

# Lab6 作业分析

# 第一题

## 一.原题目

1.  $F(s) = \frac{s^3 + 5s^2 + 9s + 7}{s^2 + 3s + 2}$ , find out the inverse Laplace transform of  $F(s)$ .

## 二.常见错误

### 1. 原题目公式输入错误

## 三.参考代码和运行结果

1.  $F(s) = \frac{s^3 + 5s^2 + 9s + 7}{s^2 + 3s + 2}$ , find out the inverse Laplace transform of  $F(s)$ .

```
% method 1
clear;clf;
syms s
F=(s^3+5*s^2+9*s+7)/(s^2+3*s+2);
ilaplace(F)
```

ans =  $2e^{-t} - e^{-2t} + 2\delta(t) + \delta'(t)$

```
% method 2
a = [1 5 9 7];
b = [1 3 2];
[k, p, c] = residue(a,b);
F = s+2-1/(s+2)+2/(s+1);
ilaplace(F)
```

ans =  $2e^{-t} - e^{-2t} + 2\delta(t) + \delta'(t)$

#### 四.优秀作答

```
clear;clf;  
syms s  
F = (s^3+5*s^2+9*s+7)/(s^2+3*s+2);  
ft = ilaplace(F)
```

$$ft = 2e^{-t} - e^{-2t} + 2\delta(t) + \delta'(t)$$

# 第二题

## 一.原题目

2.  $y''(t) + 4y'(t) + 4y(t) = f'(t) + 3f(t)$ ,  $f(t) = e^{-t}u(t)$ . Find out the zero-state response by using Laplace transform and inverse Laplace transform. Plot the incentive and response in one figure.

## 二.概念错误

1. Incentive: 激励信号, 即输入信号 $f(t)$
2.  $H(t)$ : 系统冲激响应
3. Response: 系统响应, 指输入信号经过系统输出的信号 $y(t)$

## 三.绘图错误

1. 信号范围选取不合理, 突显 $t>0$ 的信号变化
2. 没有合适的标注, 标注横坐标为 $t$ , 纵坐标可为 $y/f$

## 四.参考代码和运行结果

Step1: 输入ft, hs , 计算拉斯变换fs

```
syms s t
t1 = 0:0.01:5;
hs = (s+3)/(s^2+4*s+4);
ft = exp(-t)*heaviside(t);
fs = laplace(ft)
```

fs =

$$\frac{1}{s+1}$$

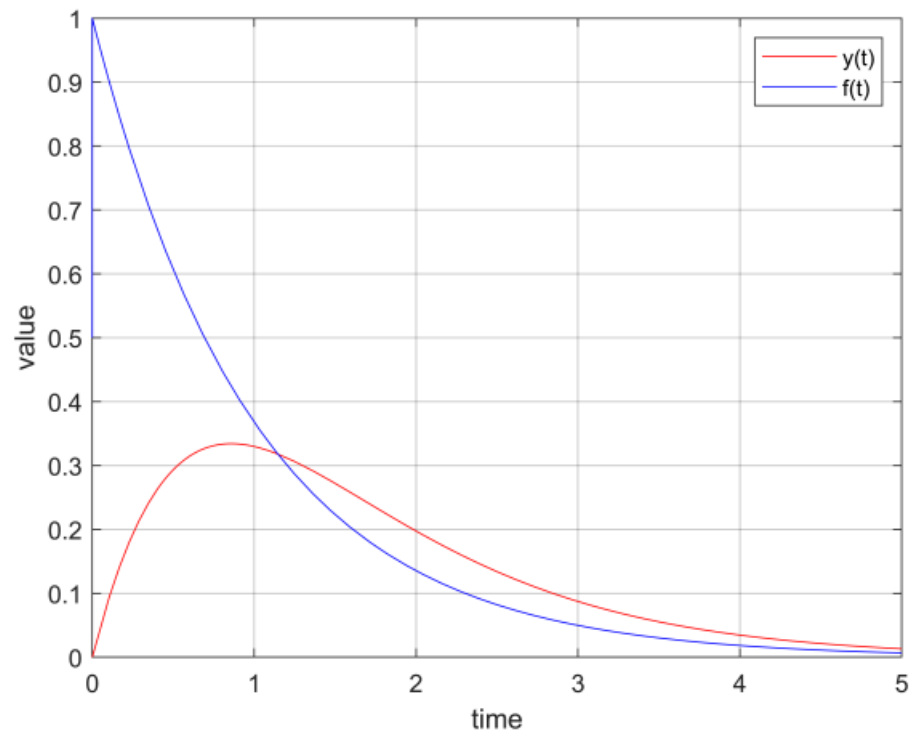
Step2:根据 fs, hs计算ys, 拉斯反变换yt

```
ys = fs*hs;
ht = ilaplace(hs)
yt = ilaplace(ys)
```

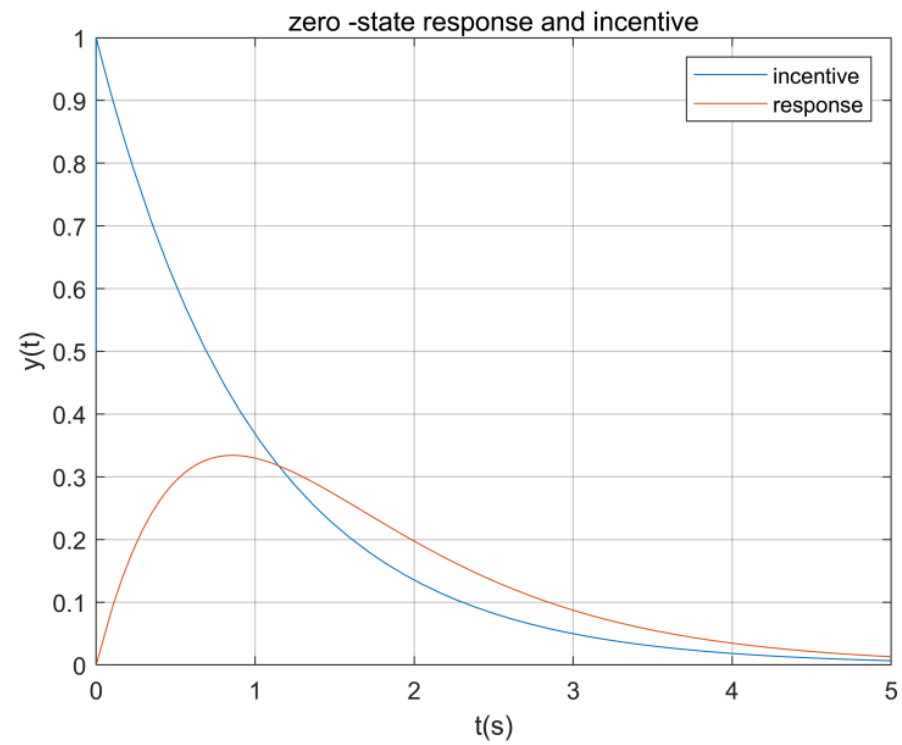
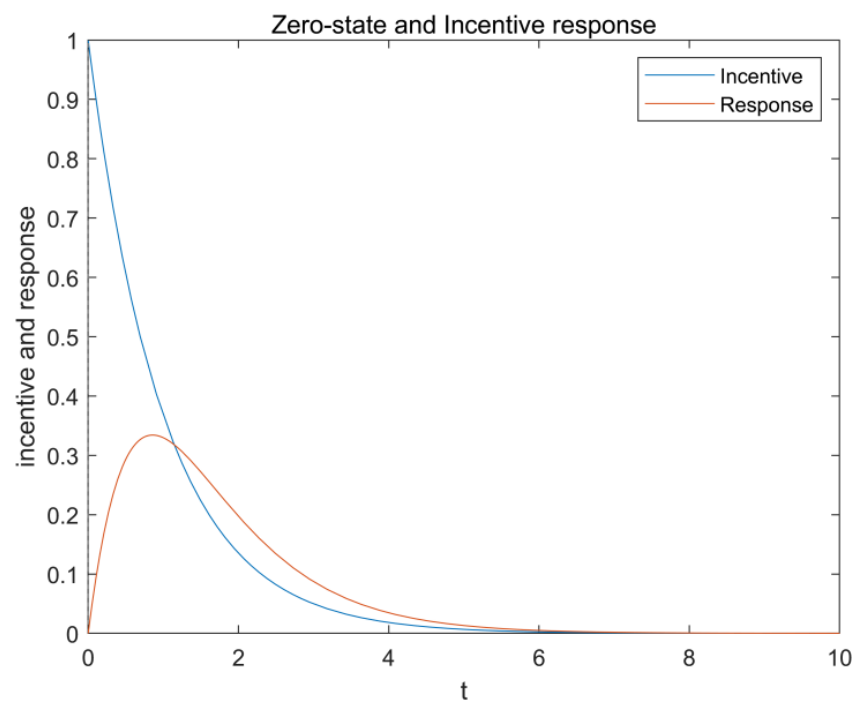
$$yt = 2e^{-t} - 2e^{-2t} - te^{-2t}$$

Step3: 绘图

```
fplot(yt,[0 5],'r'); hold on;
fplot(ft,[0 5],'b'); hold off;
xlabel('time'); ylabel('value'); legend('y(t)','f(t)');grid on;
```



## 五.优秀作答





### 第三题

$$H1(s) = \frac{s^2 + s + 2}{3s^3 + 5s^2 + 4s + 6}, H2(s) = \frac{3s(s^2 - 9)}{s^4 + 20s^2 + 64}, H3(s) = \frac{s^2 + s + 2}{s^4 + 10s^2 + 25},$$

find out the pole-zero of the system and decide whether the system is stable or not.

## 1.第一常见的错误（每个信号1分）

参数设置错误导致结果及绘图错误，其中  $H2(s) = \frac{3s(s^2 - 9)}{s^4 + 20s^2 + 64}$  出错最多。

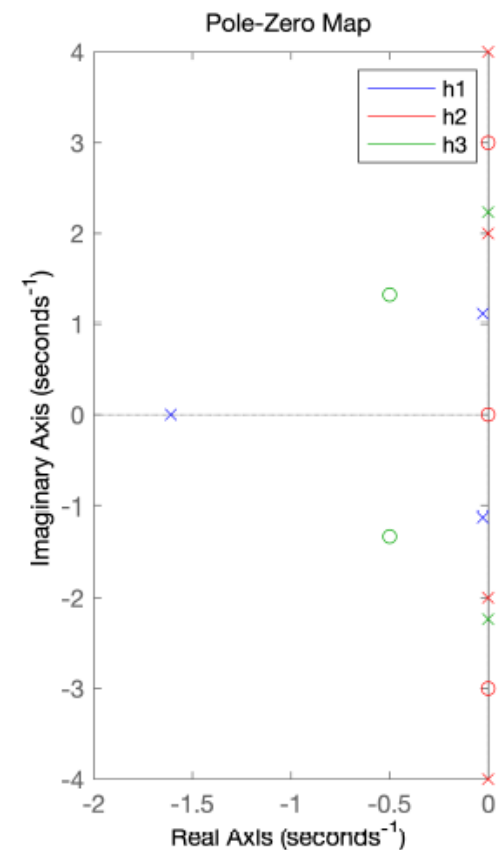
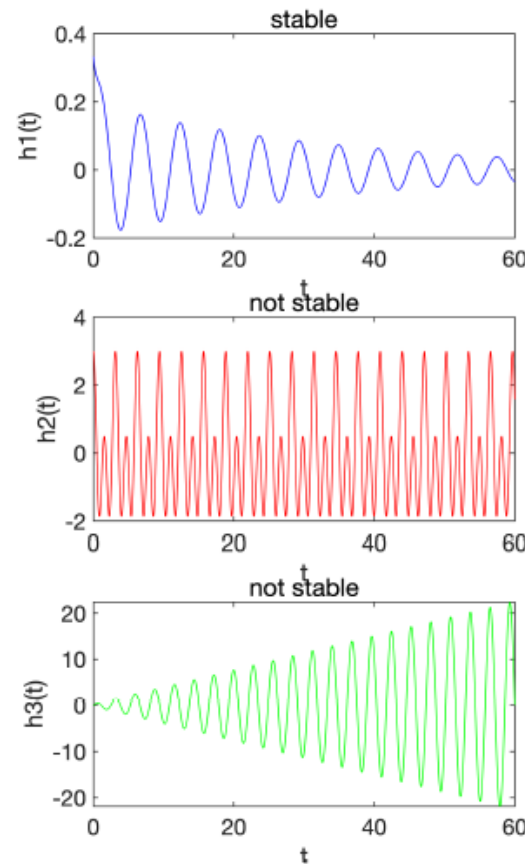
常见错误有[3,0,-9,0],[3,0,27,0],[3,0,0,-27]等。导致错误的原因估计是此形式导致部分同学条件反射使用了求根的思路，正确参数应该为[3,0,-27,0]

# 1.第一常见的错误（每个信号1分）

参数设置错误导致结果及绘图错误，其中  $H2(s) = \frac{3s(s^2 - 9)}{s^4 + 20s^2 + 64}$  出错最多。

举例：

参数[3,0,27,0]导致的错误：

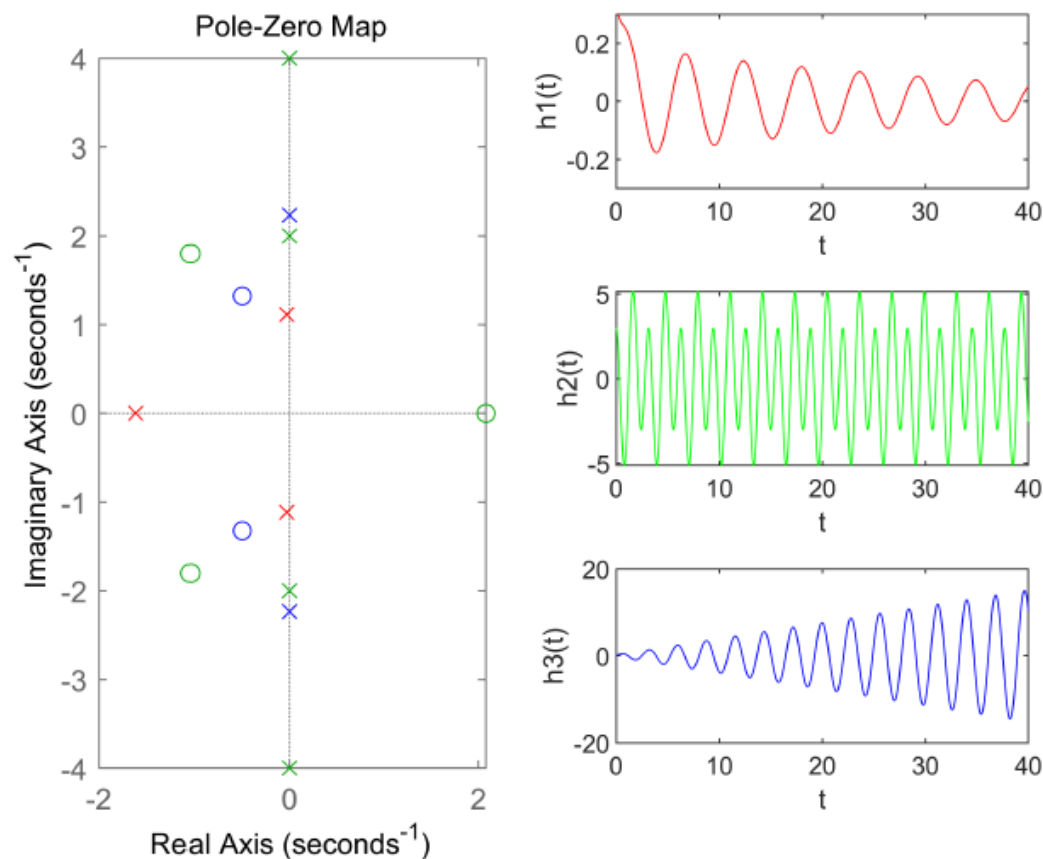


## 1.第一常见的错误（每个信号1分）

参数设置错误导致结果及绘图错误，其中  $H2(s) = \frac{3s(s^2 - 9)}{s^4 + 20s^2 + 64}$  出错最多。

举例：

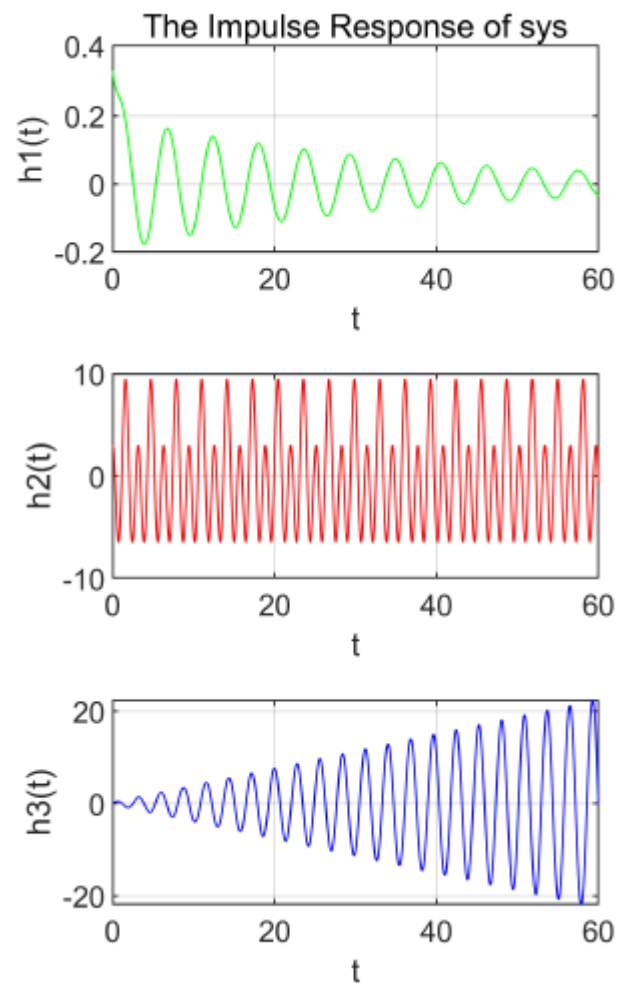
参数[3,0,0,-27]导致的错误：



## 2.第二常见的错误

对stable的判断错误，扣0.5~1分

出错最多的是对H2的判断，其波形规整但是并不说明其收敛，因此是not stable的



## 4.参考代码及结果（优秀示例）

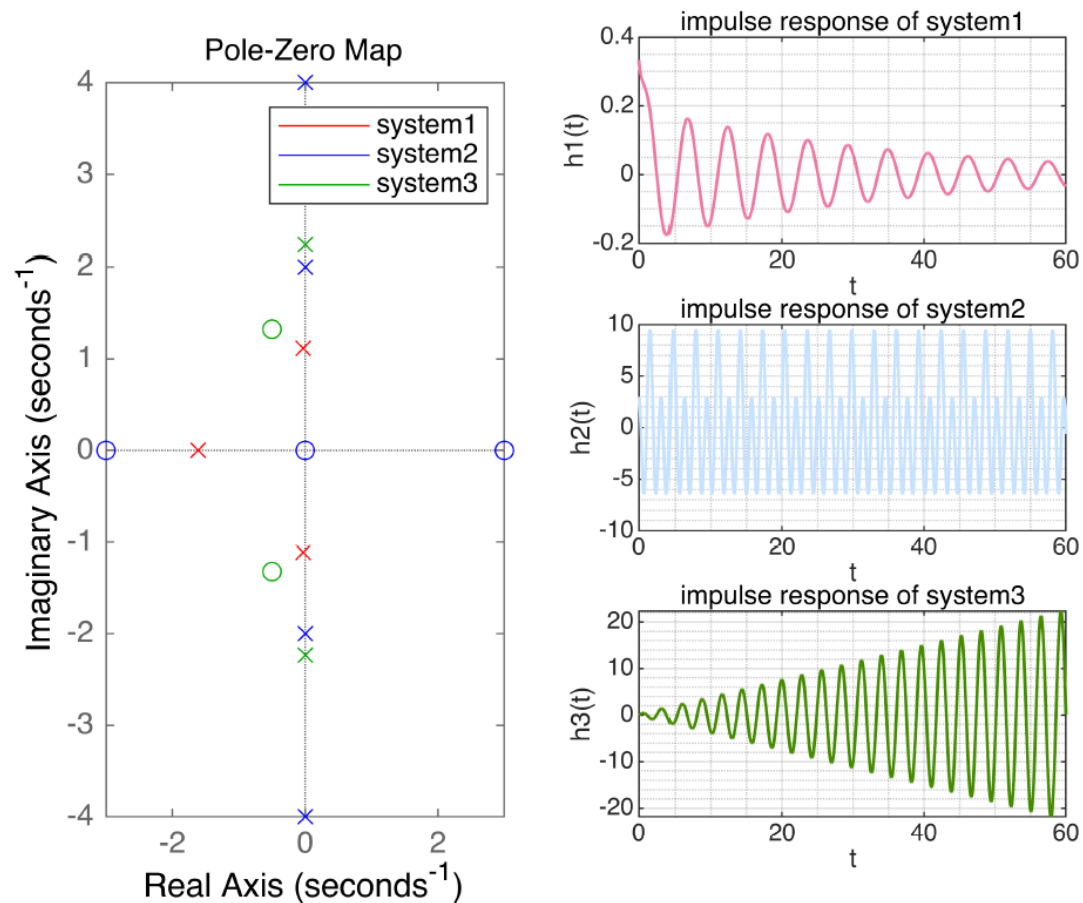
```
clear;clf;
t=0:0.01:60;

b1=[1,1,2];
a1=[3,5,4,6];
sys1=tf(b1,a1);
subplot(3,2,2);plot(t,impulse(sys1,t),"Color","#EE799F","LineWidth",1);
title('impulse response of system1'); xlabel('t');ylabel('h1(t)');
grid on;
grid minor;

b2=[3,0,-27,0];
a2=[1,0,20,0,64];
sys2=tf(b2,a2);
subplot(3,2,4);plot(t,impulse(sys2,t),"Color","#C6E2FF","LineWidth",1);
title('impulse response of system2'); xlabel('t');ylabel('h2(t)');
grid on;grid minor;

b3=[1,1,2];
a3=[1,0,10,0,25];
sys3=tf(b3,a3);
subplot(3,2,6);plot(t,impulse(sys3,t),"Color","#458B00","LineWidth",1);
title('impulse response of system3'); xlabel('t');ylabel('h3(t)');
grid on;grid minor;

subplot(3,2,[1 3 5]);
pzplot(sys1,'r');hold on;
pzplot(sys2,'b');
pzplot(sys3,'g');hold off;
legend('system1','system2','system3');
```



# 第四题

4.  $f(t) = e^{-t}\sin(10t)u(t)$ , plot the 3D surface of Laplace transform and graph of Fourier transform. Adjust the observation range and angle of the 3D surface to find out the relationship between Laplace transform and Fourier Transform.

常见错误一：画出的拉普拉斯3d图未调整观察角度，未见虚轴上的切面

解决办法：可添加代码如下 `axis([0,5,-20,20,0,0.5]);`

常见错误二：画拉普拉斯图像时，采样范围过窄

解决办法：可添加代码如下 `x = -30:0.1:30; y = x; [x,y] = meshgrid(x,y);`

常见错误三：通过`fourier`函数进行傅立叶变换时横坐标错误

解决办法：`fourier`函数变换后横坐标应该是角频率

4.  $f(t) = e^{-t}\sin(10t)u(t)$ , plot the 3D surface of Laplace transform and graph of Fourier transform. Adjust the observation range and angle of the 3D surface to find out the relationship between Laplace transform and Fourier Transform.

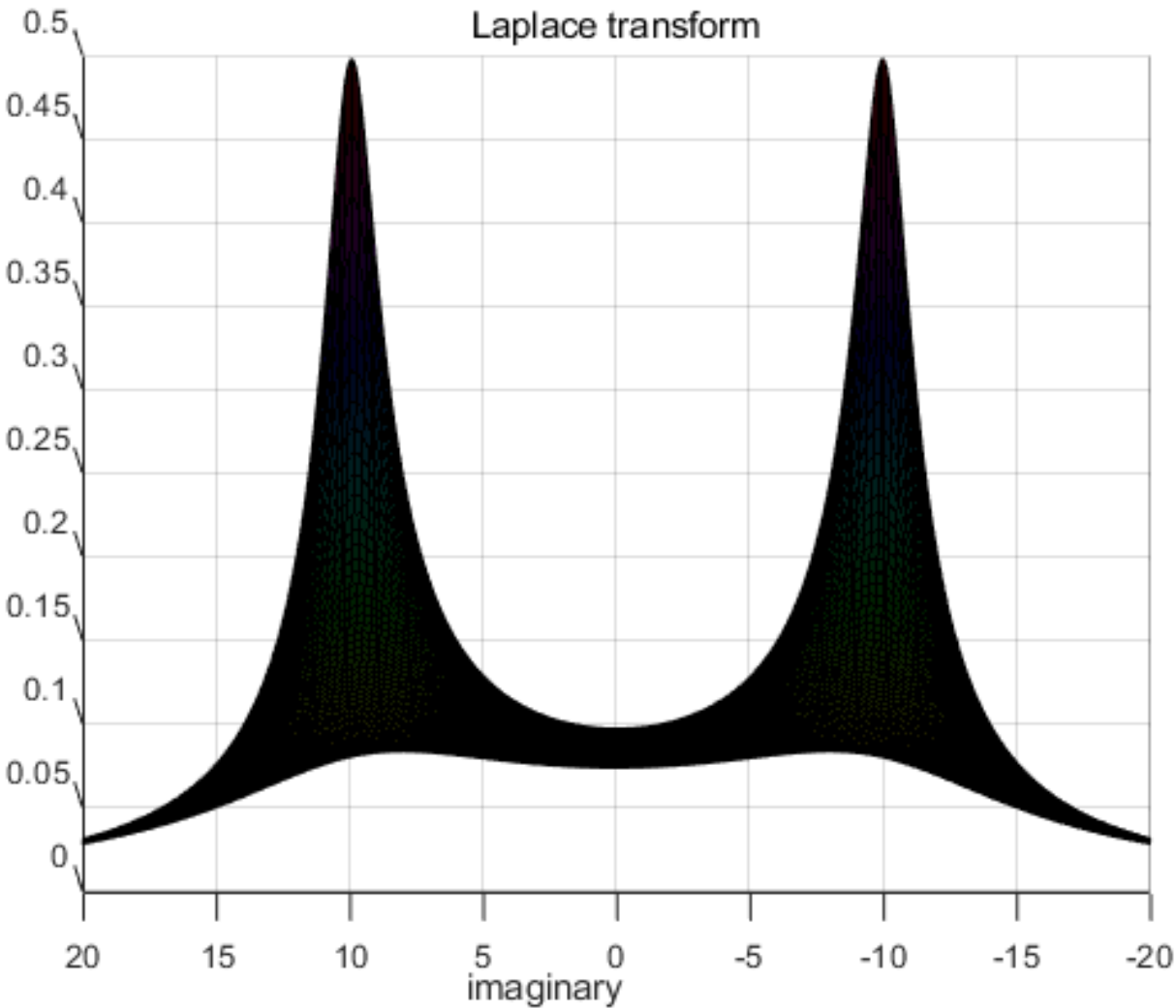
参考答案:

```
clear;clf;
syms t
f = exp(-t)*sin(10*t)*heaviside(t);
L = laplace(f);
x = 0:0.1:5;
y = -30:0.1:30;
[x,y] = meshgrid(x,y);
z = x+1j*y;
L = subs(L,'s',z);
Labs = abs(L);
Labs = double(Labs);
surf(x,y,Labs);colormap(hsv);axis([0,5,-20,20,0,0.5]);
title('Laplace transform');xlabel('real');ylabel('imaginary ');rotate3d on;
```



4.  $f(t) = e^{-t}\sin(10t)u(t)$ , plot the 3D surface of Laplace transform and graph of Fourier transform. Adjust the observation range and angle of the 3D surface to find out the relationship between Laplace transform and Fourier Transform.

参考答案:



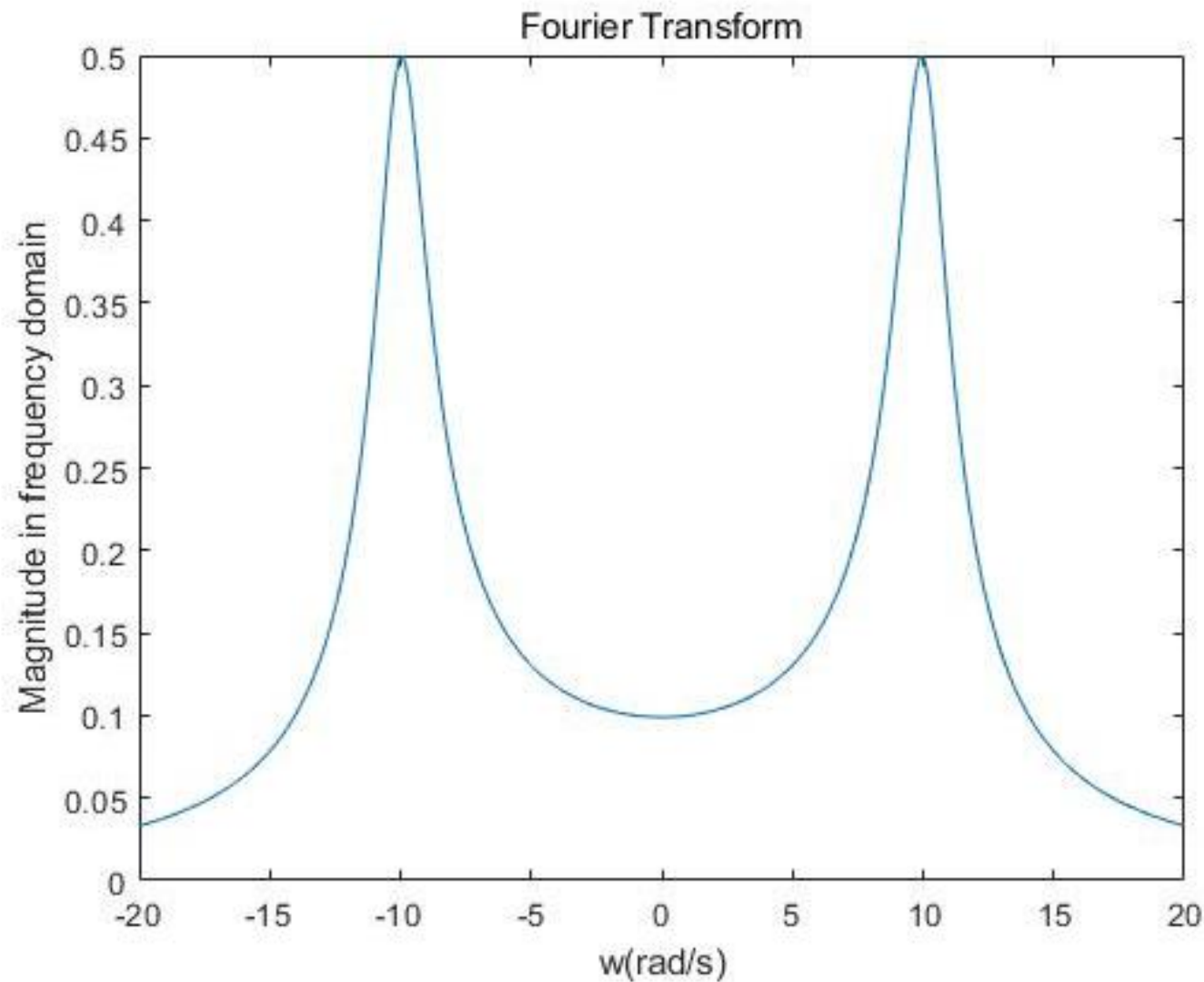
4.  $f(t) = e^{-t}\sin(10t)u(t)$ , plot the 3D surface of Laplace transform and graph of Fourier transform. Adjust the observation range and angle of the 3D surface to find out the relationship between Laplace transform and Fourier Transform.

参考答案:

```
F = fourier(f);  
w = -30:0.1:30;  
F = subs(F, 'w', w);  
% F = double(F);  
Fabs = abs(F);  
figure; plot(w, Fabs); axis([-20, 20, 0, 0.5]);  
title('Fourier Transform'); xlabel('w(rad/s)'); ylabel('Magnitude in frequency domain');
```

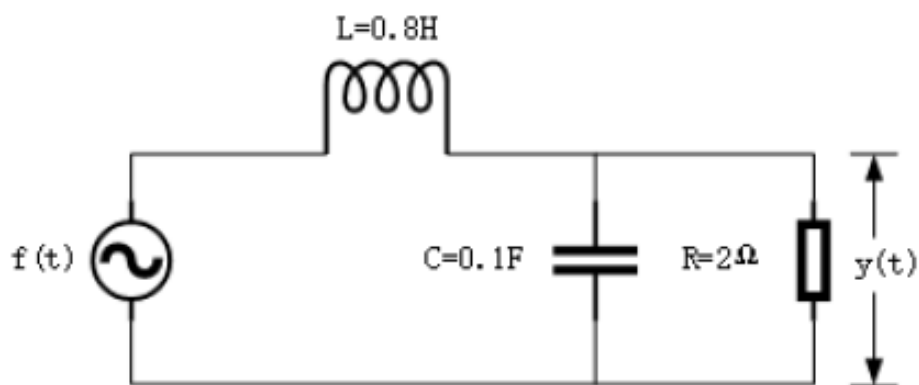
4.  $f(t) = e^{-t}\sin(10t)u(t)$ , plot the 3D surface of Laplace transform and graph of Fourier transform. Adjust the observation range and angle of the 3D surface to find out the relationship between Laplace transform and Fourier Transform.

参考答案:

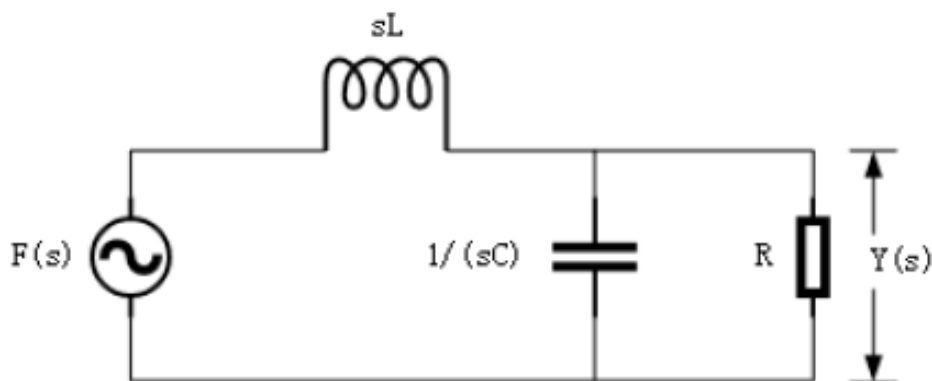


## 第五题

5. Find out the frequency response of the following system. In the system,  $f(t)$  is the input while  $y(t)$  is the output.



复频域等效电路



1) Write the transform function  $H(s)$  of the system\_\_\_\_\_.

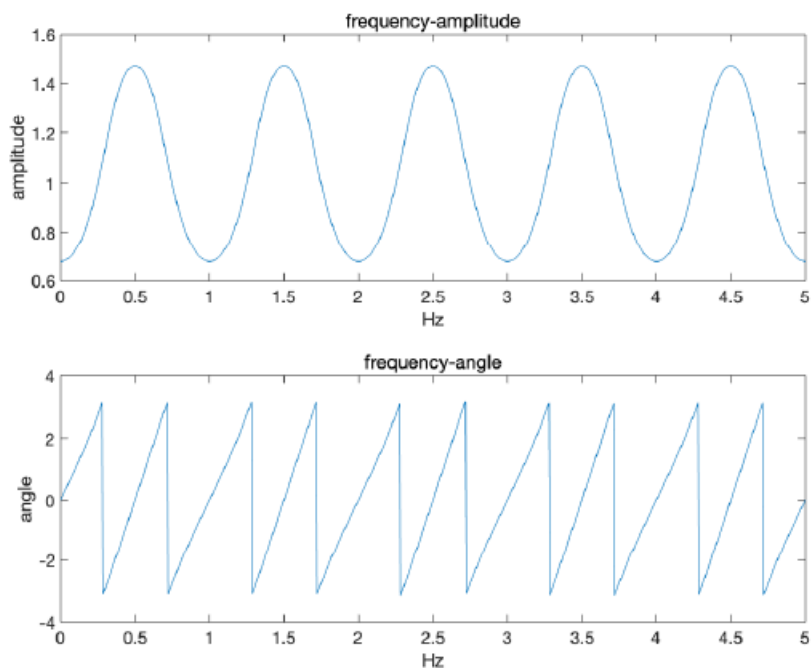
2) Find out the frequency response with function **freqs(b,a,w)**. Plot its frequency-amplitude and frequency-angle figure within the range of  $[0,5Hz]$  in a 2\*1 subplot.

## 典型错误一: 错误使用freqz(),当做离散信号处理

```
clear;clf;  
a=[1];  
b=[0.08,0.4,1];  
w=linspace(0,2*pi*5,1000);  
H=freqz(a,b,w);  
subplot(2,1,1);plot(w/(2*pi),abs(H));  
title('frequency-amplitude');xlabel('Hz');ylabel('amplitude');  
subplot(2,1,2);plot(w/(2*pi),angle(H));  
title('frequency-angle');xlabel('Hz');ylabel('angle');
```

错误使用离散信号  
处理 -1

Note:  
freqs()对应连续信号  
freqz()对应离散信号



## 典型错误二: linspace 选择不当, 区间内点选择过疏, 导致信息受损

错误示例:

区间过大但个数没变, 导致多疏

```
clear;
clf;
b = [10];
a = [0.8 4 10];
w = linspace(0, 10000*2*pi, 1000);
H = freqs(b, a, w);
subplot(2,1,1); plot(w/(2*pi)/1000, abs(H)); title('Amplitude-Frequency');
xlabel('kHz'); ylabel('Amplitude'); xlim([0, 0.01])
subplot(2,1,2); plot(w/(2*pi)/1000, angle(H)); title('Angle-Frequency');
xlabel('kHz'); ylabel('Angle'); xlim([0, 0.01])
```

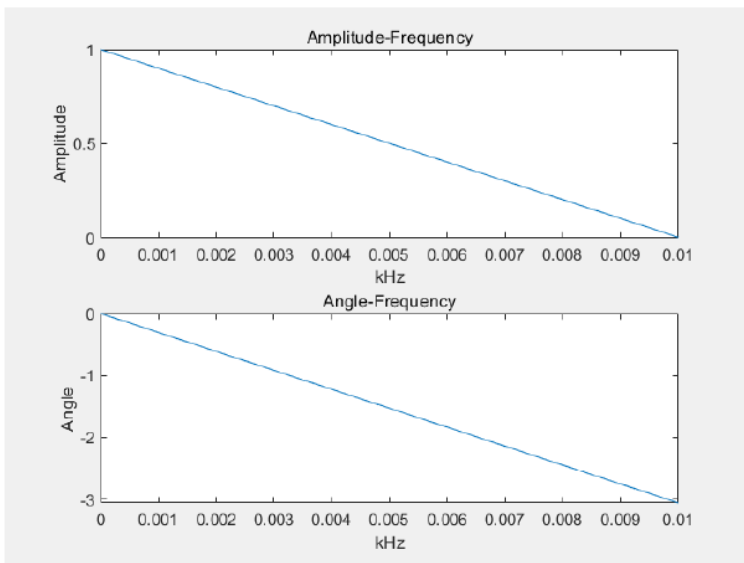
Note:

`linspace(x1,x2,N=100)` 中

`x1` 为起始位置

`x2` 为终止位置

`N` 为元素个数, 忽略则为默认值 100



## 四.参考代码和运行结果

Step1: 计算得出方程

$$H(s) = \frac{1}{0.08s^2 + 0.4s + 1}$$

Step2:

```
clear;clf;  
b=[2];  
a=[0.16 0.8 2];  
w=linspace(0,5*2*pi,1000);  
H=freqs(b,a,w);
```

Step3: 绘图

```
subplot(2,1,1);plot(w/(2*pi),abs(H));title('Amplitude-Frequency');xlabel('f(Hz)');ylabel('Amplitude');grid on;  
subplot(2,1,2);plot(w/(2*pi),angle(H));title('Angle-Frequency');xlabel('f(Hz)');ylabel('Angle');grid on;
```

