信号作业（4）

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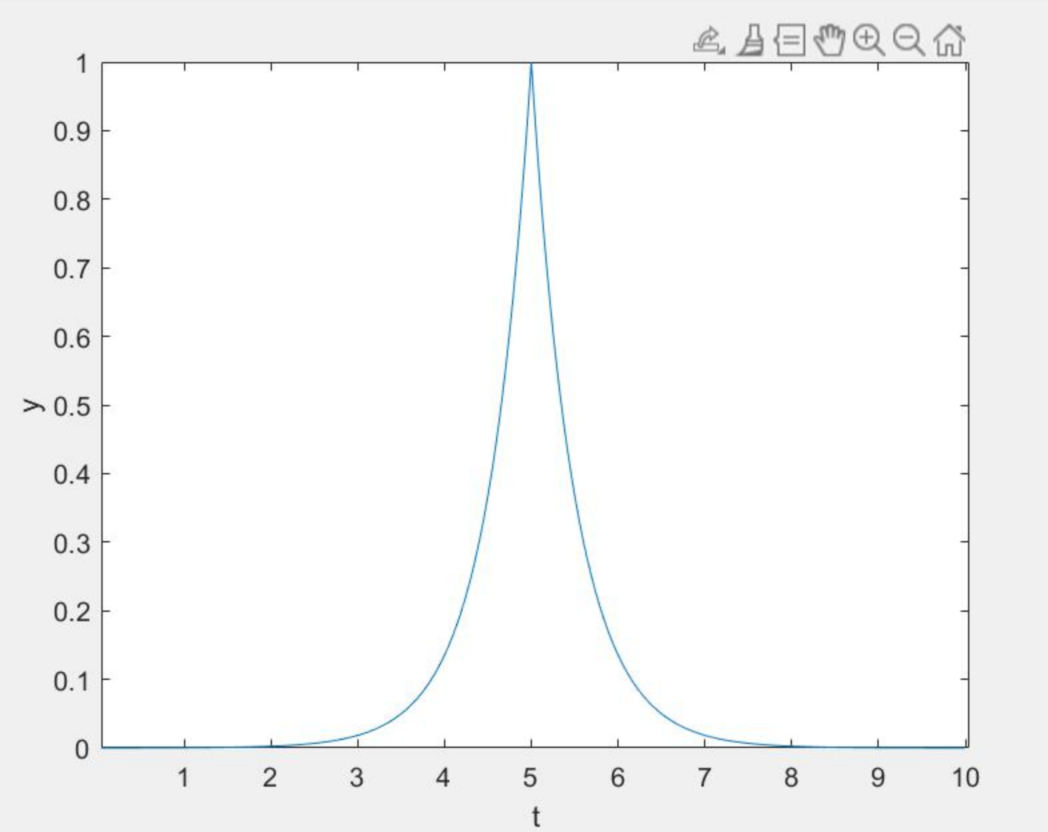
4.2（a）

- 令x(t) = g(t) + g(-t)，g(t) = exp（-2t）u(t)。则 $X1(jw) = \frac{1}{2+j\omega}$
- g（-t）= X2（-jw）= $\frac{1}{2-j\omega}$
- 所以，$X(jw) = \frac{1}{2+j\omega} + \frac{1}{2-j\omega} = \frac{4}{4+\omega^2}$

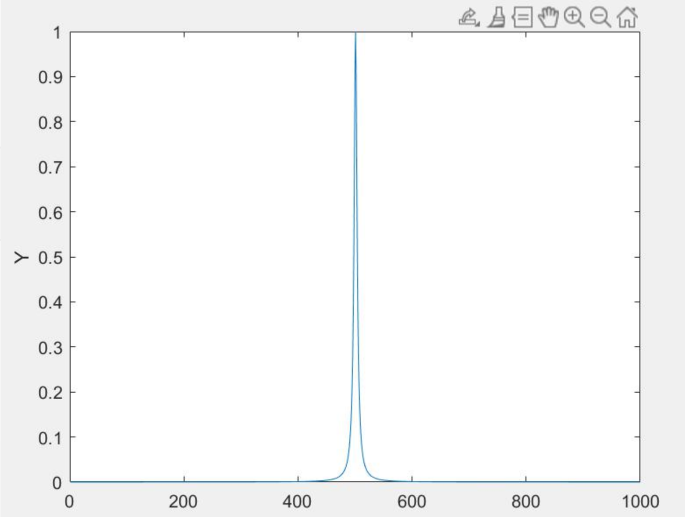
4.2（b）

```
tau=0.01;
T=10;
t=[0:tau:T-tau];
N=T/tau;
n=t/tau;
yt=exp(-2*abs(t-5));
for i = [1:N]
    y(i) = exp(-2*abs(tau.*(i-1)-5));
end
plot(t,y);
```



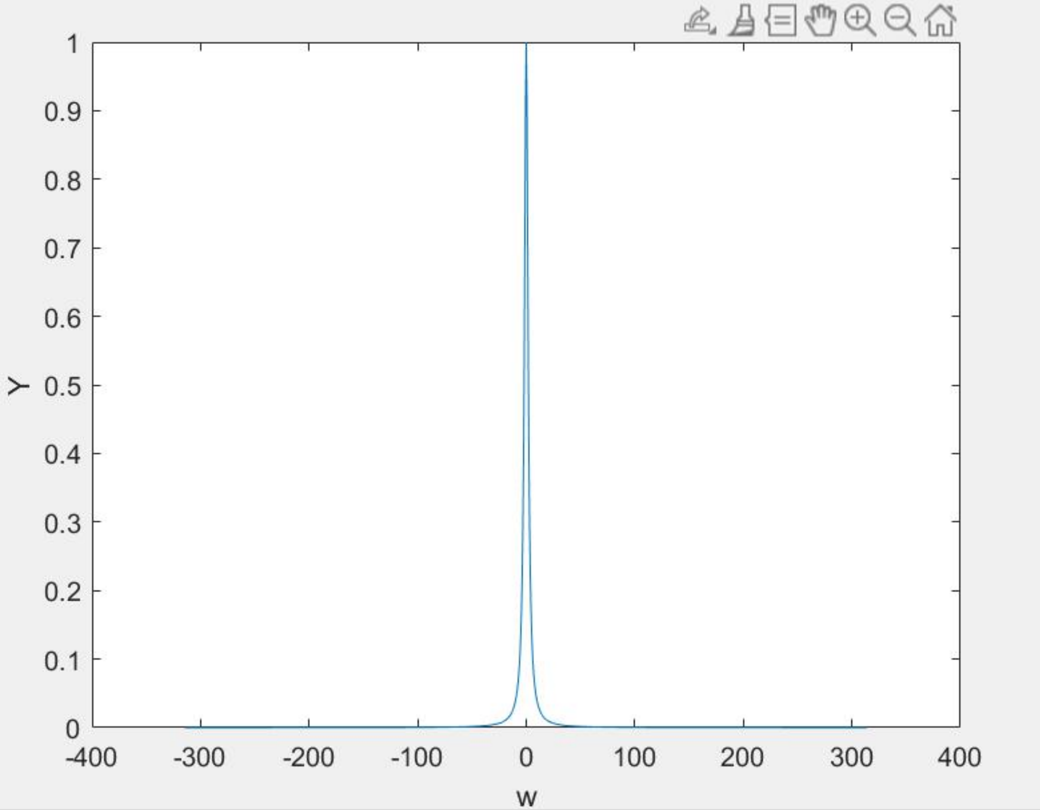
4.2（c）

```
Y = fftshift(tau*fft(y));
plot(Y);
```



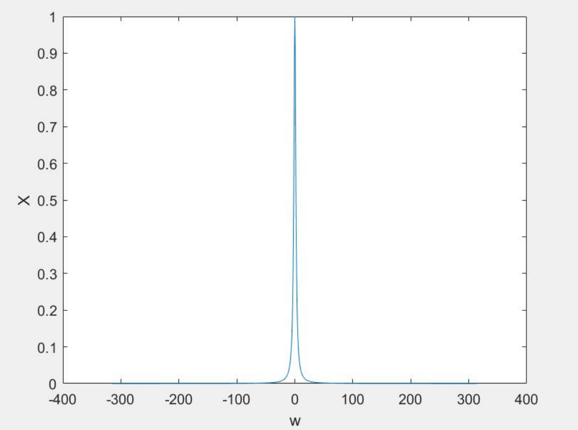
4.2（d）

```
w=-(pi/tau)+(0:N-1)*(2*pi/(N*tau));
plot(w,abs(Y));
```



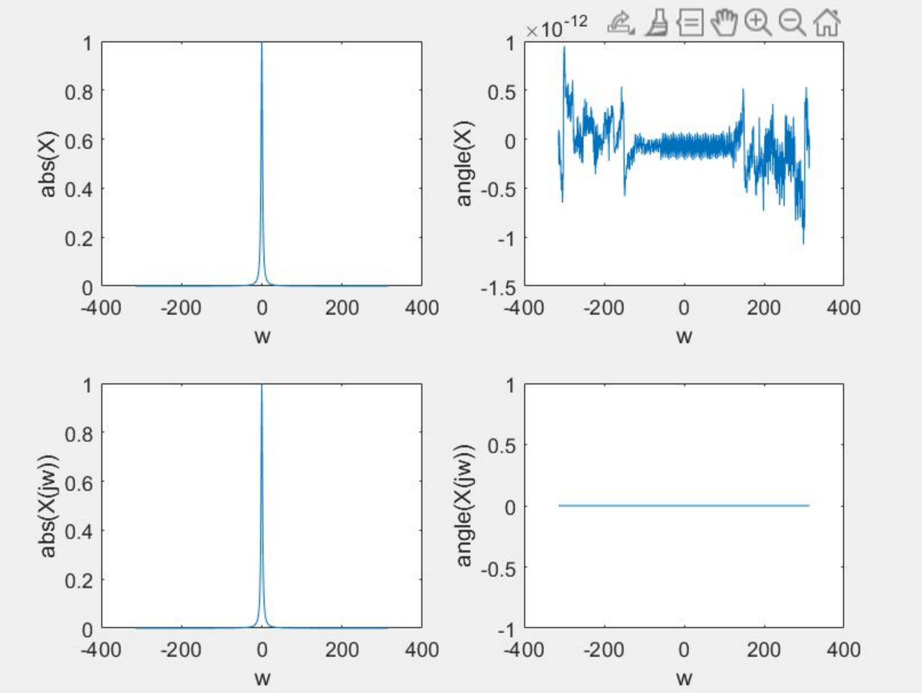
4.2 (e)

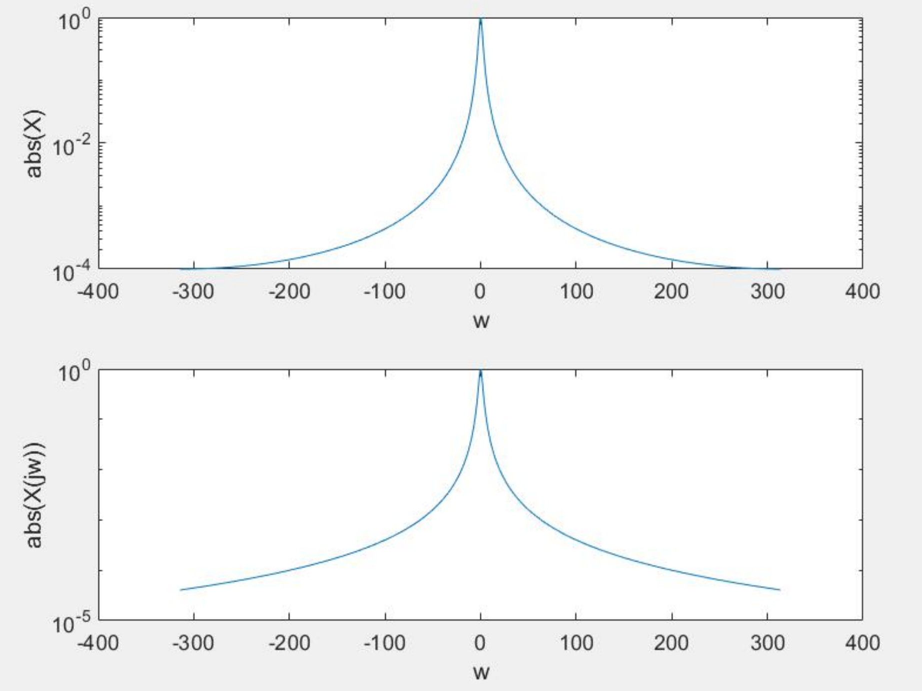
```
X = Y.*exp(1j*5*w);
plot(w,abs(X));
```



4.2 (f)

```
subplot(2,2,1), plot(w,abs(X));
subplot(2,2,2), plot(w,unwrap(angle(X)));
subplot(2,2,3), plot(w,abs(1./(2+1j*w)+1./(2-1j*w)));
subplot(2,2,4), plot(w,angle(1./(2+1j*w)+1./(2-1j*w)));
figure;subplot(2,1,1), semilogy(w,abs(X));
subplot(2,1,2), semilogy(w,abs(1./(2+1j*w)+1./(2-1j*w)));
```

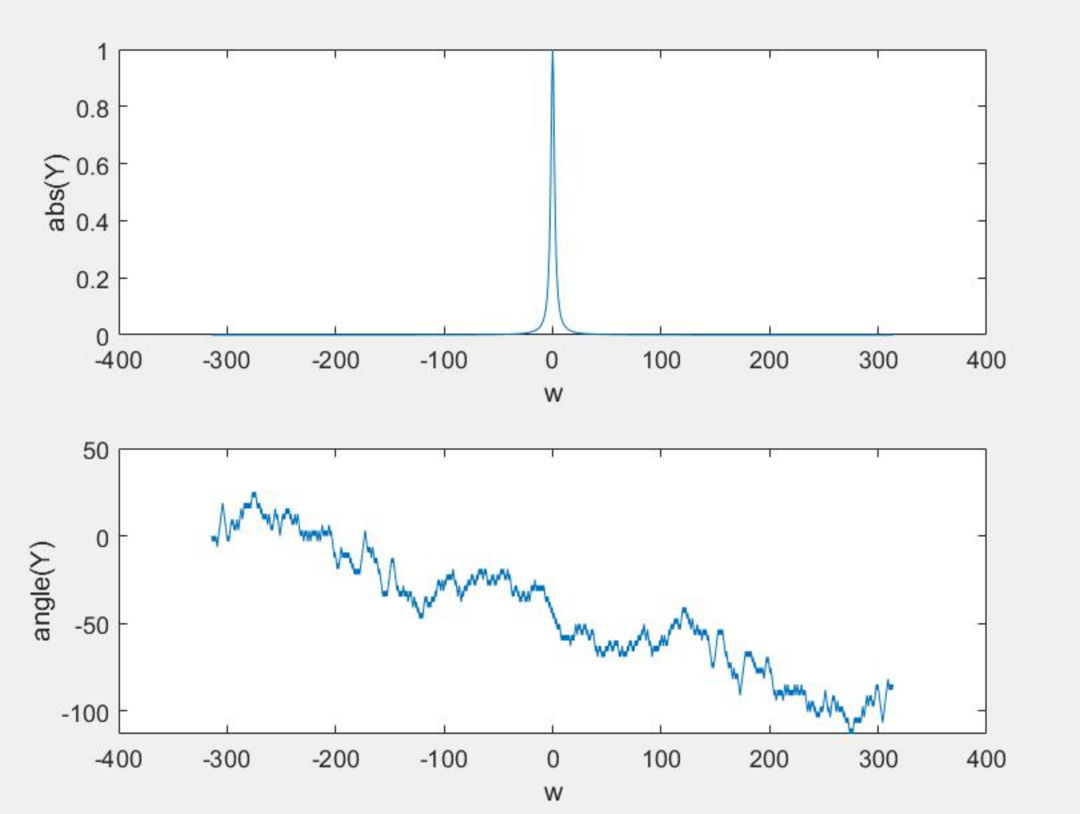




4.2（g）

```
figure;subplot(2,1,1), plot(w,abs(Y));
subplot(2,1,2), plot(w,unwrap(angle(Y)));
```

Y与X的大小相等，角度相差为5w。（由于T的取值，只有在低频时符合预测，Y的角度是一条斜线。）



4.5（a）

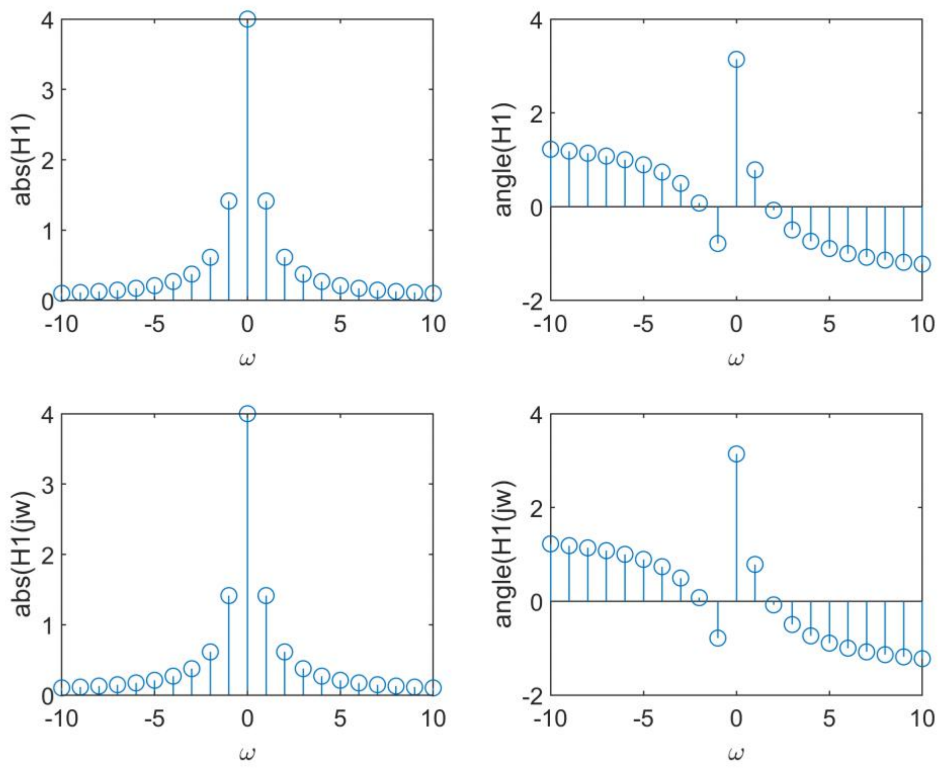
```
b1=[1,-2];
a1=[1,1.5,0.5];
[r,p,k]=residue(b1,a1)
```

```
r = 2×1
     6
    -5
p = 2×1
   -1.0000
   -0.5000
k =

     []
```

4.5（b）

```
b1=[1,-2];
a1=[1,1.5,0.5];
[r1,p1]=residue(b1,a1);
w=(-10:1:10);
H1=0;
for c=1:length(r1)
    H1=H1+r1(c)./(i*w-p1(c));
end
subplot(2,2,1),stem(w,abs(H1)),xlabel('\omega'),ylabel('abs(H1)');
subplot(2,2,2),stem(w,angle(H1)),xlabel('\omega'),ylabel('angle(H1)');
H1jw=(i*w-2)./((i*w).^2+(i*w)*1.5+0.5);
subplot(2,2,3),stem(w,abs(H1jw)),xlabel('\omega'),ylabel('abs(H1(jw)');
subplot(2,2,4),stem(w,angle(H1jw)),xlabel('\omega'),ylabel('angle(H1(jw)');
```




```
%the first two pictures are FT of frequency response which was calculated
%by r1 and p1,while the last two pictures are calculated by a1 and b1
```

4.5（c）

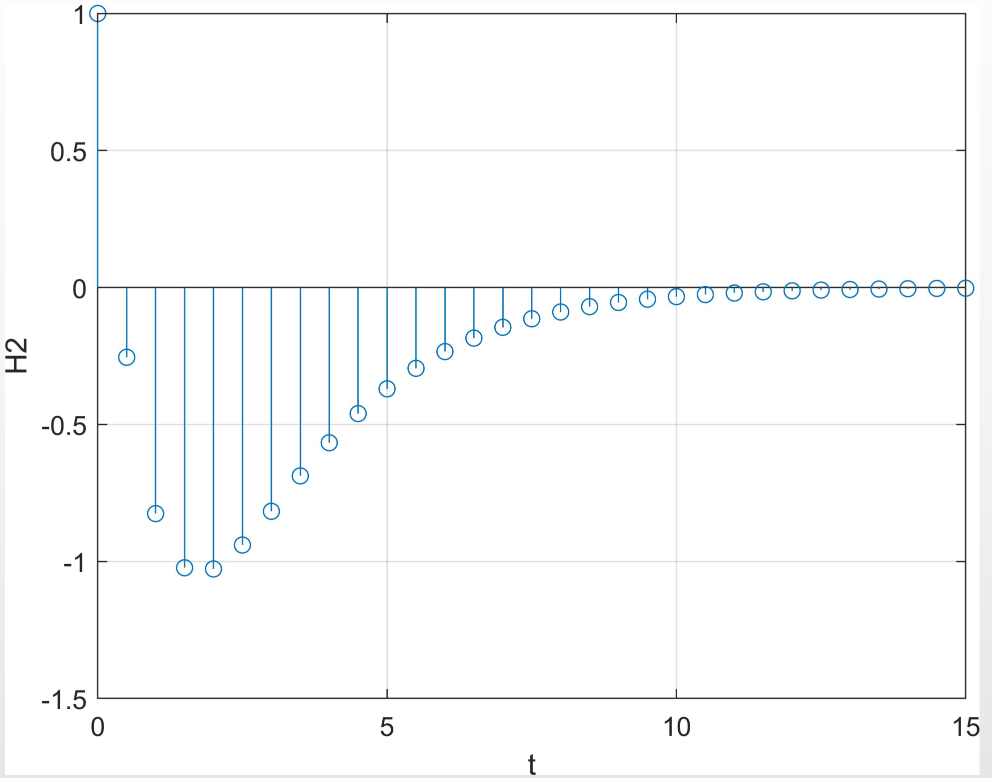
```
b1=[1,-2];
a1=[1,1.5,0.5];
[r1,p1]=residue(b1,a1);
H2=0;
t=[0:0.5:15]
```

```
t = 1×31
        0    0.5000    1.0000    1.5000    2.0000    2.5000    3.0000    3.5000 ···
```

```
for d=1:length(r1)
    H2=H2+r1(d).*exp(p1(d).*t)
end
```

```
H2 = 1×31
    6.0000    3.6392    2.2073    1.3388    0.8120    0.4925    0.2987    0.1812 ···
H2 = 1×31
    1.0000   -0.2548   -0.8254   -1.0231   -1.0274   -0.9400   -0.8169   -0.6877 ···
```

```
stem(t,H2);xlabel('t'),ylabel('H2');grid on;
```



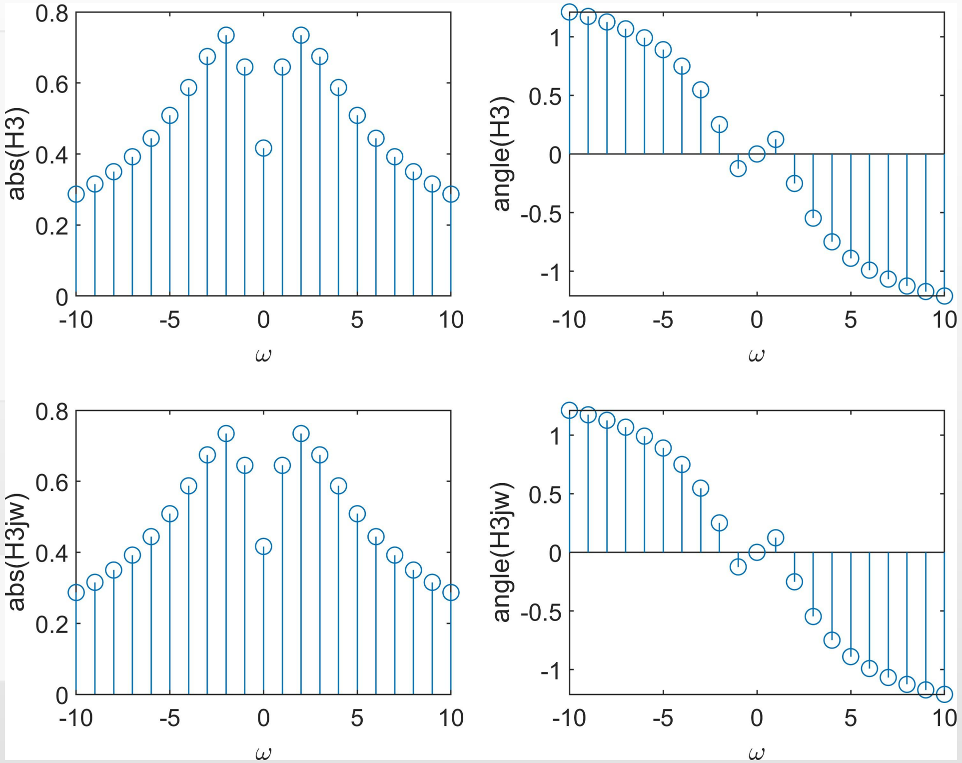

```
%from the picture, we can know that the value at every point is finite and
%h1(t) is convergent,so h1(t) is absolutely integrable.
```

4.5（d）

```
b2=[3,10,5];
a2=[1,7,16,12];
```

4.5（e）

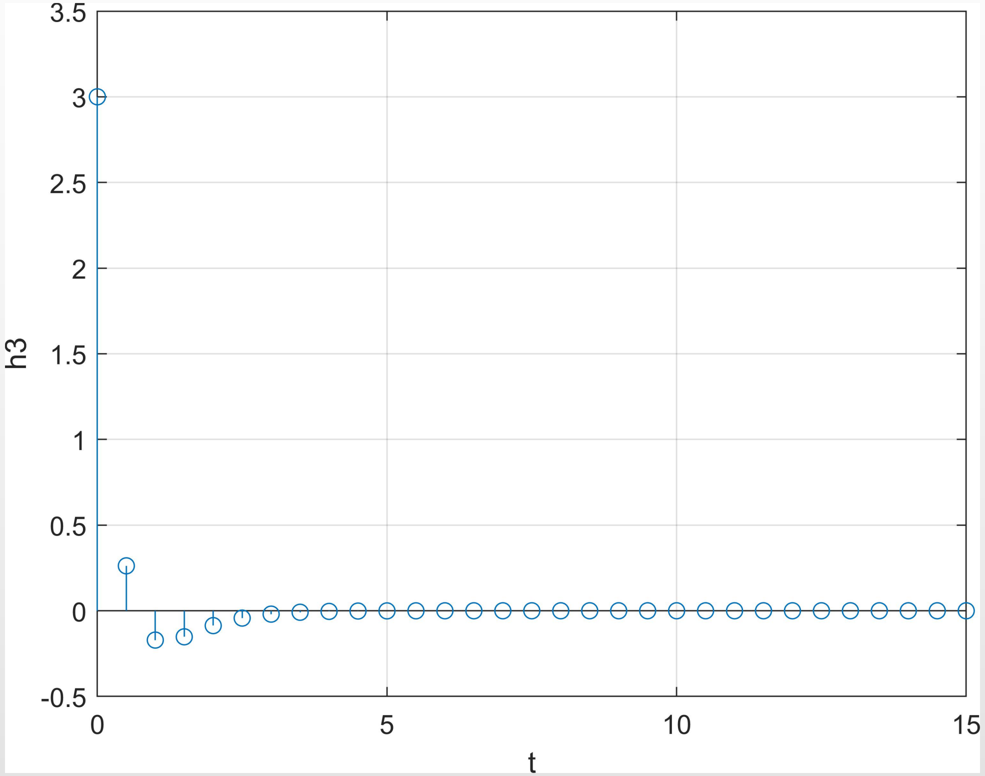
```
b2=[3,10,5];
a2=[1,7,16,12];
[r2,p2]=residue(b2,a2);
w2=[-10:1:10];
H3=r2(1)./(1i*w2-p2(1))+r2(2)./(1i*w2-p2(2))+r2(3)./((1i*w2-p2(3)).^2);
subplot(2,2,1),stem(w2,abs(H3)),xlabel('\omega'),ylabel('abs(H3)');
subplot(2,2,2),stem(w2,angle(H3)),xlabel('\omega'),ylabel('angle(H3)');
H3jw=(3*((1i.*w2).^2)+10*(1i.*w2)+5)./((1i.*w2).^3+7*((1i.*w2).^2)+16*(1i.*w2)+12);
subplot(2,2,3),stem(w2,abs(H3jw)),xlabel('\omega'),ylabel('abs(H3jw)');
subplot(2,2,4),stem(w2,angle(H3jw)),xlabel('\omega'),ylabel('angle(H3jw)');
```




```
%the first two pictures are FT of frequency response which was calculated
%by r1 and p1,while the last two pictures are calculated by a1 and b1
%we can know they are the same
```

4.5 (f)

```
b2=[3,10,5];
a2=[1,7,16,12];
[r2,p2]=residue(b2,a2);
t=[0:0.5:15];
h3=r2(1).*exp(p2(1).*t)+r2(2).*exp(p2(2).*t)+r2(3).*exp(p2(3).*t).*t;
stem(t,h3);xlabel('t'),ylabel('h3');grid on;
```



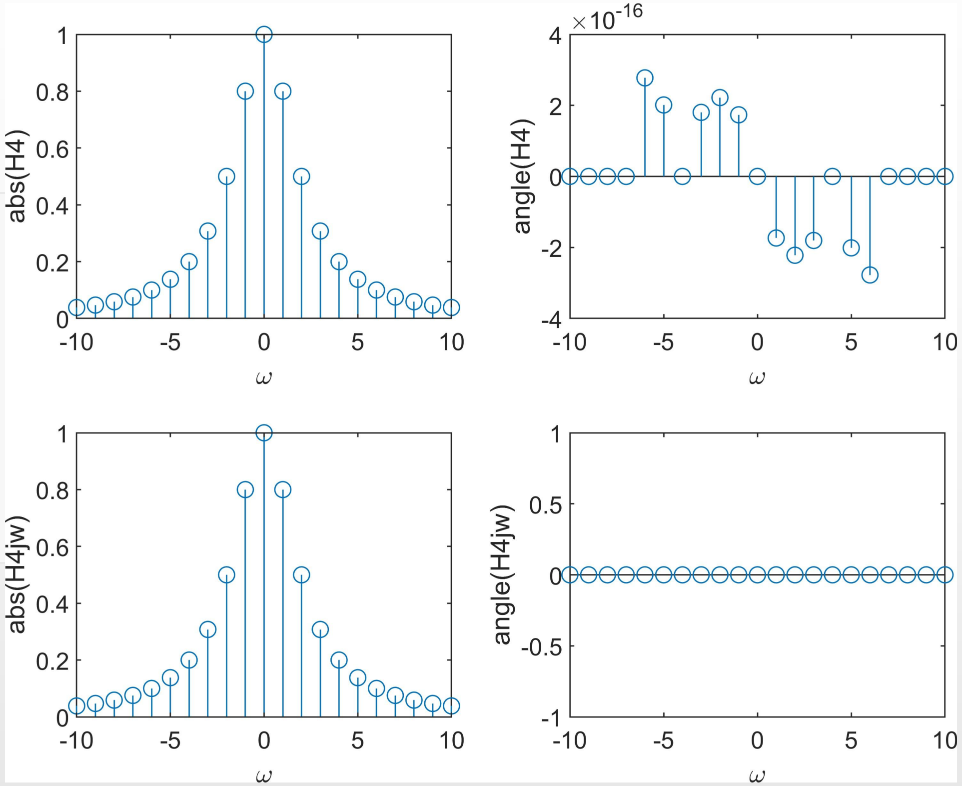

```
%from the picture, we can know that the value at every point is finite and
%h2(t) is convergent,so h2(t) is absolutely integrable.
```

4.5（g）

```
b3=[-4];
a3=[1,0,-4];
```

4.5（h）

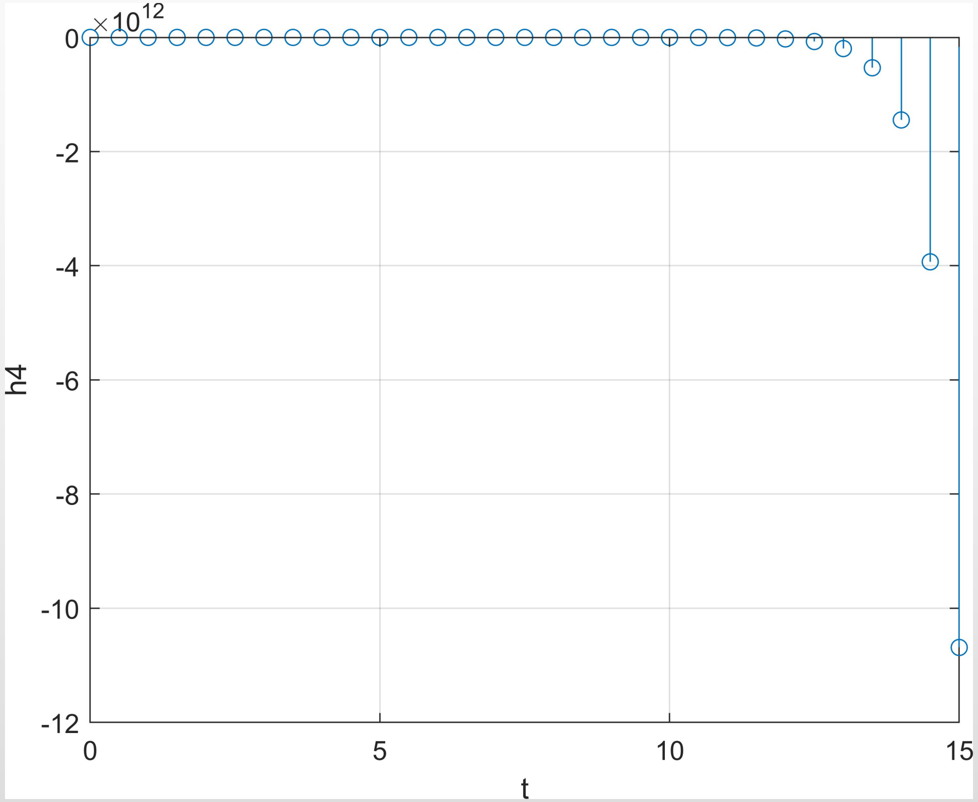
```
b3=[-4];
a3=[1,0,-4];
[r3,p3]=residue(b3,a3);
w3=[-10:1:10];
H4=r3(1)./((1i*w3)-p3(1))+r3(2)./((1i*w3)-p3(2));
subplot(2,2,1),stem(w3,abs(H4)),xlabel('\omega'),ylabel('abs(H4)');
subplot(2,2,2),stem(w3,angle(H4)),xlabel('\omega'),ylabel('angle(H4)');
H4jw=(-4)./((1i*w3).^2-4);
subplot(2,2,3),stem(w3,abs(H4jw)),xlabel('\omega'),ylabel('abs(H4jw)');
subplot(2,2,4),stem(w3,angle(H4jw)),xlabel('\omega'),ylabel('angle(H4jw)');
```




```
%From the second picture,we can know that the value at every point is so
%small that we can ignore them.So the pictures are approximately the same
%for the two function.
```

4.5（i）

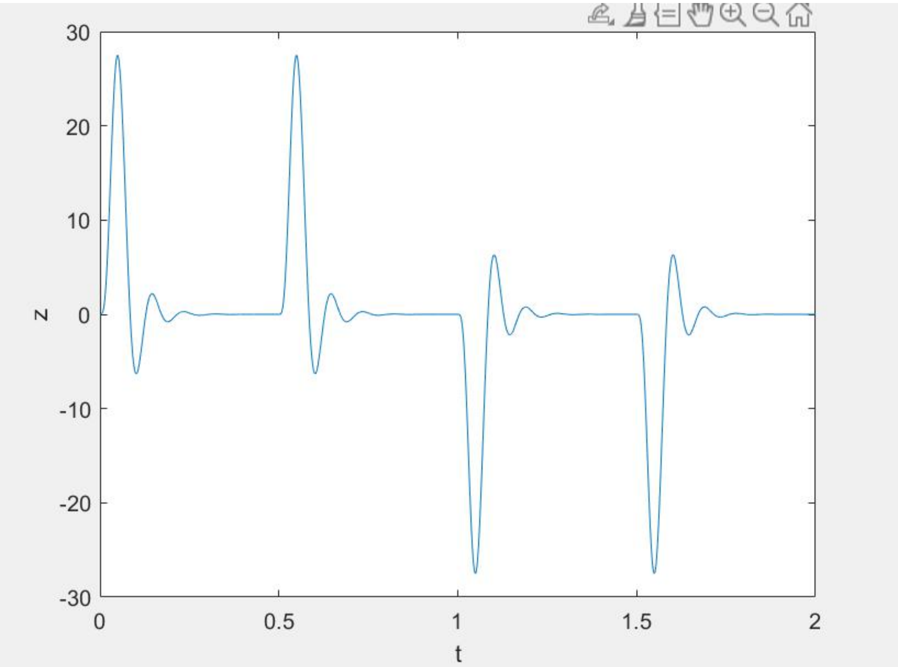
```
b3=[-4];
a3=[1,0,-4];
[r3,p3]=residue(b3,a3);
t=[0:0.5:15];
h4=r3(1).*exp(p3(1).*t)+r3(2).*exp(p3(2).*t);
stem(t,h4);xlabel('t'),ylabel('h4');grid on;
```



%对于这问，我有疑惑，从理论上算 h3(t)应该为 exp(-2*t)*u(t)-exp(2*t)*u(t),不收敛，不可积

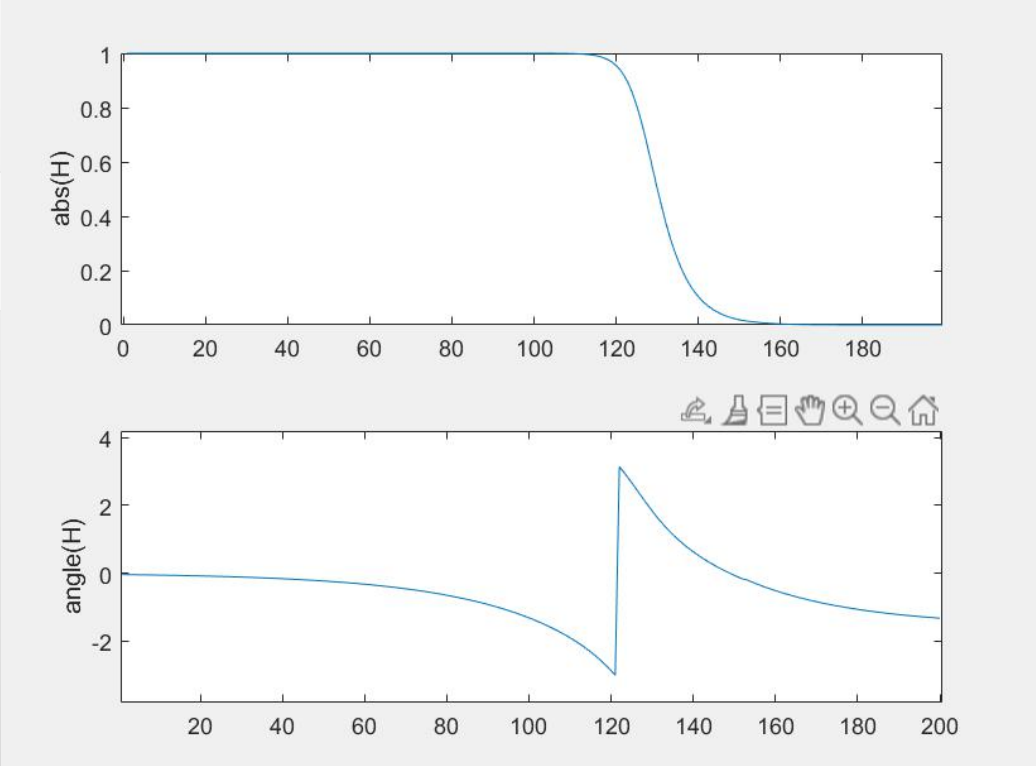
4.6（a）

```
z = [dash dash dot dot];
plot(t,z);
```



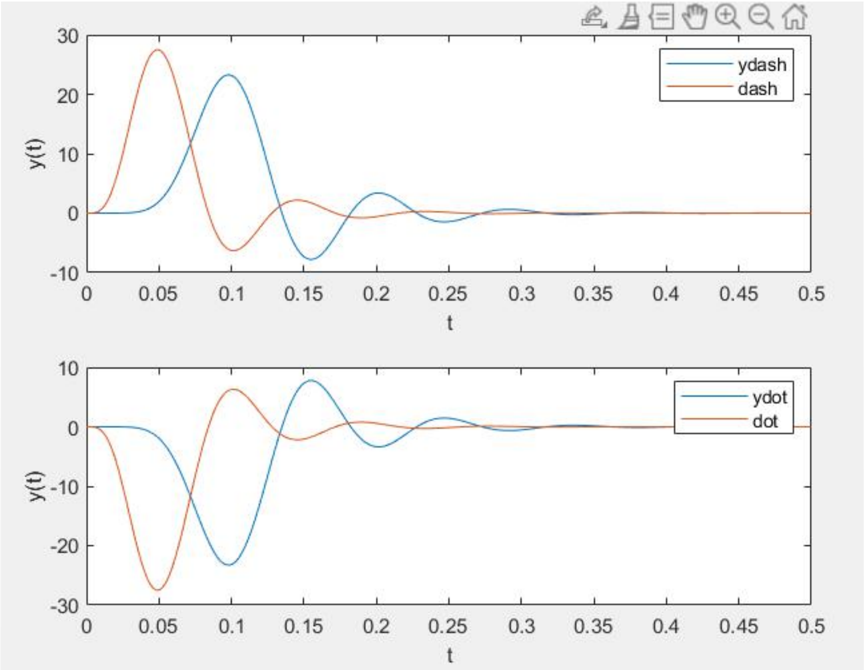
4.6（b）

```
H =  freqs(bf,af);
figure;subplot(2,1,1), plot(abs(H));
subplot(2,1,2), plot(angle(H));
```



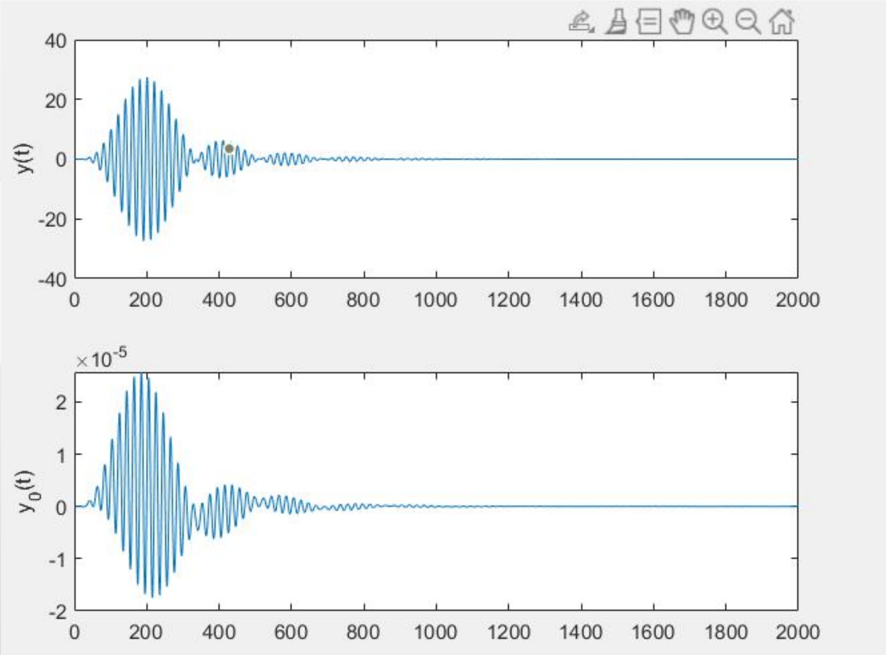
4.6（c）

```
ydash=lsim(bf,af,dash,t(1:length(dash)));
ydot=lsim(bf,af,dot,t(1:length(dot)));
subplot(2,1,1),plot(t(1:length(dash)),ydash),xlabel('t');
hold on;plot(t(1:length(dash)),dash);legend('ydash','dash');
subplot(2,1,2),plot(t(1:length(dot)),ydot),xlabel('t'),ylabel('y(t)');
hold on;plot(t(1:length(dot)),dot);legend('ydot','dot');
```



4.6（d）

```
y=dash.*cos(2*pi*f1*t(1:length(dash)));
y0=lsim(bf,af,y,t(1:length(dash)));
subplot(2,1,1),plot(y),ylabel('y(t)');
subplot(2,1,2),plot(y0),ylabel('y_0(t)');
```



y0（t）中的能量几乎为零，和预计一样。

4.6（e）

$$X_1(j\omega) = \frac{1}{4}M\big(j(\omega - 4\pi f_1)\big) + \frac{1}{2}M(j\omega) + \frac{1}{4}M\big(j(\omega + 4\pi f_1)\big)$$

$$X_2(j\omega) = \frac{1}{4j}M\big(j(\omega - 4\pi f_1)\big) - \frac{1}{4j}M\big(j(\omega + 4\pi f_1)\big)$$

$$X_3(j\omega) = \frac{1}{4}M\big(j(\omega - 2\pi f_1 - 2\pi f_2)\big) + \frac{1}{4}M\big(j(\omega + 2\pi f_1 - 2\pi f_2)\big) + \frac{1}{4}M\big(j(\omega - 2\pi f_1 + 2\pi f_2)\big) + \frac{1}{4}M\big(j(\omega + 2\pi f_1 + 2\pi f_2)\big)$$

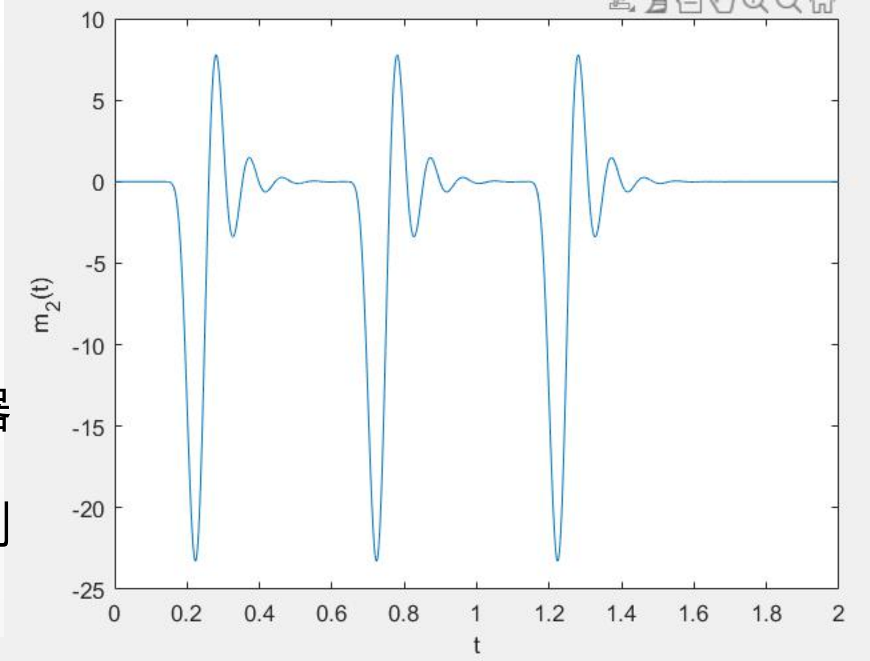
A tip: $$X_4(j\omega) = -\frac{1}{4}M\big(j(\omega - 4\pi f_1)\big) + \frac{1}{2}M(j\omega) - \frac{1}{4}M\big(j(\omega + 4\pi f_1)\big)$$

4.6（f&g）

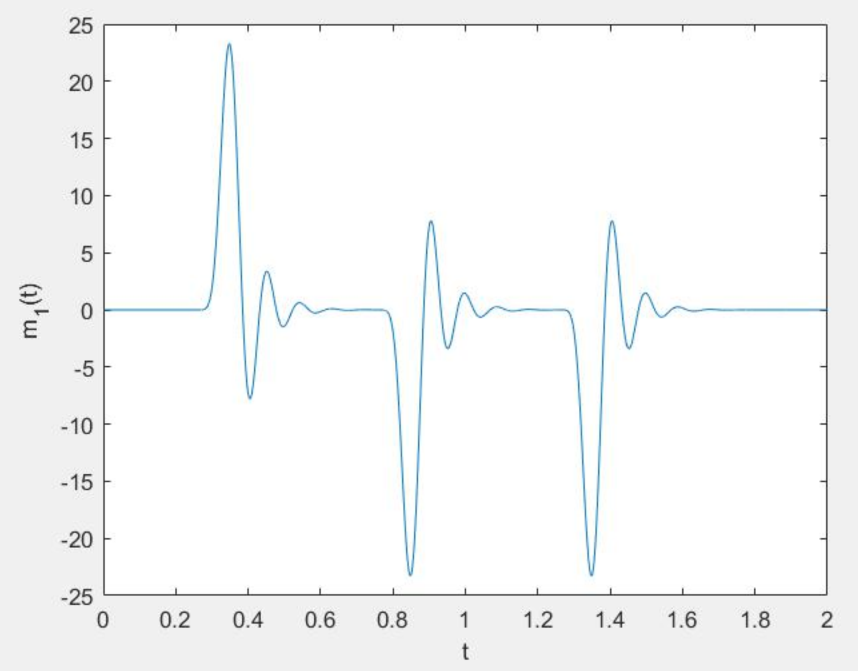
```
x0=x.*cos(2*pi*f1*t(1:length(x)));
m1=2*lsim(bf,af,x0,t);
figure;plot(t,m1),xlabel('t'),ylabel('m_1(t)');
m2=4i*lsim(bf,af,exp(1i*2*pi*(f1-f2)*t).*x0,t);
figure;plot(t,m2),xlabel('t'),ylabel('m_2(t)');
m3=4i*(lsim(bf,af,exp(-1i*4*pi*f1*t).*x0,t)-0.25*m1);
figure;plot(t,m3),xlabel('t'),ylabel('m_3(t)');
```

通过移动x，
使其在经过滤波器
后得到相应的值，
再利用各自的比例
系数求解。

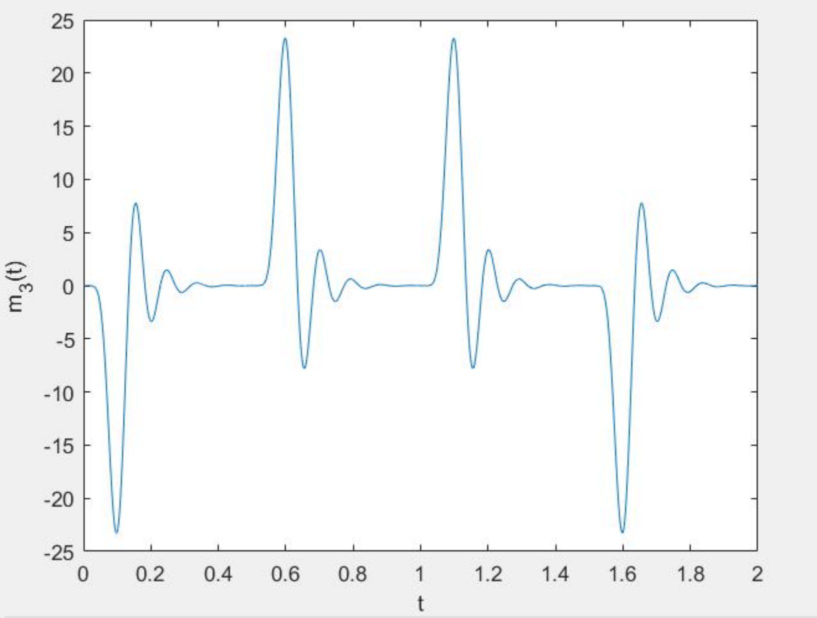
DSP！



S



D



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