Matlab Homework week 2

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1 Problem 1

1.1 Description

Differential equations and excitation signals for known systems, zero-state response (with symbolism, numerical method, convolution integral method)

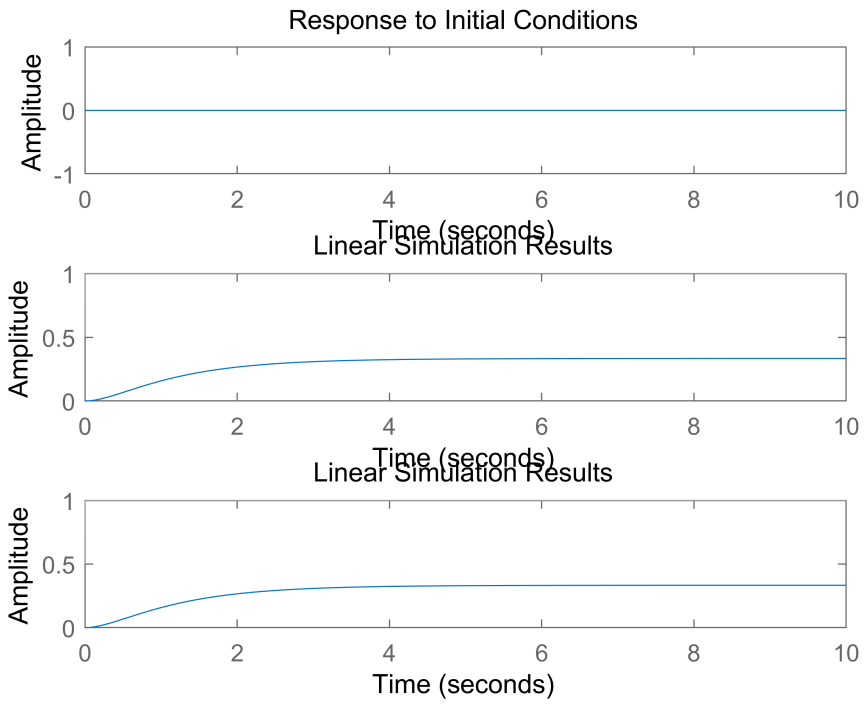
$$y''(t) + 4y'(t) + 3y(t) = f(t), f(t) = u(t)$$
$$y''(t) + 4y'(t) + 4y(t) = f'(t) + 3f(t), f(t) = e^{-t}u(t)$$

1.2 Code and result

(1-1)

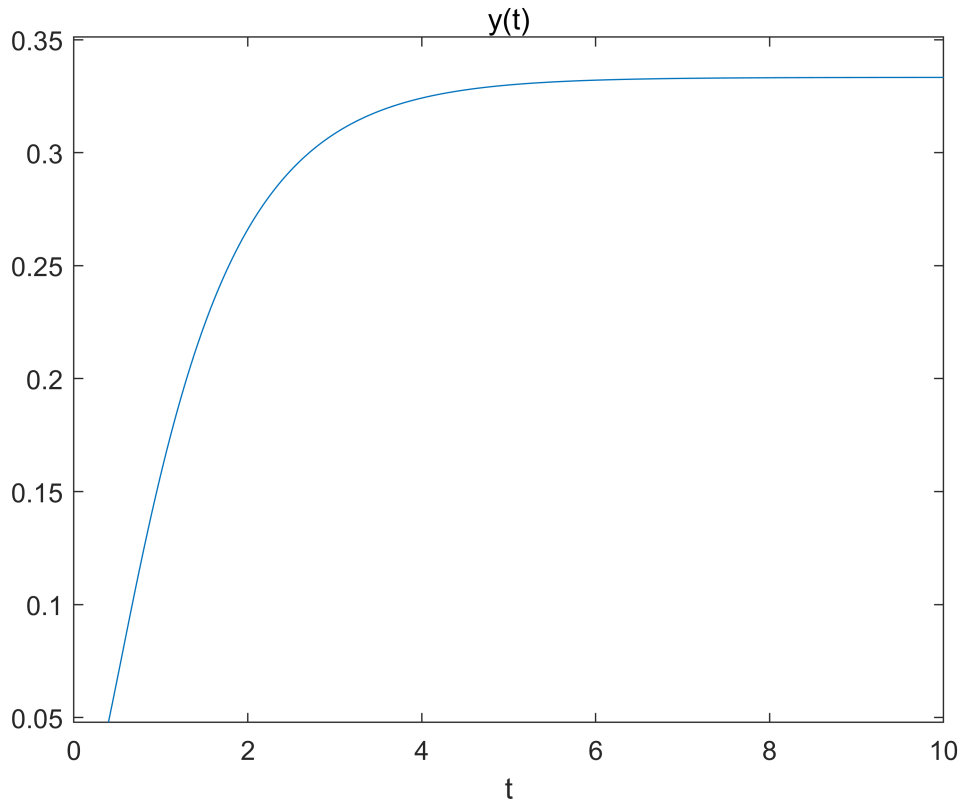
Numberical method

```
clear all;
a=[1 4 3];
b=[0 0 1];
t=0:0.001:10;
x=heaviside(t);
rc=[0,0];
sys=tf(b,a)
[A,B,C,D]=tf2ss(b,a)
subplot(3,1,1),initial(A,B,C,D,rc,t) %零输入响应
subplot(3,1,2),lsim(b,a,x,t)         %零状态响应
subplot(3,1,3),lsim(A,B,C,D,x,t,rc)  %全响应只能用状态系数来表示
    系统,
```



symbolic method

```
clear all;
eq1='D2y+4*Dy+3*y=heaviside(t)';
cond='y(-0.01)=0,Dy(-0.01)=0';
result=dsolve(eq1,cond);
simplify(result);
ezplot(result,[0:0.01:10]) ;
title('y(t)')
```



Convolution method

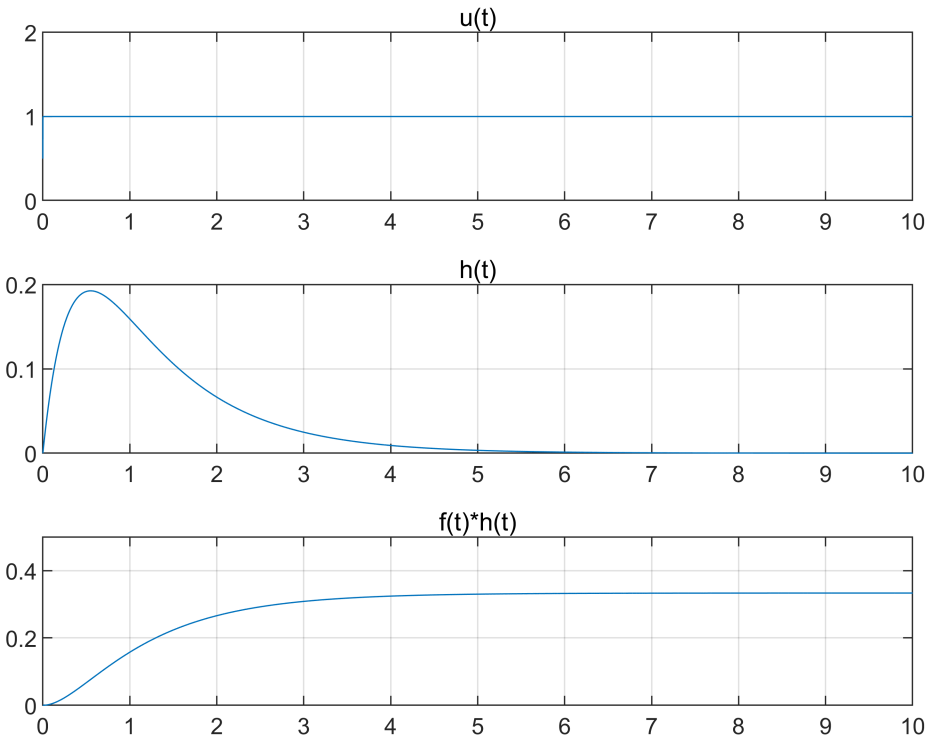
```
function [f,t]=ctsconv(f1,f2,t1,t2,dt)
f=conv(f1,f2);
f=f*dt;
ts=min(t1)+min(t2);
te=max(t1)+max(t2);
t=ts:dt:te;
plot(t,f);
grid on;
title('f(t)')
end

clear all;
dt = 0.001 ;
t1 = 0:dt:10 ;
f1 = heaviside(t1) ;
t2 = t1 ;
b = [0 0 1] ;
```

```
a = [1 4 3] ;
[A B C D] = tf2ss(b,a) ;
sys = ss(A,B,C,D) ;
f2 = impulse(sys,t2) ;
[f,t] = ctsconv(f1,f2,t1,t2,dt) ;
subplot(3,1,1)
plot(t1,f1) ;
hold on;
axis([0,10,0,2])
grid on ;
title('u(t)') ;
subplot(3,1,2)
plot(t2,f2) ;
grid on ;
title('h(t)') ;
subplot(3,1,3)
plot(t,f) ;
hold on;
axis([0,10,0,0.5])
grid on ;
title('f(t)*h(t)') ;

1-2
clear all;
dt = 0.001 ;
t1 = 0:dt:10 ;
f1 = exp(-t1).*heaviside(t1);
t2 = t1 ;
b = [0 0 1] ;
a = [1 4 3] ;
[A B C D] = tf2ss(b,a) ;
sys = ss(A,B,C,D) ;
f2 = impulse(sys,t2) ;
[f,t] = ctsconv(f1,f2,t1,t2,dt) ;
subplot(3,1,1)
plot(t1,f1) ;
hold on;
axis([0,10,0,2])
grid on ;
title('f(t) = u(t)e^{-t}','Interpreter','Latex') ;
subplot(3,1,2)
plot(t2,f2) ;
```

```
grid on ;
title('h(t)') ;
subplot(3,1,3)
plot(t,f) ;
hold on;
axis([0,10,0,0.5])
grid on ;
title('f(t)*h(t)') ;
```

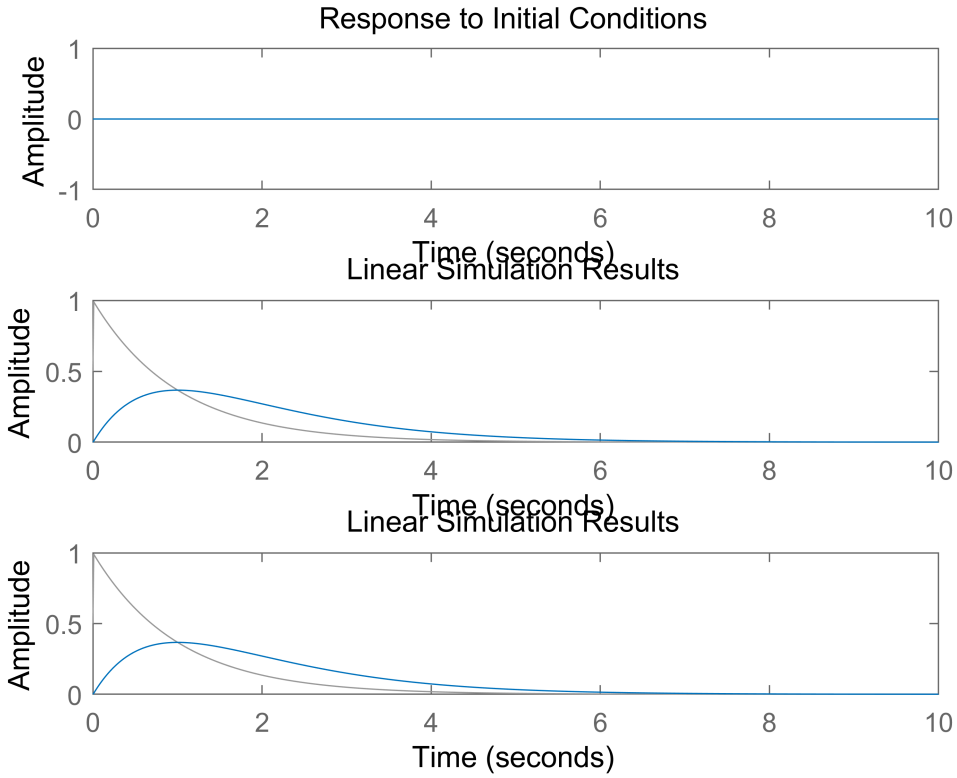


(1-2)

Numberical method:

```
clear all;
a=[1 4 4];
b=[0 1 3];
t=0:0.001:10;
x=heaviside(t),*exp(-t);
```

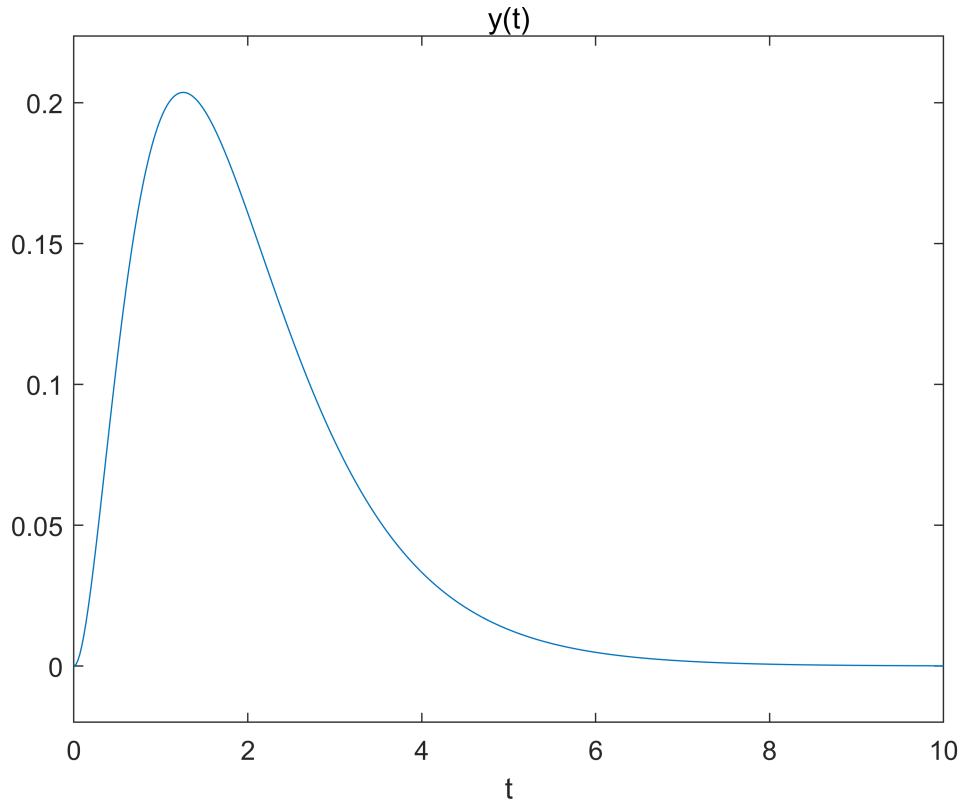
```
rc=[0,0];
sys=tf(b,a)
[A,B,C,D]=tf2ss(b,a)
subplot(3,1,1),initial(A,B,C,D,rc,t) %零输入响应
subplot(3,1,2),lsim(b,a,x,t)         %零状态响应
subplot(3,1,3),lsim(A,B,C,D,x,t,rc)  %全响应只能用状态系数来表示
    系统,
```



Symbolic method:

```
clear all
eq1 ='D2y+4*Dy+4*y=Dx+3*x' ;
eq2 = 'x=heaviside(t)*exp(-t)' ;
cond = 'y(-0.01)=0,Dy(-0.01)=0,D2y(-0.01)=0';
ans1 = dsolve( eq1,eq2,cond);
simplify(ans1.y);
ezplot(ans1.y,[0:0.01:10]) ;
```

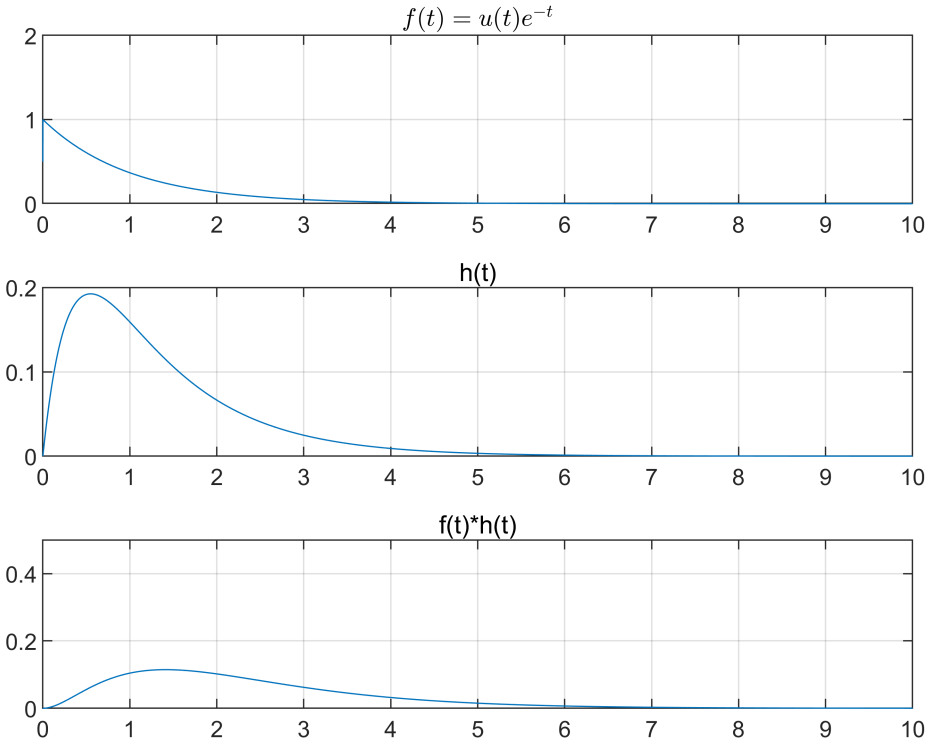
```
8 title('y(t)');
```



Convolution method:

```
1   clear all;
2   dt = 0.001 ;
3   t1 = 0:dt:10 ;
4   f1 = exp(-t1).*heaviside(t1);
5   t2 = t1 ;
6   b = [0 0 1] ;
7   a = [1 4 3] ;
8   [A B C D] = tf2ss(b,a) ;
9   sys = ss(A,B,C,D) ;
10  f2 = impulse(sys,t2) ;
11  [f,t] = ctsconv(f1,f2,t1,t2,dt) ;
12  subplot(3,1,1)
13  plot(t1,f1) ;
14  hold on;
```

```
15    axis([0,10,0,2])
16    grid on ;
17    title('$f(t) = u(t)e^{-t}$','Interpreter','Latex') ;
18    subplot(3,1,2)
19    plot(t2,f2) ;
20    grid on ;
21    title('h(t)') ;
22    subplot(3,1,3)
23    plot(t,f) ;
24    hold on;
25    axis([0,10,0,0.5])
26    grid on ;
27    title('f(t)*h(t)') ;
```



2 Problem 2

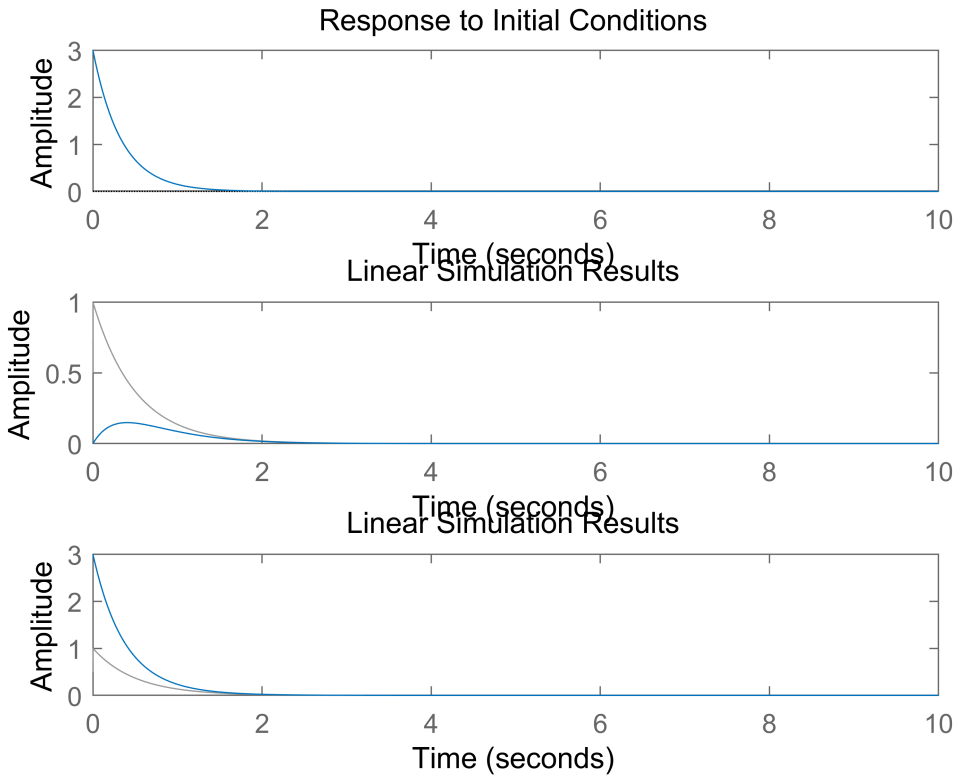
2.1 Description

Differential equations and excitation signals for known systems, zero-state response (with symbolism, numerical method, convolution integral method)

$$y''(t) + 4y'(t) + 3y(t) = f'(t) + f(t), f(t) = e^{-2t}u(t)$$
$$y(0) = 2, y'(0) = 1$$

Numberical method:

```
clear all;
a=[1 4 3];
b=[0 1 1];
t=0:0.001:10;
x=heaviside(t),*exp(-2*t);
rc=[2,1];
sys=tf(b,a)
[A,B,C,D]=tf2ss(b,a)
subplot(3,1,1),initial(A,B,C,D,rc,t) %零输入响应
subplot(3,1,2),lsim(b,a,x,t)          %零状态响应
subplot(3,1,3),lsim(A,B,C,D,x,t,rc)   %全响应只能用状态系数来表示
    系统,
```

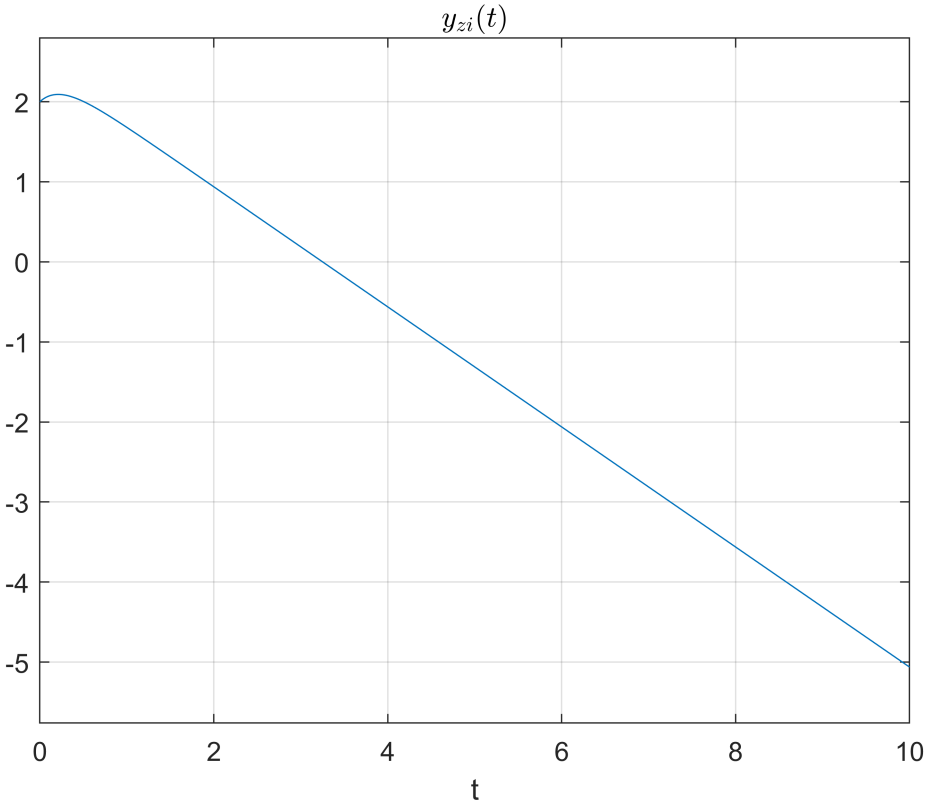


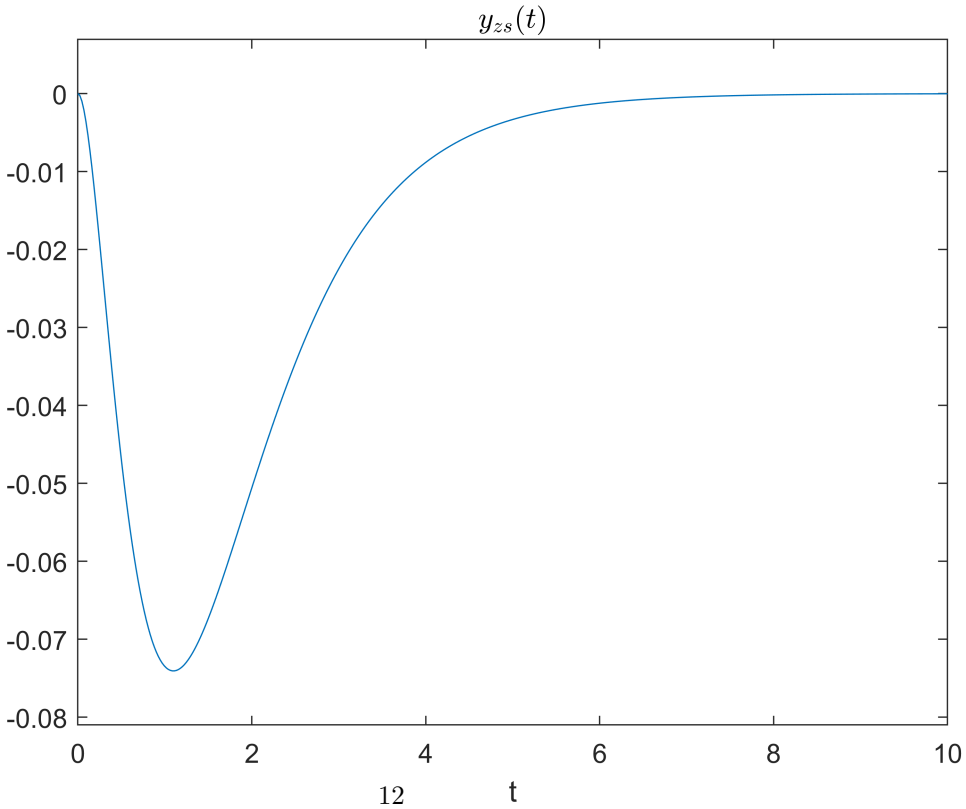
Symbolic method:

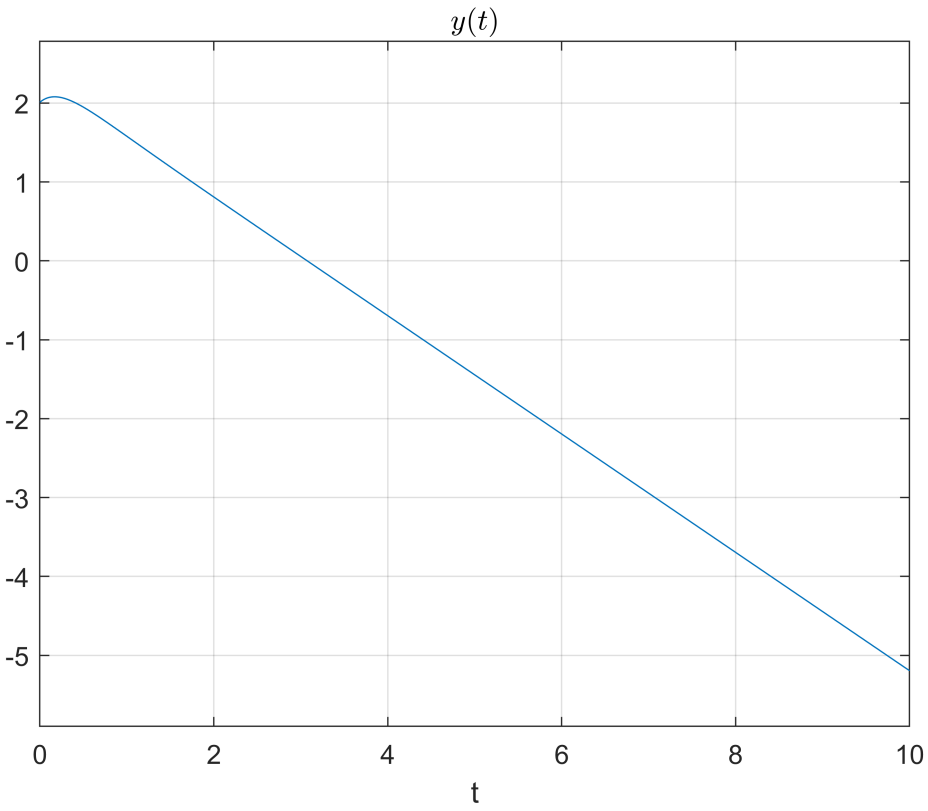
```
% 2
clear all
% 零状态
eq1 ='D2y+4*Dy+3*y=Dx+x' ;
eq2 = 'x=heaviside(t)*exp(-2*t)' ;
cond = 'y(-0.01)=0,Dy(-0.01)=0,D2y(-0.01)=0';
ans1 = dsolve( eq1,eq2,cond);
simplify(ans1.y);
ezplot(ans1.y,[0:0.01:10]) ;
title('y_{zs}(t)','Interpreter','Latex');

2
clear all;
%零输入响应
eq1_1 ='D2y+4*Dy+3=0' ;
cond_1 ='y(0)=2,Dy(0)=1';
yzi = dsolve(eq1_1,cond_1);
```

```
18    ezplot(yzi,[0:0.01:10])
19    title('$y_{zi}(t)$','Interpreter','Latex');
20    hold on;
21    grid on;
22    axis([0,10])
23
24
25    2
26    clear all;全响应响应
27
28    eq1_1 ='D2y+4*Dy+3=Dx+x';
29    eq2 = 'x=heaviside(t)*exp(-2*t)';
30    cond_1 ='y(-0.01)=2,Dy(-0.01)=1';
31    y = dsolve(eq1_1,eq2,cond_1);
32    ezplot(y.y,[0:0.01:10])
33    hold on;
34    grid on;
35    title('$y(t)$','Interpreter','Latex');
```


$y_{zi}(t)$
2
1
0
-1
-2
-3
-4
-5
0
2
4
6
8
10
t


$y_{zs}(t)$
0
-0.01
-0.02
-0.03
-0.04
-0.05
-0.06
-0.07
-0.08
0
2
4
6
8
10
t



3 Problem 3

3.1 Description

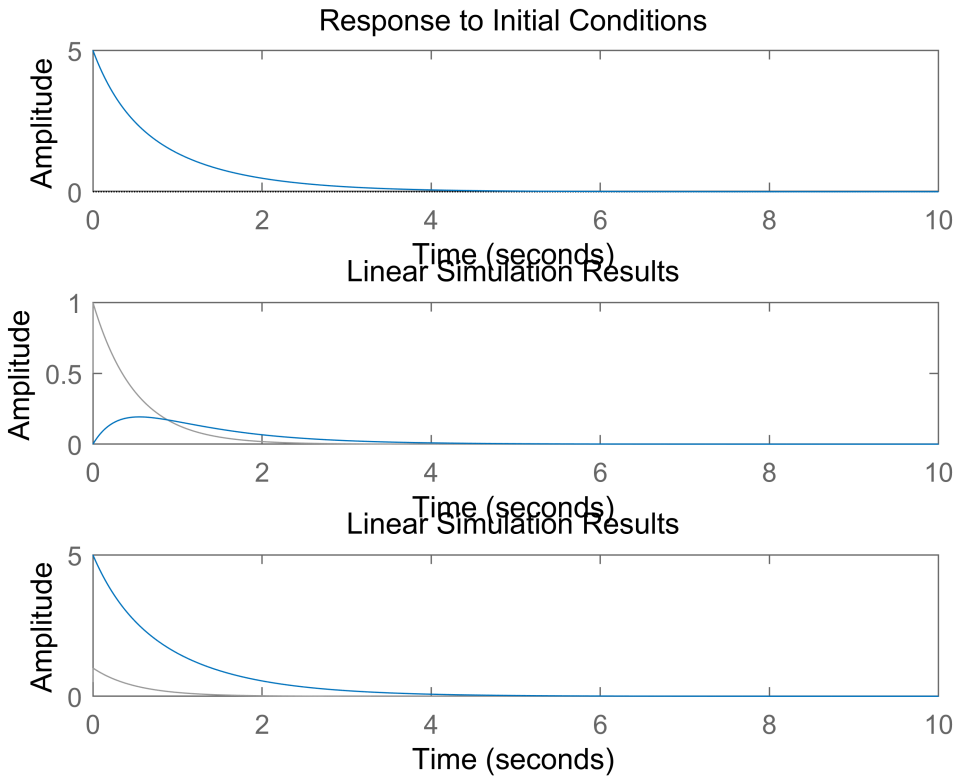
Differential equations and excitation signals for known systems, zero-state response (with symbolism, numerical method, convolution integral method)

$$y''(t) + 4y'(t) + 3y(t) = f'(t) + 2f(t), f(t) = e^{-2t}u(t)$$
$$y(0) = 2, y'(0) = 1$$

Numberical method:

```
clear all;
a=[1 4 3];
b=[0 1 2];
t=0:0.001:10;
x=heaviside(t).*exp(-2*t);
rc=[1,2];
```

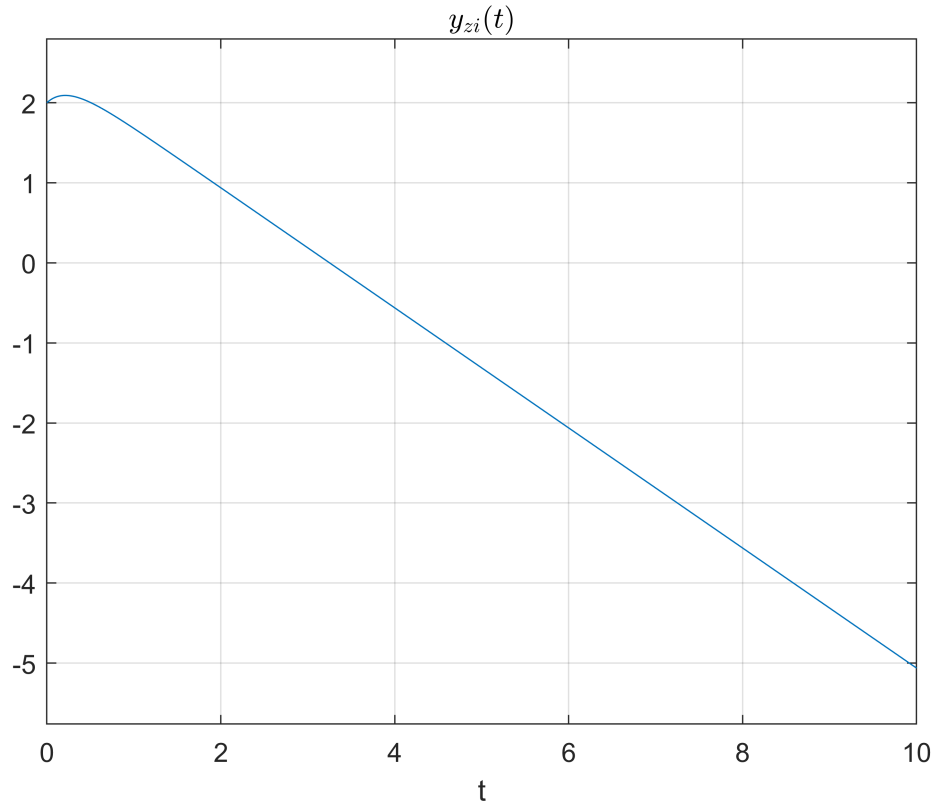
```
sys=tf(b,a)
[A,B,C,D]=tf2ss(b,a)
subplot(3,1,1),initial(A,B,C,D,rc,t) %零输入响应
subplot(3,1,2),lsim(b,a,x,t)         %零状态响应
subplot(3,1,3),lsim(A,B,C,D,x,t,rc)  %全响应只能用状态系数来表示
    系统,
```

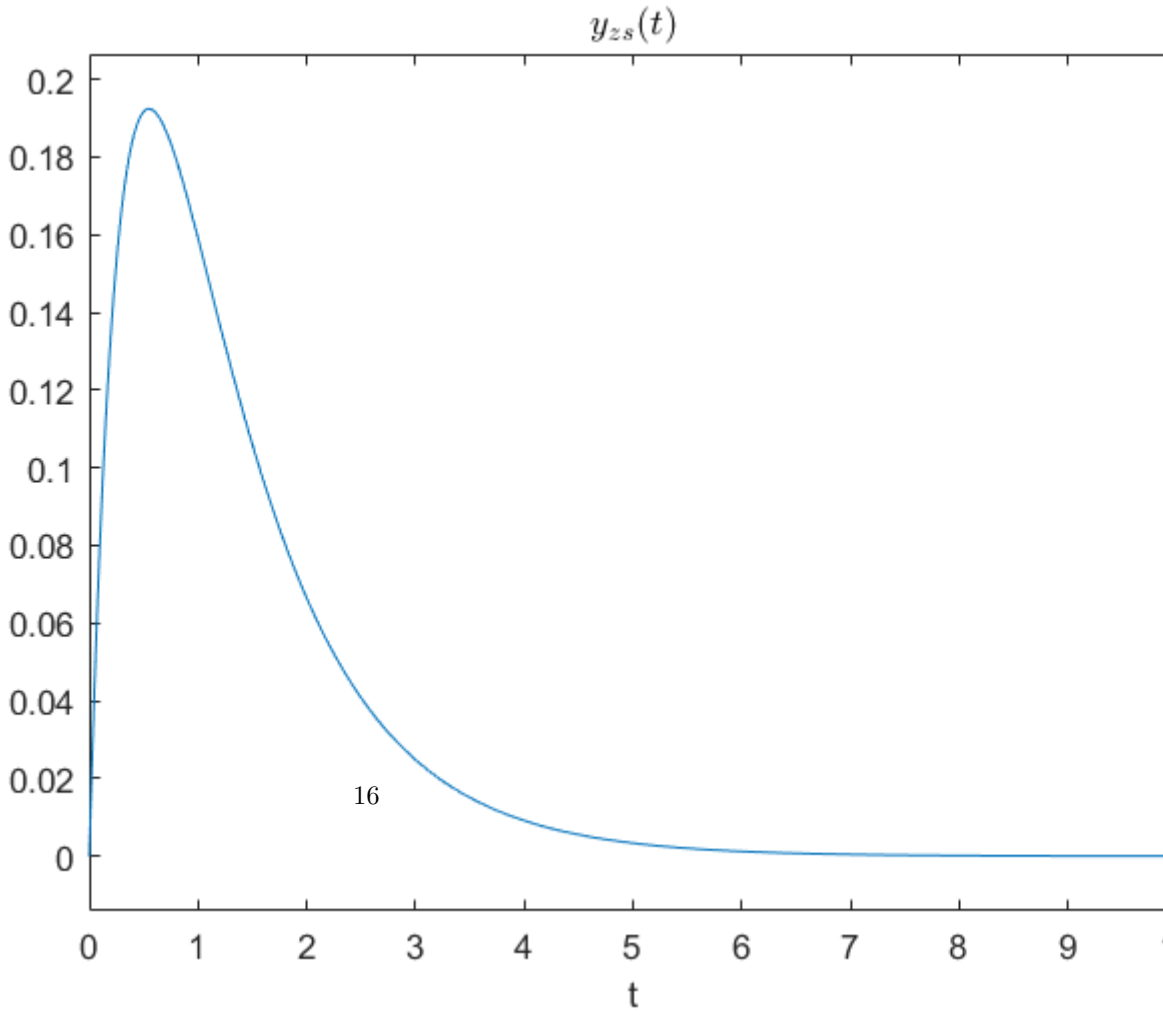


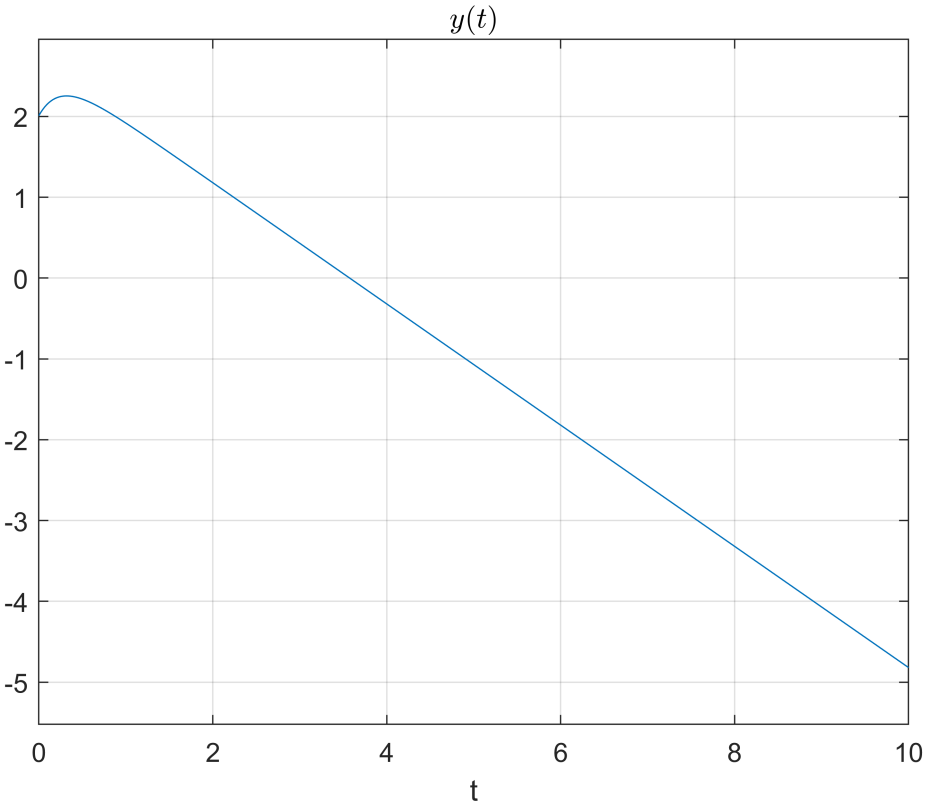
Symbolic method:

```
% 3
% 零状态
clear all
eq1 ='D2y+4*Dy+3*y=Dx+2*x' ;
eq2 = 'x=heaviside(t)*exp(-2*t)' ;
cond = 'y(-0.01)=0,Dy(-0.01)=0,D2y(-0.01)=0';
ans1 = dsolve( eq1,eq2,cond);
simplify(ans1.y);
ezplot(ans1.y,[0:0.01:10]) ;
```

```
10    title('$y_{zs}(t)$','Interpreter','Latex');
11
12    %3
13    clear all;
14    %零输入响应
15    eq1_1 ='D2y+4*Dy+3=0' ;
16    cond_1 ='y(0)=2,Dy(0)=1';
17    yzi = dsolve(eq1_1,cond_1);
18    ezplot(yzi,[0:0.01:10])
19    hold on;
20    title('$y_{zi}(t)$','Interpreter','Latex');
21    grid on;
22
23    %3
24    clear all;
25    %全响应响应
26    eq1_1 ='D2y+4*Dy+3=Dx+2*x';
27    eq2 = 'x=heaviside(t)*exp(-2*t)';
28    cond_1 ='y(-0.01)=2,Dy(-0.01)=1';
29    ans = dsolve(eq1_1,eq2,cond_1);
30    ezplot(ans.y,[0:0.01:10])
31    title('$y(t)$','Interpreter','Latex');
32    hold on;
33    grid on;
```


$y_{zi}(t)$
2
1
0
-1
-2
-3
-4
-5
0
2
4
6
8
10
t


$y_{zs}(t)$
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0
1
2
3
4
5
6
7
8
9
t



4 Problem 4

4.1 Description

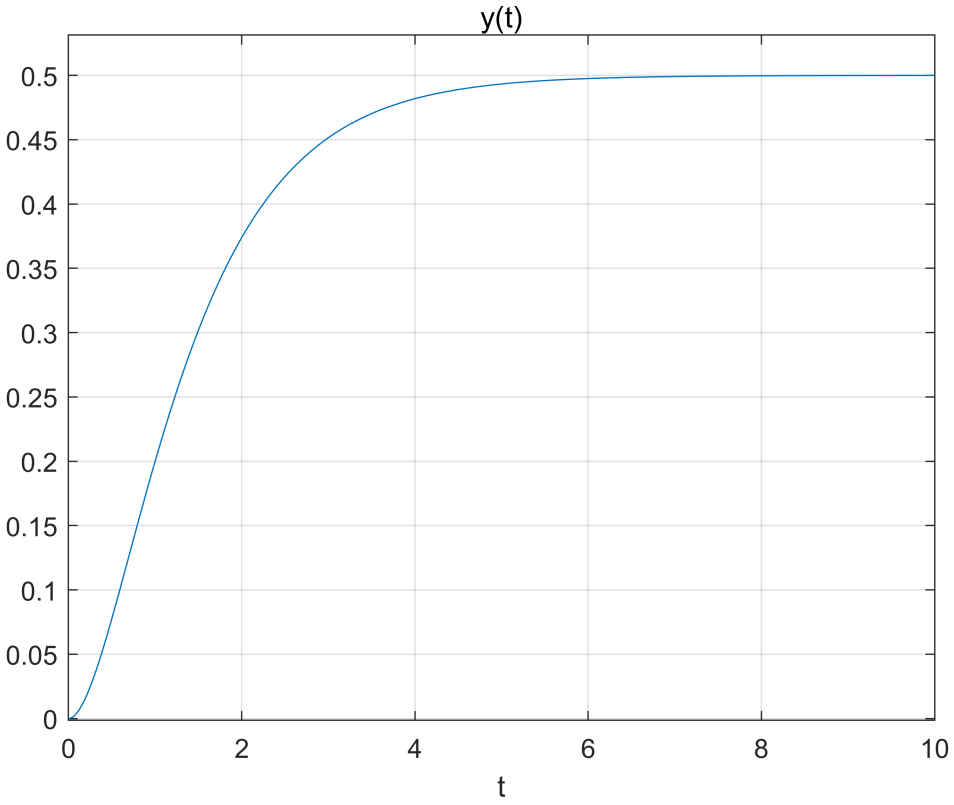
Differential equations for known systems, unit impulse response and unit step response

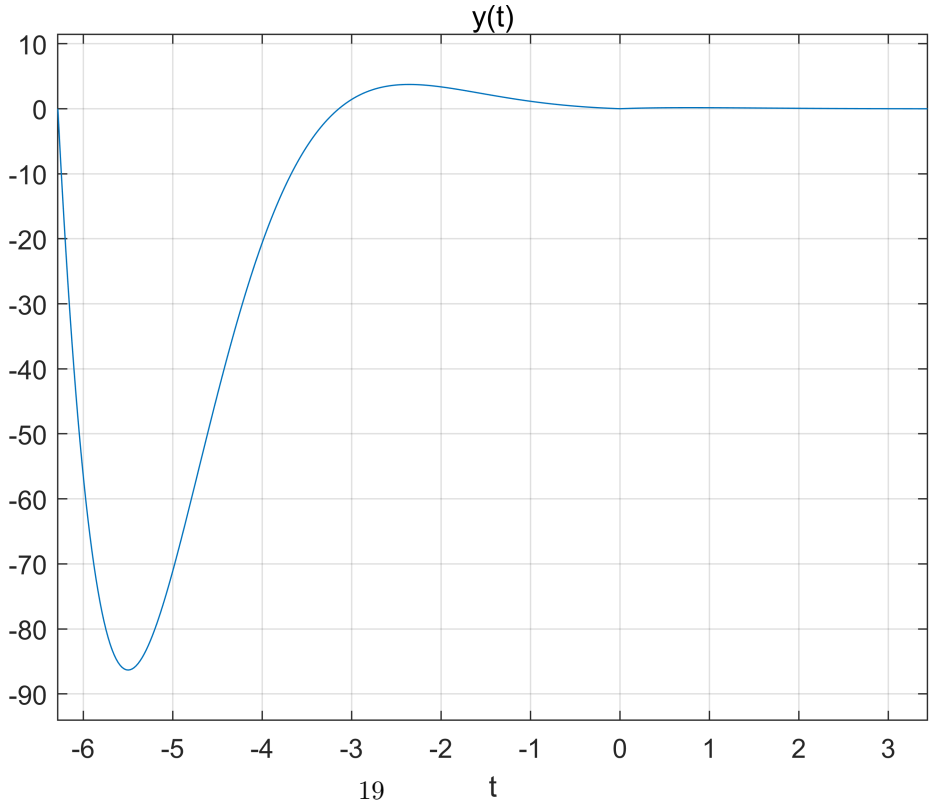
$$y''(t) + 3y'(t) + 2y(t) = f(t)$$
$$y''(t) + 2y'(t) + 2y(t) = f'(t)$$

Symbolic method:

```
4-1
clear all
eq1 ='D2y+3*Dy+2*y=heaviside(t)' ;
cond = 'y(-0.01)=0,Dy(-0.01)=0,D2y(-0.01)=0';
ans1 = dsolve(eq1,cond);
simplify(ans1);
```

```
7     ezplot(ans1,[0:0.01:10]);
8     hold on;
9     grid on;
10    title('y(t)')
11
12    % 4-2
13    clear all
14    eq1 ='D2y+2*Dy+2*y=dirac(t)';
15    cond = 'y(0)=0,Dy(0)=0';
16    ans1 = dsolve(eq1,cond);
17    ezplot(ans1);
18    grid on;
19    title('y(t)')
```


y(t)
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
2
4
6
8
10
t


y(t)
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-6
-5
-4
-3
-2
-1
0
1
2
3
t