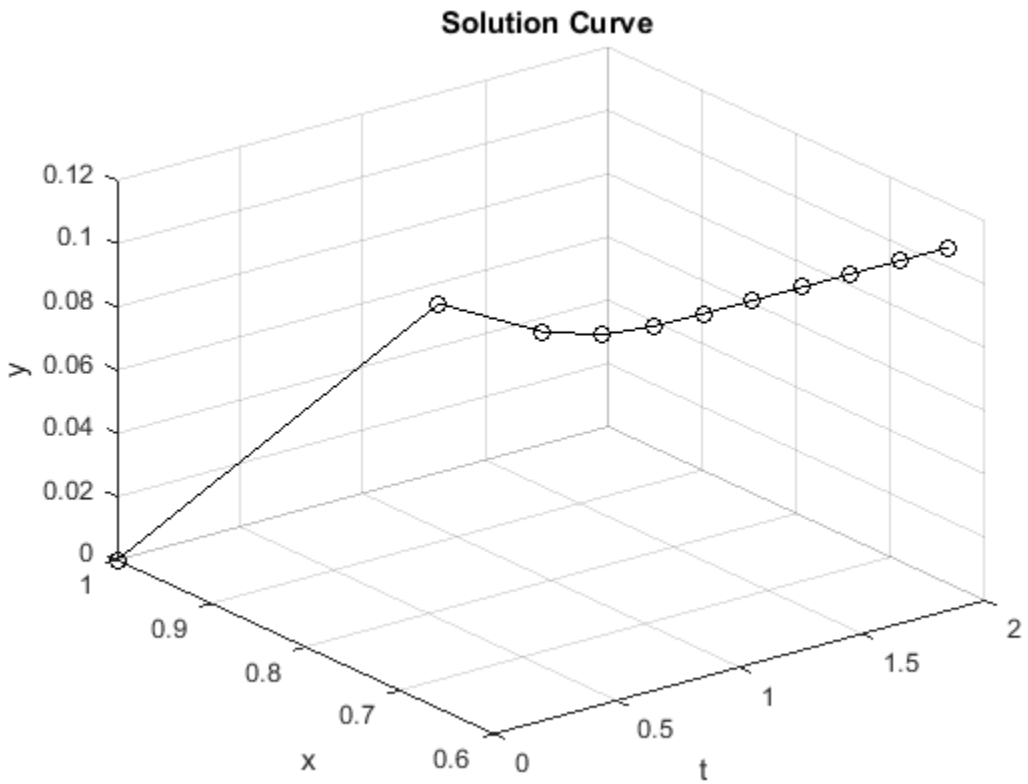
Published with MATLAB® R2015b

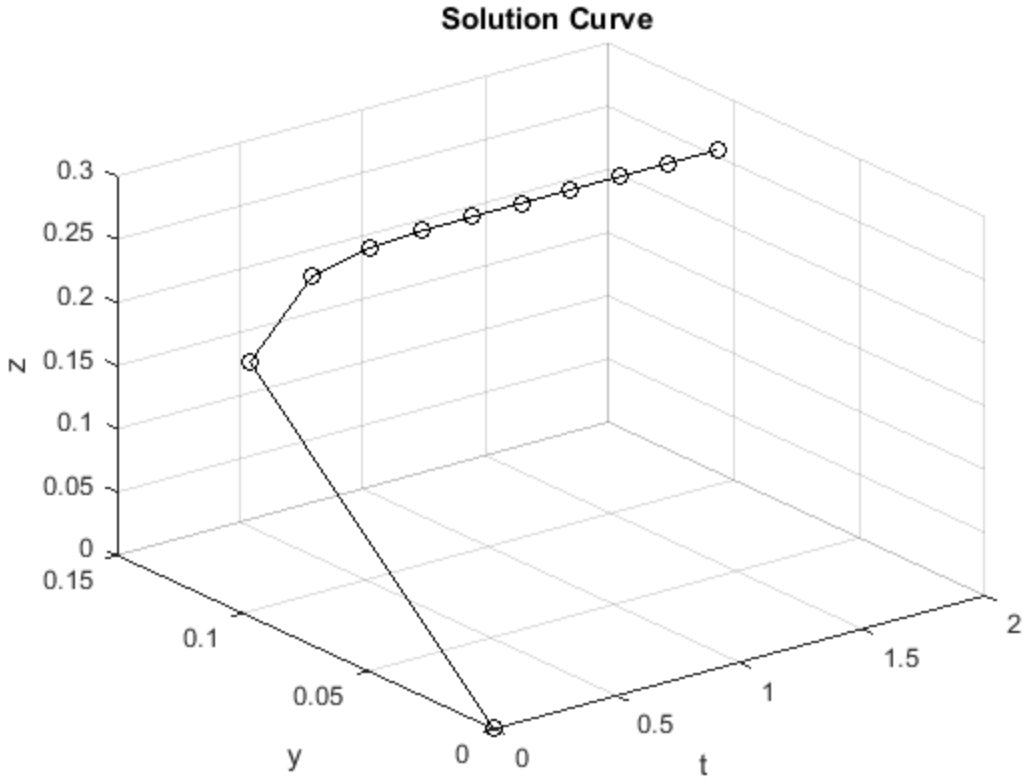
Practical 2(b)

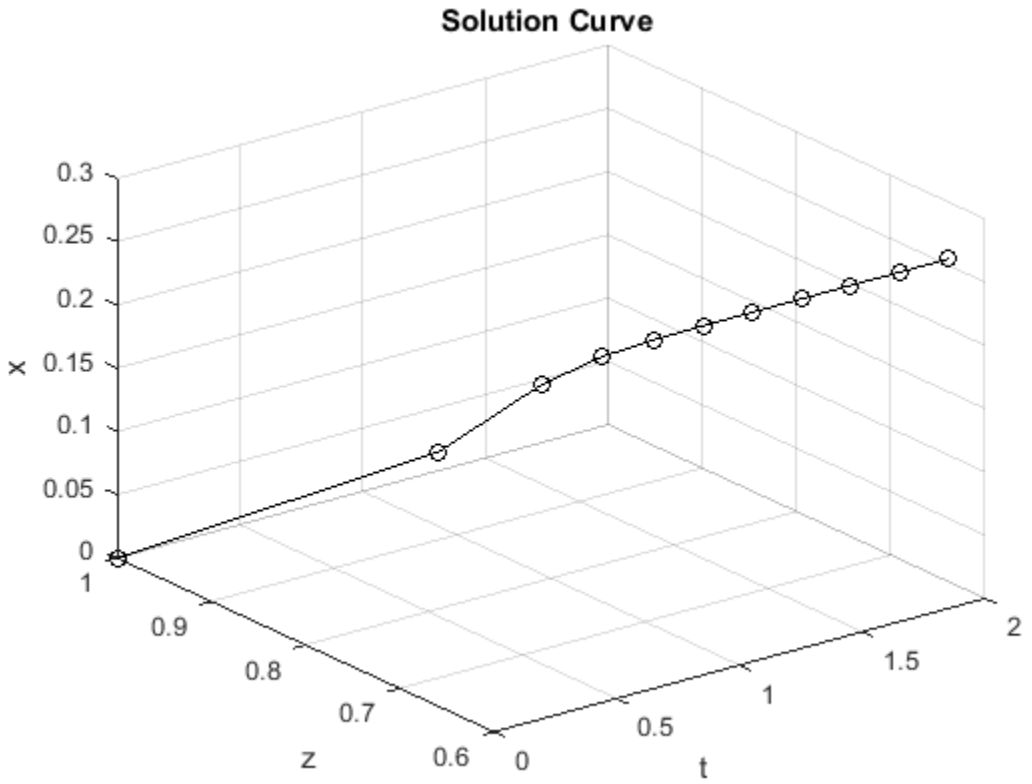
Plotting Solution of System of ODE(1st Order)

Shelly x(1)=x x(2)=y x(3)=z

```
f=@(t,x)[5*x(3)+6*x(2)-3*x(1);-12*x(2)+2*x(1);-5*x(3)+6*x(2)+x(1)];
tspan=0:0.2:2;
[t,x]=ode45(f,tspan,[1,0,0]);
figure(1)
plot3(t,x(:,1),x(:,2)','-ok');
title('Solution Curve ');
xlabel('t');ylabel('x');zlabel('y');grid on;
figure(2)
plot3(t,x(:,2),x(:,3)','-ok');
title('Solution Curve ');
xlabel('t');ylabel('y');zlabel('z');grid on;
figure(3)
plot3(t,x(:,1),x(:,3),'-ok');
title('Solution Curve ');
xlabel('t');ylabel('z');zlabel('x');grid on;
```




Solution Curve
z
0.3
0.25
0.2
0.15
0.1
0.05
0
0.15
0.1
0.05
0
y
0
0.5
1
1.5
2
t


Solution Curve
x
0.3
0.25
0.2
0.15
0.1
0.05
0
1
0.9
0.8
0.7
0.6
z
0
0.5
1
1.5
2
t

Published with MATLAB® R2015b

Practical 3(a)

Plotting Solution of System of ODE(2nd Order)

Shelly x(1)=x x(3)=y x(4)=dx/dt=dx(1)/dt x(2)=dy/dt=dx(3)/dt

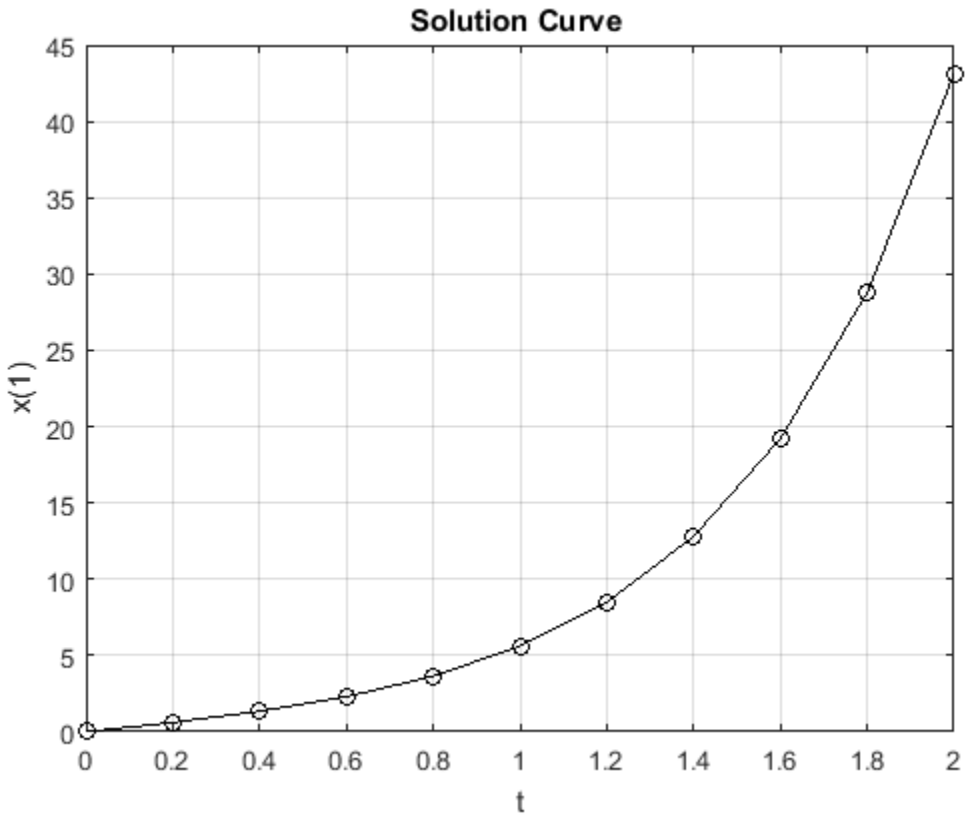
```
f=@(t,x)[x(4);6*x(1)-7*x(3);x(2);2*x(3)+3*x(1)];
tspan=0:0.2:2;
[t,x]=ode45(f,tspan,[0,2,0,3]);
figure(1)
plot(t,x(:,1),'-ok');
title('Solution Curve ');
xlabel('t');ylabel('x');grid on;
figure(2)
plot(t,x(:,3),'-ok');
title('Solution Curve');
xlabel('t');ylabel('y');grid on;
figure(3)
plot3(t,x(:,1),x(:,3),'-ok');
title('Solution Curve');
xlabel('t');ylabel('x');zlabel('y');grid on;
```

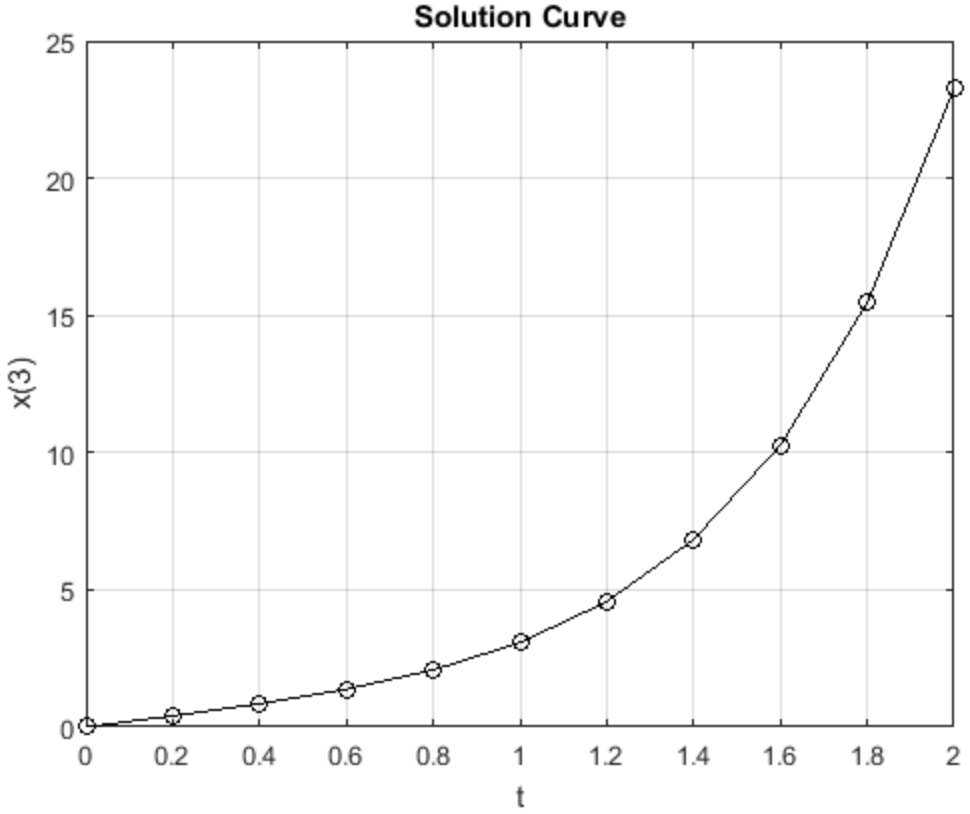
Published with MATLAB® R2015b

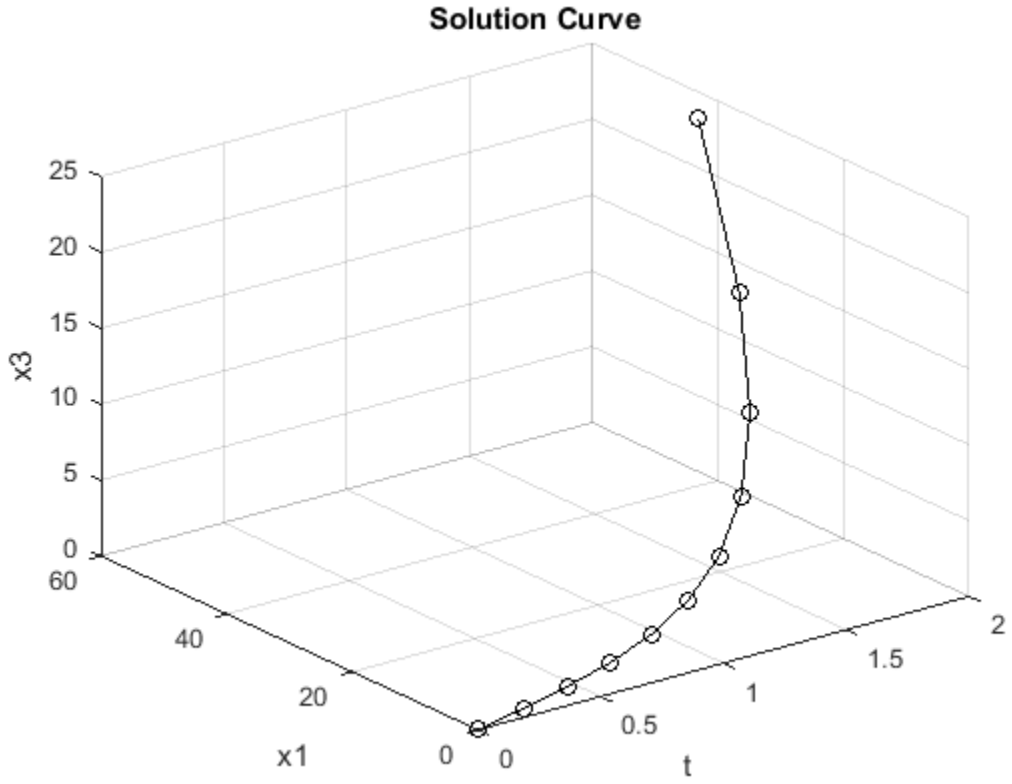
Practical 3(b)

Plotting Solution of System of ODE(2nd Order)

```
% x(1)=x
% x(2)=dx/dt=dx(1)/dt
% x(3)=y
% x(4)=dy/dt=dx(3)/dt
f=@(t,x)[x(2);2*x(3)+3*x(1);x(4);6*x(1)-7*x(3)];
tspan=0:0.2:2;
[t,x]=ode45(f,tspan,[0,3,0,2]);
figure(1)
plot(t,x(:,1),'-ok');
title('Solution Curve ');
xlabel('t');ylabel('x(1)');grid on;
figure(2)
plot(t,x(:,3),'-ok');
title('Solution Curve');
xlabel('t');ylabel('x(3)');grid on;
figure(3)
plot3(t,x(:,1),x(:,3),'-ok');
title('Solution Curve');
xlabel('t');ylabel('x1');zlabel('x3');grid on;
```




Solution Curve
x(3)
t
0
5
10
15
20
25
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2


Solution Curve
x3
x1
t
0
5
10
15
20
25
60
40
20
0
0
0.5
1
1.5
2

Published with MATLAB® R2015b

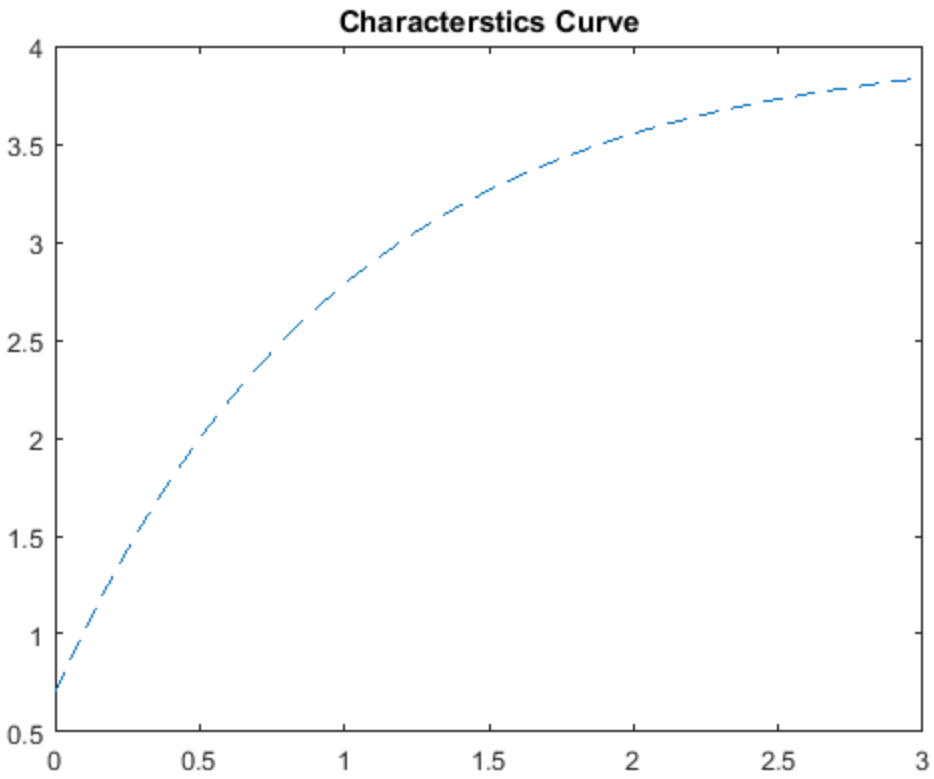
Practical 4(a)

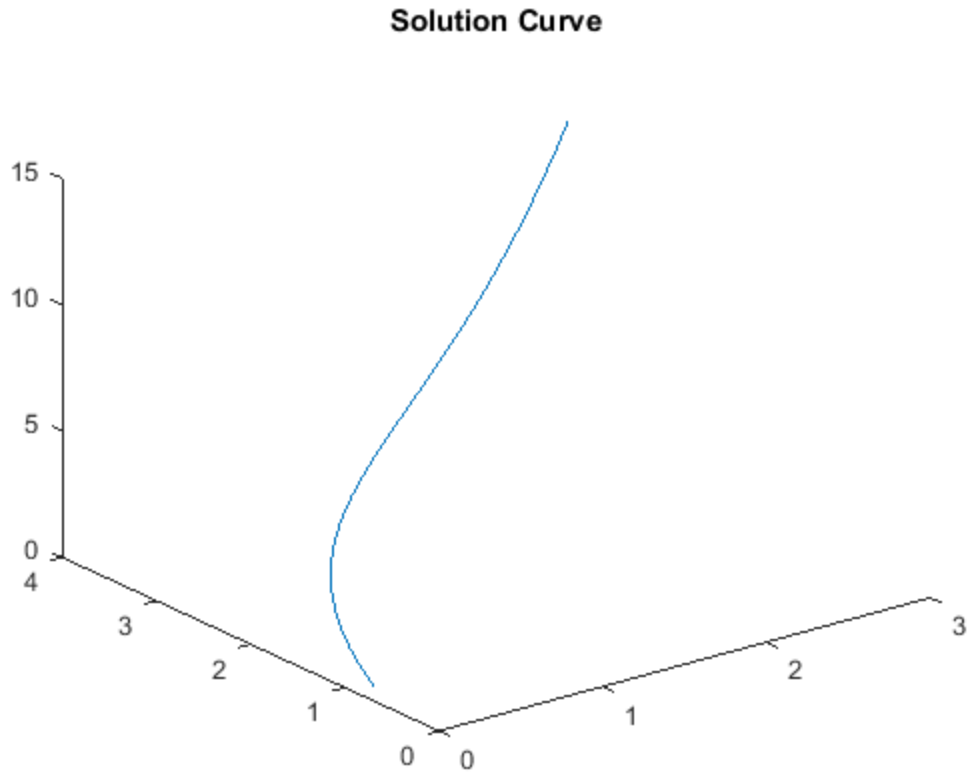
Plotting Solution of Cauchy Problem

```
% Problem: u_t+(4-x)u_x=U;u(x,0)=e^(-x.^2)

c=@(x,t,u)4-x;
f=@(x,t,u)u;
u_0=@(x)(exp(-x^2));
G=@(t,w)[c(w(1),t,w(2)); f(w(1),t,w(2))];
x_0=0.7;
tval=0:0.1:3;
[t,w]=ode45(G,tval,[x_0,u_0(x_0)]);
sol=[t';w']
x=w(:,1);u=w(:,2);
figure(1)
plot(tval,x,'--');
title('Characterstics Curve');
figure(2)
plot3(tval,x,u);
title('Solution Curve');
```

```
sol =

  Columns 1 through 7

         0    0.1000    0.2000    0.3000    0.4000    0.5000    0.6000
    0.7000    1.0140    1.2982    1.5553    1.7879    1.9984    2.1889
    0.6126    0.6771    0.7483    0.8270    0.9139    1.0101    1.1163

  Columns 8 through 14

    0.7000    0.8000    0.9000    1.0000    1.1000    1.2000    1.3000
    2.3613    2.5172    2.6583    2.7860    2.9015    3.0061    3.1006
    1.2337    1.3634    1.5068    1.6653    1.8404    2.0340    2.2479

  Columns 15 through 21

    1.4000    1.5000    1.6000    1.7000    1.8000    1.9000    2.0000
    3.1862    3.2637    3.3337    3.3971    3.4545    3.5064    3.5534
    2.4843    2.7456    3.0344    3.3535    3.7062    4.0960    4.5267

  Columns 22 through 28

    2.1000    2.2000    2.3000    2.4000    2.5000    2.6000    2.7000
    3.5959    3.6343    3.6691    3.7006    3.7291    3.7549    3.7782
    5.0028    5.5290    6.1105    6.7531    7.4633    8.2482    9.1157

  Columns 29 through 31

    2.8000    2.9000    3.0000
```

```
    3.7993    3.8184    3.8357
   10.0744   11.1340   12.3049
```





Published with MATLAB® R2015b

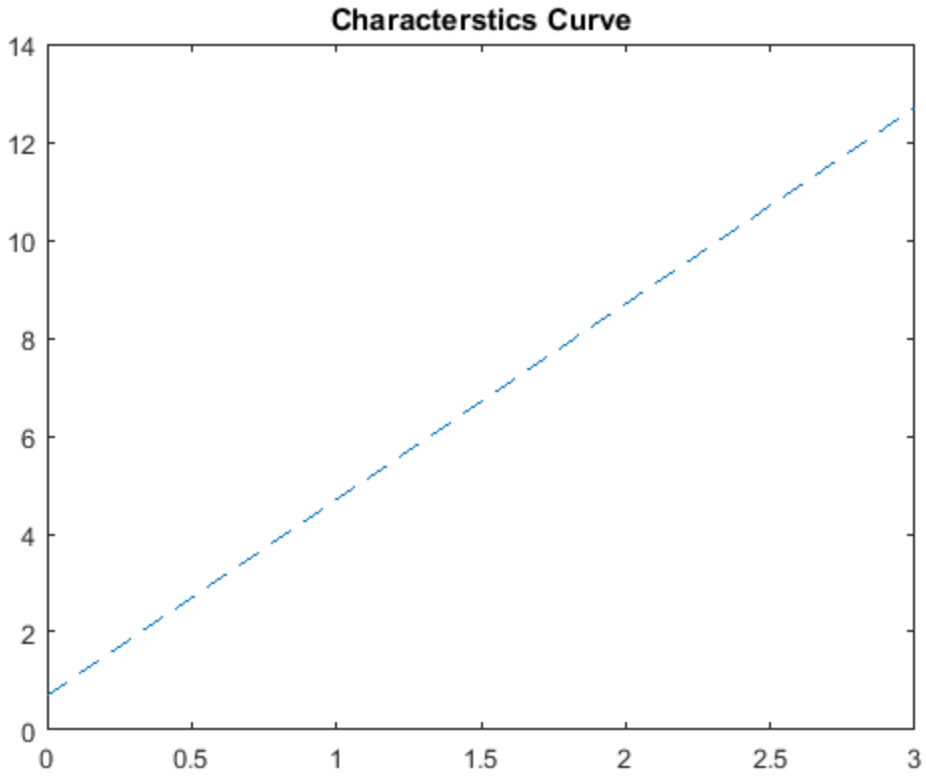
Practical 4(b)

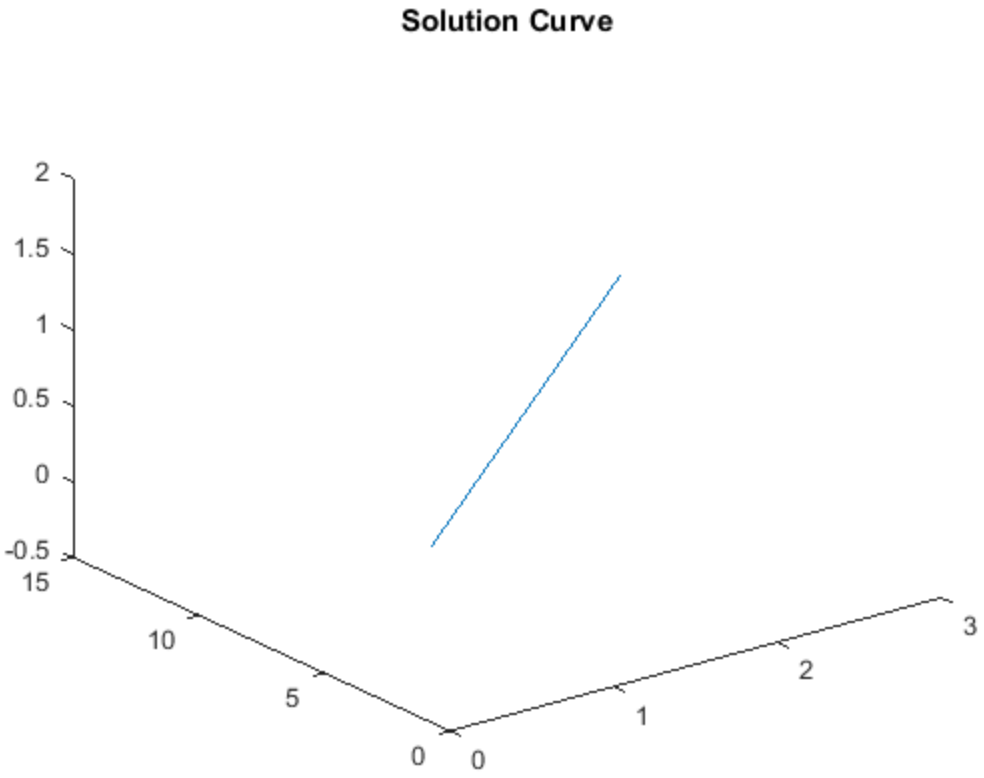
Plotting Solution of Cauchy Problem

```
% Problem: u_t+4u_x=0; u(x,0)=1/1+x^2
c=@(x,t,u)4;
f=@(x,t,u)0;
u_0=@(x)(1/(1+x^2));
G=@(t,w)[c(w(1),t,w(2));f(w(1),t,w(2))];
x_0=0.7;
tval=0:0.1:3;
[t,w]=ode45(G,tval,[x_0,u_0(x_0)]);
sol=[t';w']
x=w(:,1);u=w(:,2);
figure(1)
plot(tval,x,'--');
title('Characterstics Curve');
figure(2)
plot3(tval,x,u);
title('Solution Curve');
```

```
sol =

  Columns 1 through 7

         0    0.1000    0.2000    0.3000    0.4000    0.5000    0.6000
    0.7000    1.1000    1.5000    1.9000    2.3000    2.7000    3.1000
    0.6711    0.6711    0.6711    0.6711    0.6711    0.6711    0.6711

  Columns 8 through 14

    0.7000    0.8000    0.9000    1.0000    1.1000    1.2000    1.3000
    3.5000    3.9000    4.3000    4.7000    5.1000    5.5000    5.9000
    0.6711    0.6711    0.6711    0.6711    0.6711    0.6711    0.6711

  Columns 15 through 21

    1.4000    1.5000    1.6000    1.7000    1.8000    1.9000    2.0000
    6.3000    6.7000    7.1000    7.5000    7.9000    8.3000    8.7000
    0.6711    0.6711    0.6711    0.6711    0.6711    0.6711    0.6711

  Columns 22 through 28

    2.1000    2.2000    2.3000    2.4000    2.5000    2.6000    2.7000
    9.1000    9.5000    9.9000   10.3000   10.7000   11.1000   11.5000
    0.6711    0.6711    0.6711    0.6711    0.6711    0.6711    0.6711

  Columns 29 through 31

    2.8000    2.9000    3.0000
   11.9000   12.3000   12.7000
```

```
0.6711    0.6711    0.6711
```





Published with MATLAB® R2015b