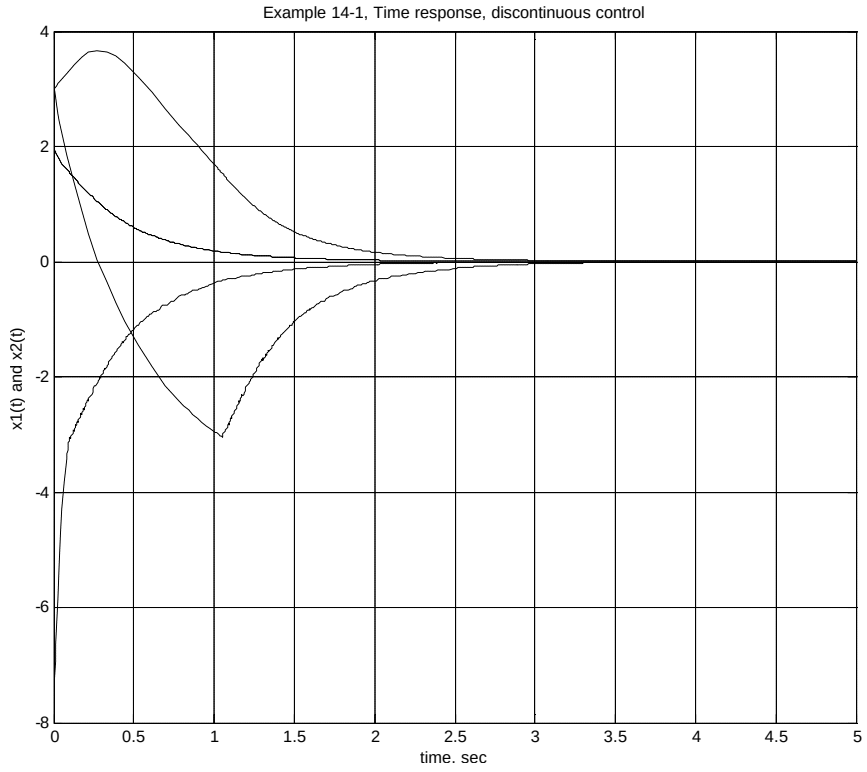
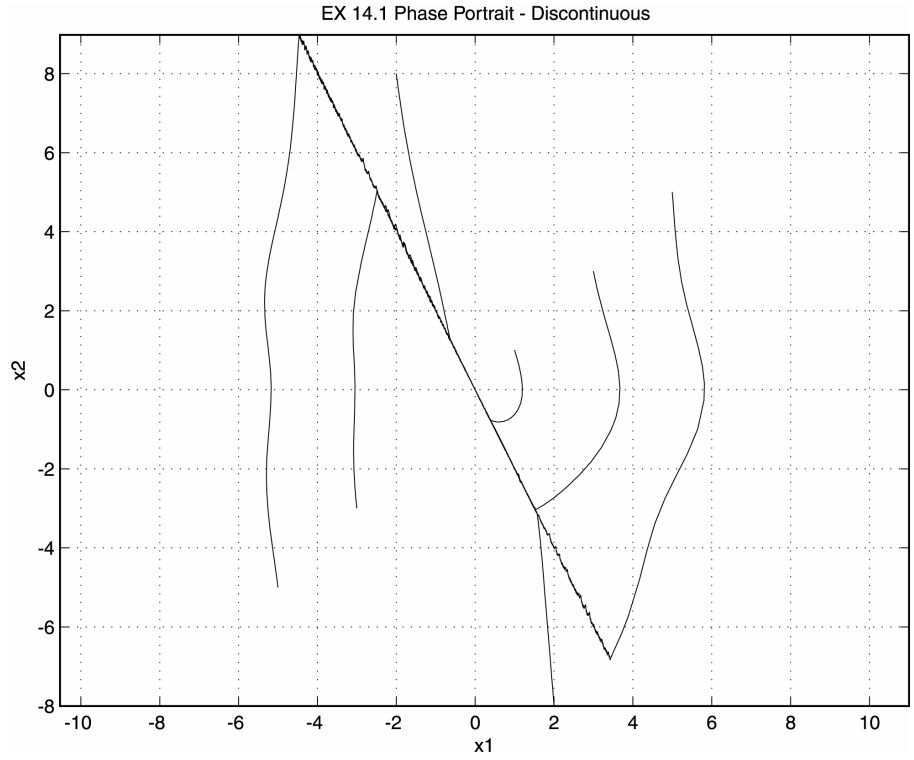
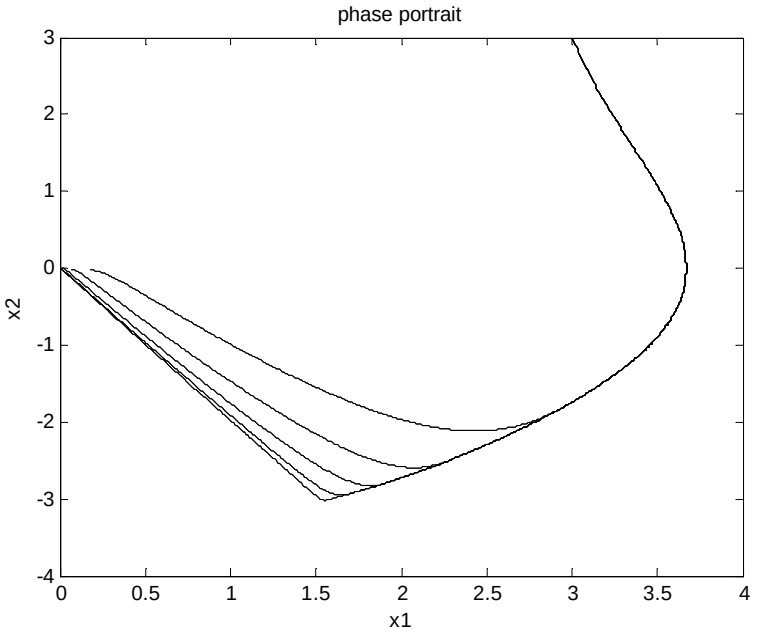
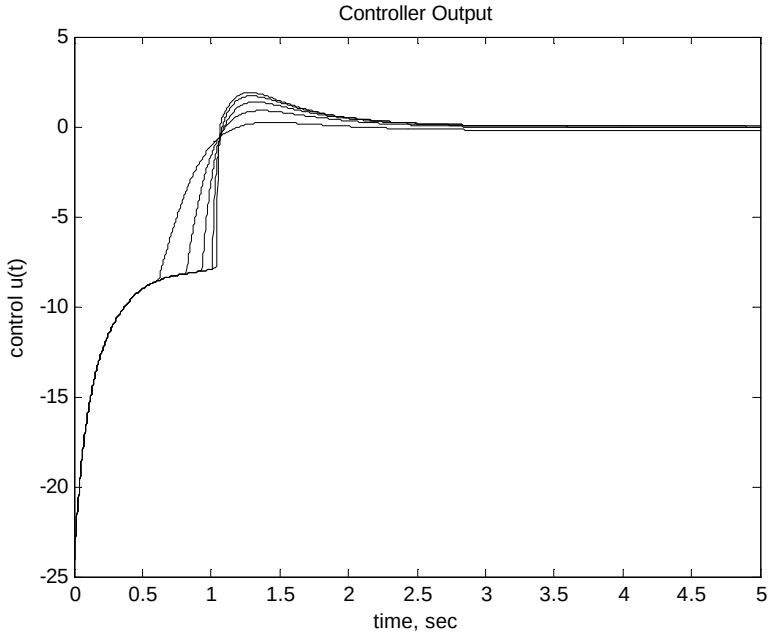
```
% Run file for example 14.1 using discontinuous control
% ME EN 7200 - Spring 2003 - Mark Minor

x0=[2 -8]
tspan=[0 5]
[t,x]=ode45('sysexample141',tspan,x0);

figure(1)
plot(t,x(:,1),'k-',t,x(:,2),'k--');
hold on

figure(2)
plot(x(:,1),x(:,2));
hold on

function xdot=sysexample141(t,x)
% Function file for simulating example 14.1
% using discontinuous sliding mode control
% MEEN 7200 - Spring 2003 - Mark Minor

theta1=.5;
theta2=.5;
a=1;
b=1;
k=2;
b0=.1;

% Defining the sliding mode controller...
s=x(2)+k*x(1);
beta=k*a*abs(x(1))+b*x(2)^2+b0;
v=-beta*sign(s);
u=-x(1)-k*x(2)+v;

% Now the system equations...
xdot(1)=x(2)+theta1*x(1)*sin(x(2));
xdot(2)=theta2*x(2)^2+x(1)+u;
xdot=xdot';
```

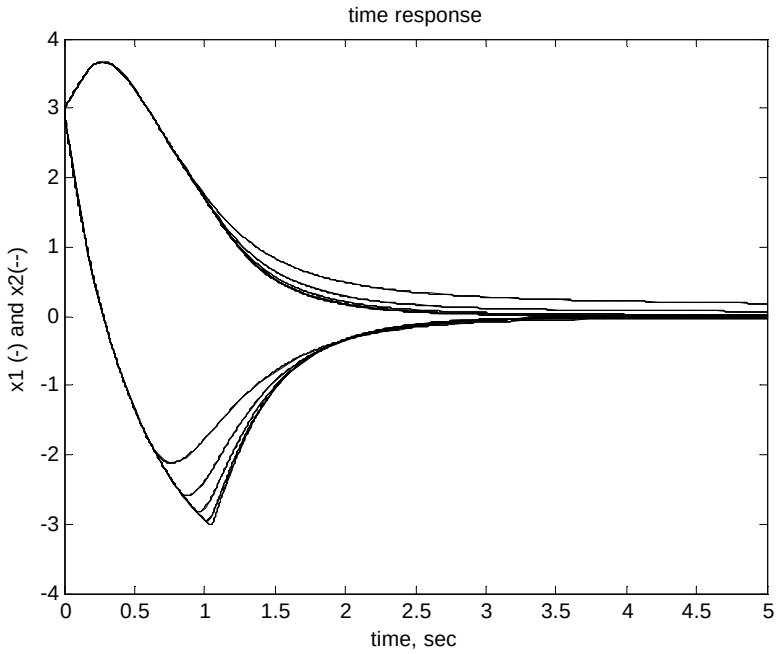




```
% Run file for example 14.1 using continuous sliding mode
control
% ME EN 7200 - Spring 2003 - Mark Minor
clear all
clf
global eps
theta1=.5; theta2=.5; a=1; b=1; k=2; b0=.1;
epsilon=[.1 .4 1 2 4];
options=odeset('MaxStep',.01)
for i=1:length(epsilon),
eps=epsilon(i)
x0=[3 3]
tspan=[0 5]
[t,x]=ode45('syscont',tspan,x0,options);

figure(1)
plot(t,x(:,1),'k-',t,x(:,2),'k--');
xlabel('time, sec')
ylabel('x1 (-) and x2(--)')
title('time response')
hold on

figure(2)
plot(x(:,1),x(:,2),'k-');
xlabel('x1')
ylabel('x2')
title('phase portrait')
hold on

figure(3)
u=0;
for j=1:length(t),
    s=x(j,2)+k*x(j,1);
    beta=k*a*abs(x(j,1))+b*x(j,2)^2+b0;
    if abs(s)>eps
      v=-beta*sign(s/eps);
    else
      v=-beta*s/eps;
    end
      u(j)=-x(j,1)-k*x(j,2)+v;
end
plot(t,u,'k-')
xlabel('time, sec')
ylabel('control u(t)')
title('Controller Output')
hold on
end

function xdot=syscont(t,x)
% Function file for simulating example 14.1
% using continuous sliding mode control
% MEEN 7200 - Spring 2003 - Mark Minor

global eps

theta1=.5;
theta2=.5;
a=1;
b=1;
k=2;
b0=.1;

% Defining the sliding mode controller...
s=x(2)+k*x(1);
beta=k*a*abs(x(1))+b*x(2)^2+b0;

if abs(s)>eps
    v=-beta*sign(s/eps);
else
    v=-beta*s/eps;
end

u=-x(1)-k*x(2)+v;

% Now the system equations...
xdot(1)=x(2)+theta1*x(1)*sin(x(2));
xdot(2)=theta2*x(2)^2+x(1)+u;
xdot=xdot';
```


phase portrait
x2
x1


Controller Output
control u(t)
time, sec


time response
x1 (-) and x2(--)
time, sec