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```
clear all
close all
clc

x0 = [0;0];
A = [0 1; -10 -2];
B = [0; 1];
```

Part 1

```
[v, d] = eig(A);
d
% underdamped b/c real part is negative and has imaginary parts
```

```
d =
  -1.0000 + 3.0000i   0.0000 + 0.0000i
   0.0000 + 0.0000i  -1.0000 - 3.0000i
```

Part 2

```
syms s
Us = 1/s - exp(-5*s)/s;
Xs = inv(s * eye(2) - A) * x0+ inv(s * eye(2) - A) * B * Us;
X1s = simplify(Xs(1,1))
X2s = simplify(Xs(2,1))
```

```
X1s =
-(exp(-5*s) - 1)/(s*(s^2 + 2*s + 10))
X2s =
-(exp(-5*s) - 1)/(s^2 + 2*s + 10)
```

Part 3

```
x1t = ilaplace(X1s)
x2t = ilaplace(X2s)
ut = ilaplace(Us)
```

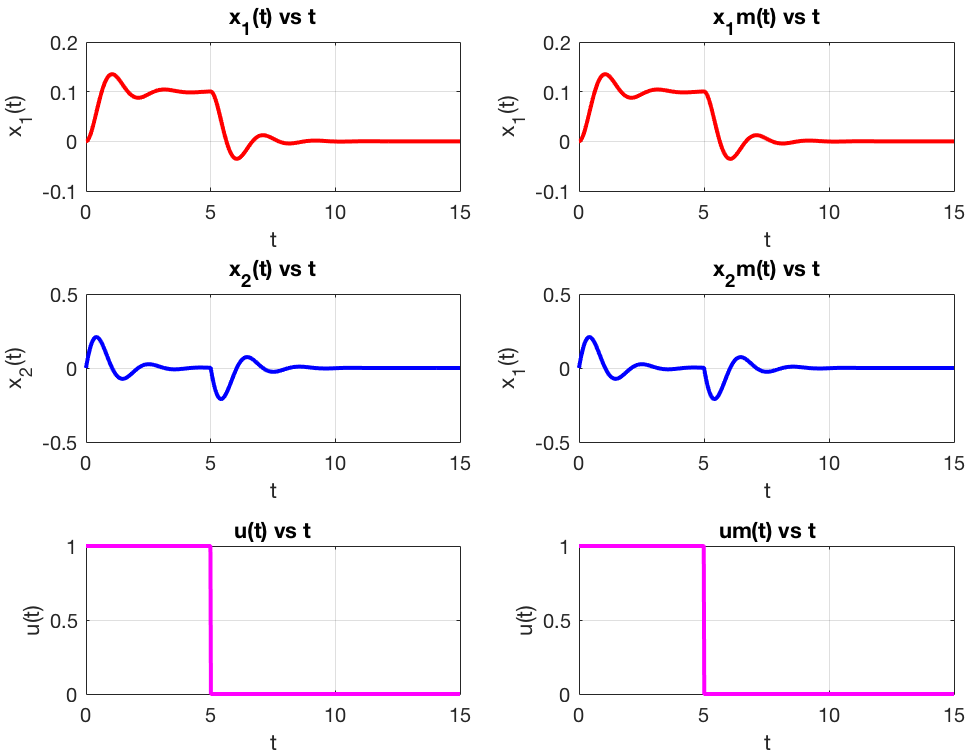
```
x1t =
```

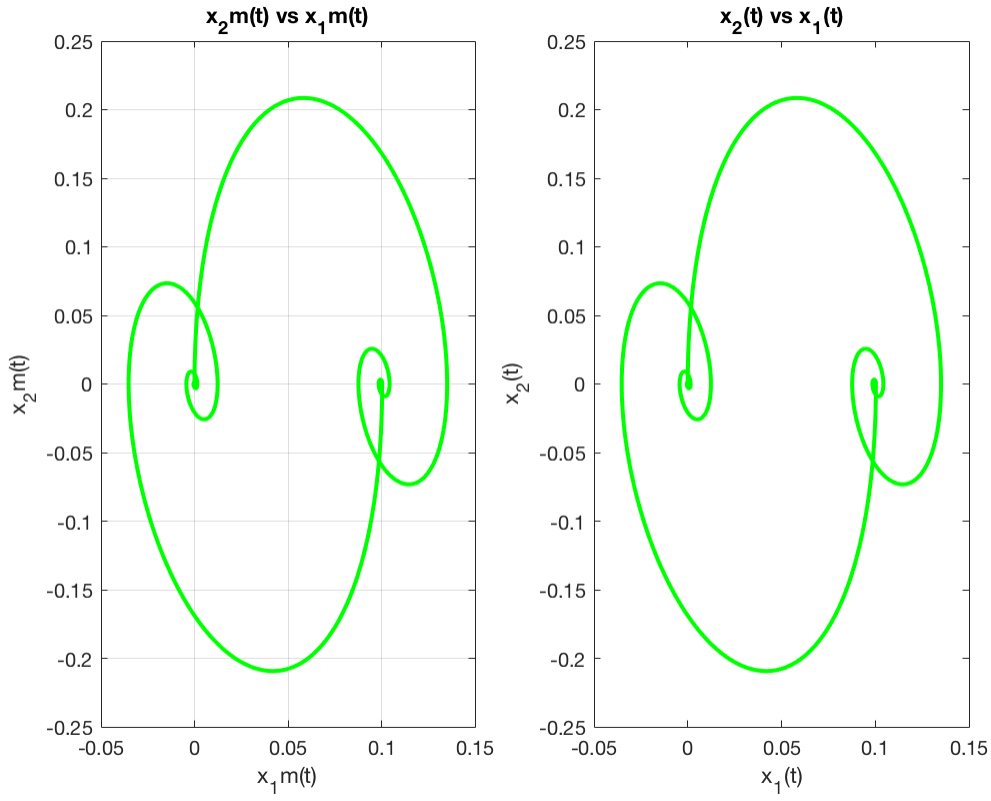
```
heaviside(t - 5)*((exp(5 - t)*(cos(3*t - 15) + sin(3*t - 15)/3))/10 -
 1/10) - (exp(-t)*(cos(3*t) + sin(3*t)/3))/10 + 1/10
x2t =
(sin(3*t)*exp(-t))/3 - (heaviside(t - 5)*exp(5 - t)*sin(3*t - 15))/3
ut =
1 - heaviside(t - 5)
```

Part 4

```
IC = x0;
ep = inv(A) * -B;
x1 = matlabFunction(x1t);
x2 = matlabFunction(x2t);
u = matlabFunction(ut);

% my_matlabFunction
x1m = my_matlabFunction_v2(x1t);
x2m = my_matlabFunction_v2(x2t);
um = my_matlabFunction_v2(ut);

t = 0:0.01:15;

figure;
subplot(3,2,1);
plot(t,x1(t),'r', 'linewidth', 2);
grid on;
ylabel('x_1(t)');
xlabel('t');
title('x_1(t) vs t');

subplot(3,2,2); % my_matlabFunction_v2
plot(t,double(x1m(t)),'r', 'linewidth', 2);
grid on;
ylabel('x_1(t)');
xlabel('t');
title('x_1m(t) vs t');

subplot(3,2,3);
plot(t,x2(t),'b', 'linewidth', 2);
grid on;
ylabel('x_2(t)');
xlabel('t');
title('x_2(t) vs t');

subplot(3,2,4); % my_matlabFunction_v2
plot(t,double(x2m(t)),'b', 'linewidth', 2);
grid on;
ylabel('x_1(t)');
xlabel('t');
title('x_2m(t) vs t');

subplot(3,2,5);
plot(t,u(t),'m', 'linewidth', 2);
```

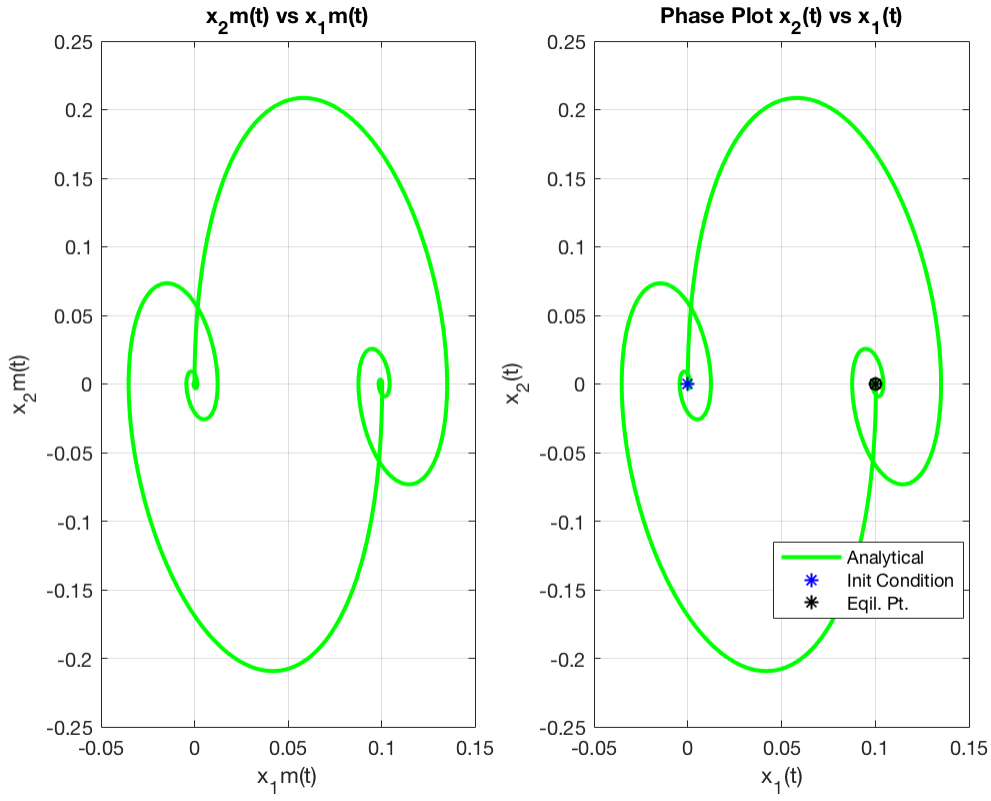
```
grid on;
ylabel('u(t)');
xlabel('t');
title('u(t) vs t');

subplot(3,2,6); % my_matlabFunction_v2
plot(t,double(um(t)),'m', 'linewidth', 2);
grid on;
ylabel('u(t)');
xlabel('t');
title('um(t) vs t');

figure;
subplot(1,2,1)
plot(double(x1m(t)),double(x2m(t)),'g', 'linewidth', 2);
ylabel('x_2m(t)');
xlabel('x_1m(t)');
title('x_2m(t) vs x_1m(t)');
grid on;

subplot(1,2,2)
plot(x1(t),x2(t),'g', 'linewidth', 2);
ylabel('x_2(t)');
xlabel('x_1(t)');
title('x_2(t) vs x_1(t)');
hold on;
```





Part 5

```
plot(IC(1),IC(2),'b*',ep(1),ep(2),'k*');
plot(ep(1),ep(2),'ko');
xlabel('x_1(t)'), ylabel('x_2(t)');
title('Phase Plot x_2(t) vs x_1(t)');
legend('Analytical','Init Condition','Eqil. Pt.','Location','best');
grid on;
```



Part 6

```
%{
a.) The phase plot approaches the equilibrium point which is where the
pulse turns off and then the plot returns to the initial condition.
 Goes up
and right first, then down and left when pulse is turned off to return
 to IC.
b.) At around 12 seconds, x1(t) goes to 0
c.) At around 12 seconds, x2(t) goes to 0
%}
```

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