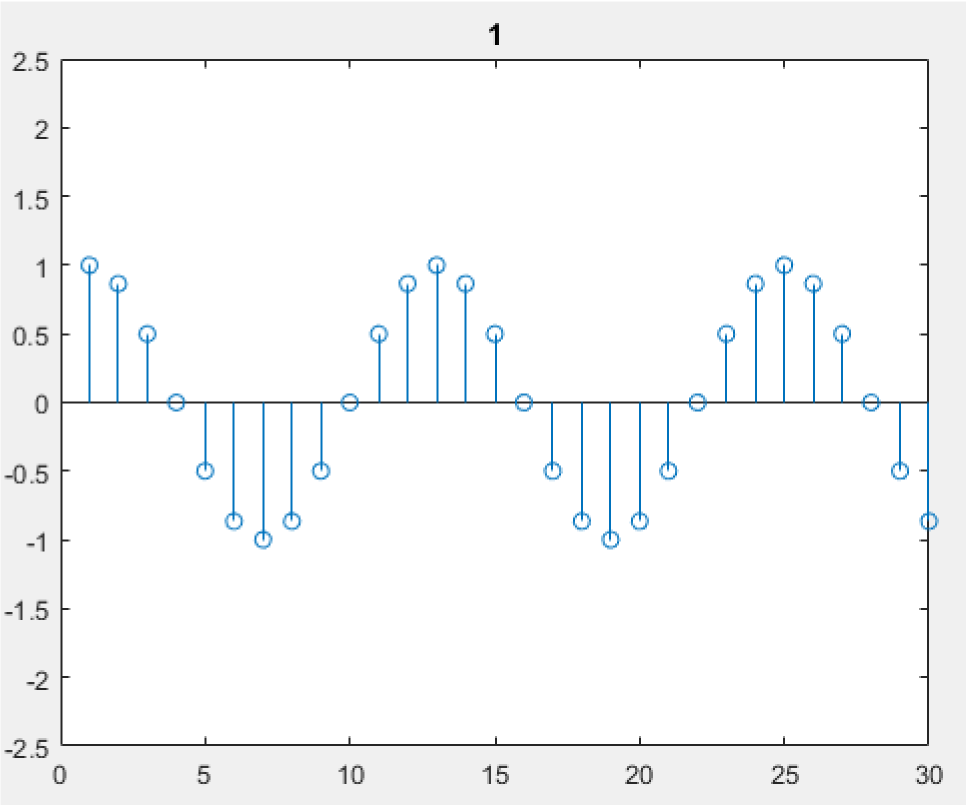
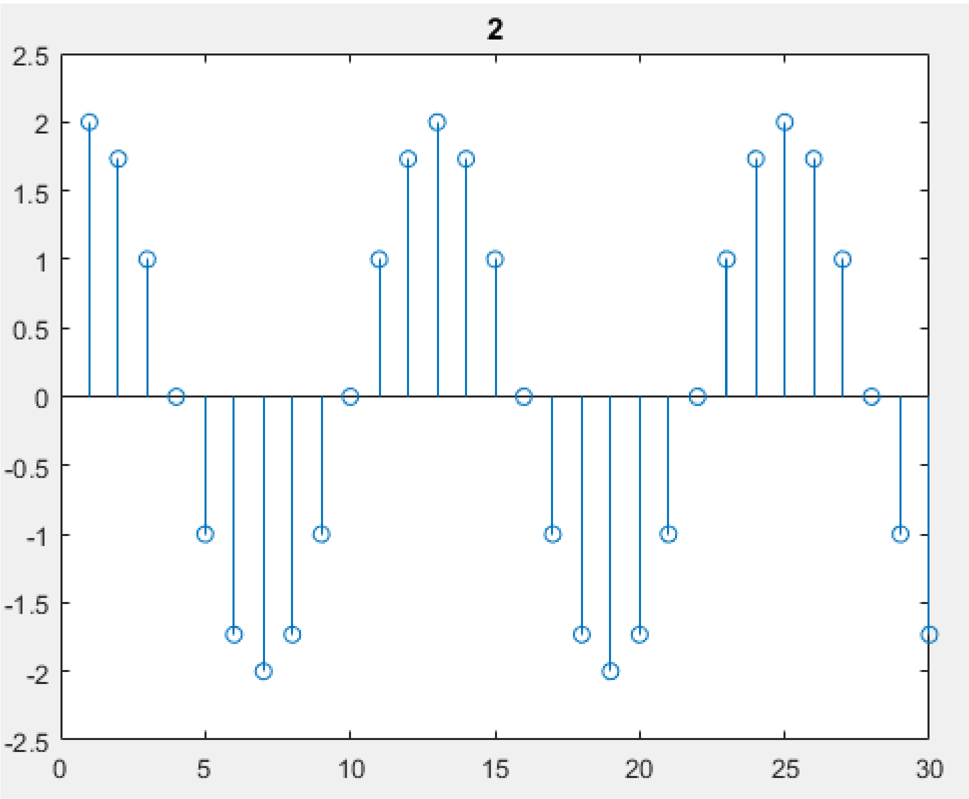
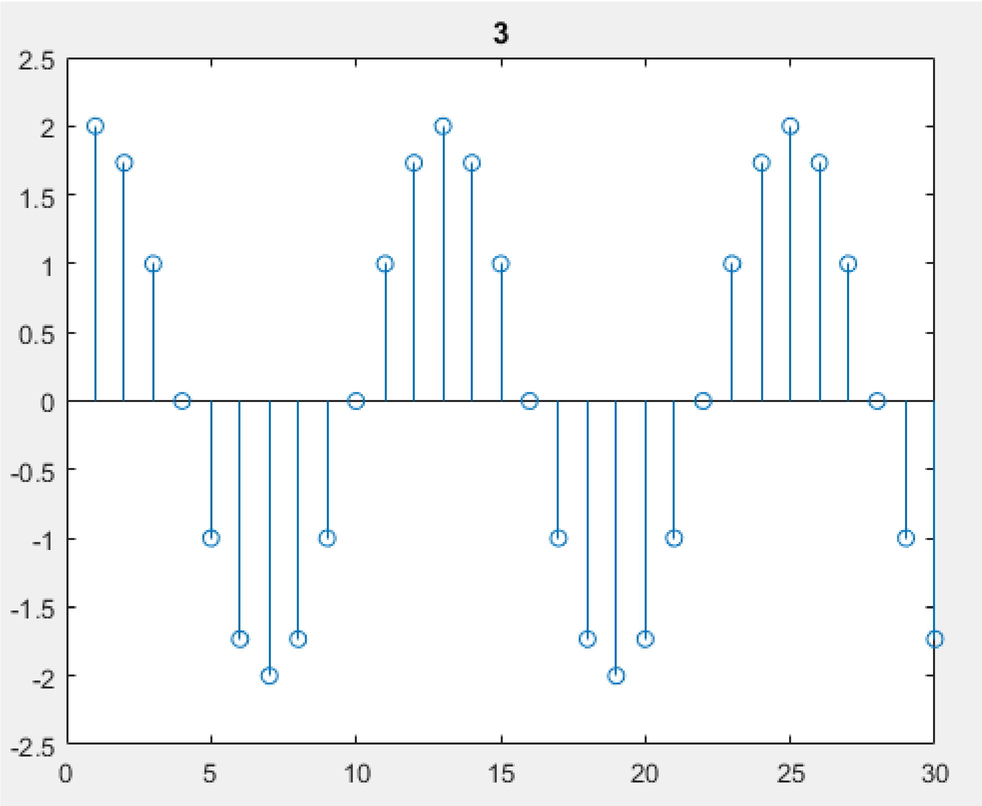
BLG354E – HOMEWORK 1

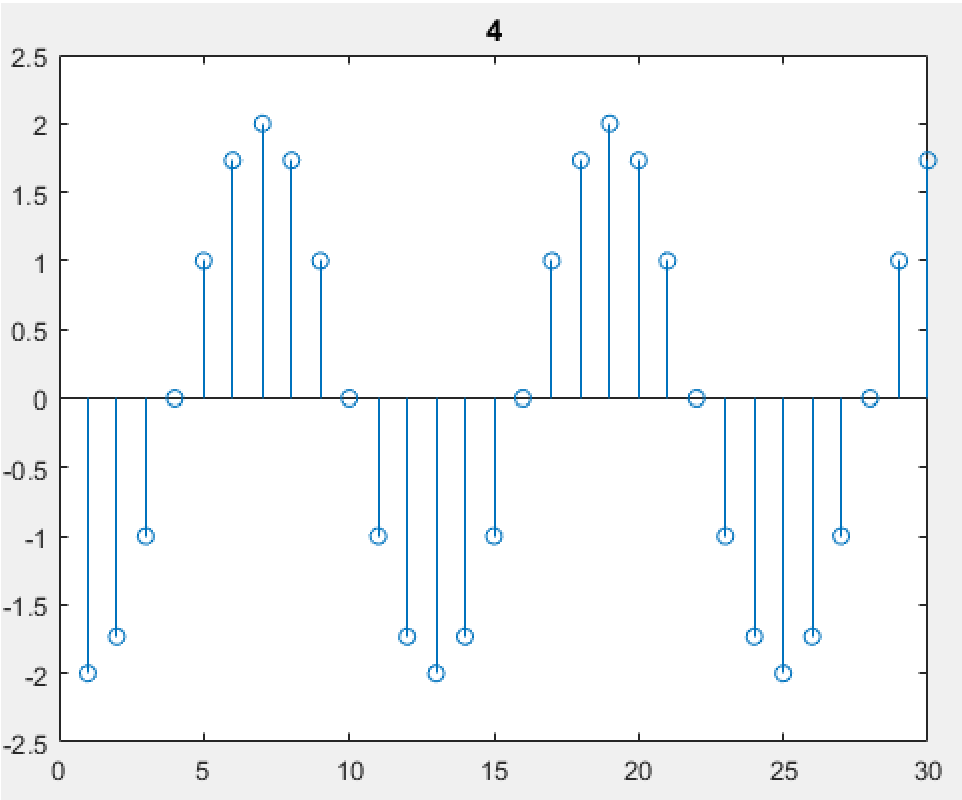
Ece Naz Sefercioğlu
150130140

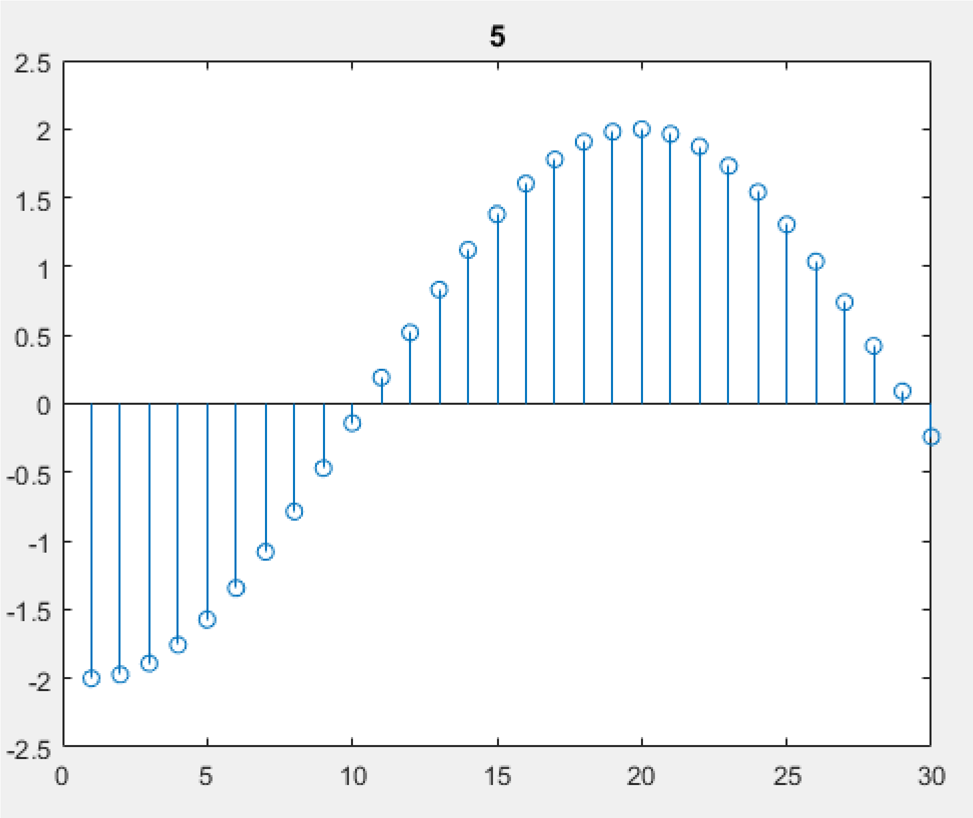
1)


1
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
0
5
10
15
20
25
30


2
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
0
5
10
15
20
25
30


3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
0
5
10
15
20
25
30


4
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
0
5
10
15
20
25
30



Matlab script SaS_Q1.m is used for plotting the signals.

```
A=[1 2 2 2 2];
omega0=[pi/6 pi/6 pi/6 pi/6 1/6];
theta=[0 0 4*pi pi pi];
n=0:30;

for a = 1:5
    figure(a)
    stem(A(a)*cos(omega0(a)*n+theta(a)))
    title([num2str(a)])
    axis([0 30 -2.5 2.5])
end
```

$x_1[n] = 1\cos\left(\frac{\pi}{6}n\right)$ half the magnitude

$x_2[n] = 2\cos\left(\frac{\pi}{6}n\right)$ no time shift here

$x_3[n] = 2\cos\left(\frac{\pi}{6}n + 4\pi\right)$ Bigger time shift

$x_4[n] = 2\cos\left(\frac{\pi}{6}n + \pi\right)$ Smaller period

$x_5[n] = 2\cos\left(\frac{1}{6} + \pi\right)$

2)

a) $x_1 = \cos(t)$

period $T_0 = \dfrac{2\pi m}{w_0}$

$w_0 = 1 \qquad T_1 = \dfrac{2\pi m}{1} = 2\pi$

$x_2 = \sin(\pi t)$

$w_0 = \pi \qquad T_2 = \dfrac{2\cancel{\pi} m}{\cancel{\pi}} = 2$

b) $x_3(t) = \cos(t) + \sin(\pi t)$

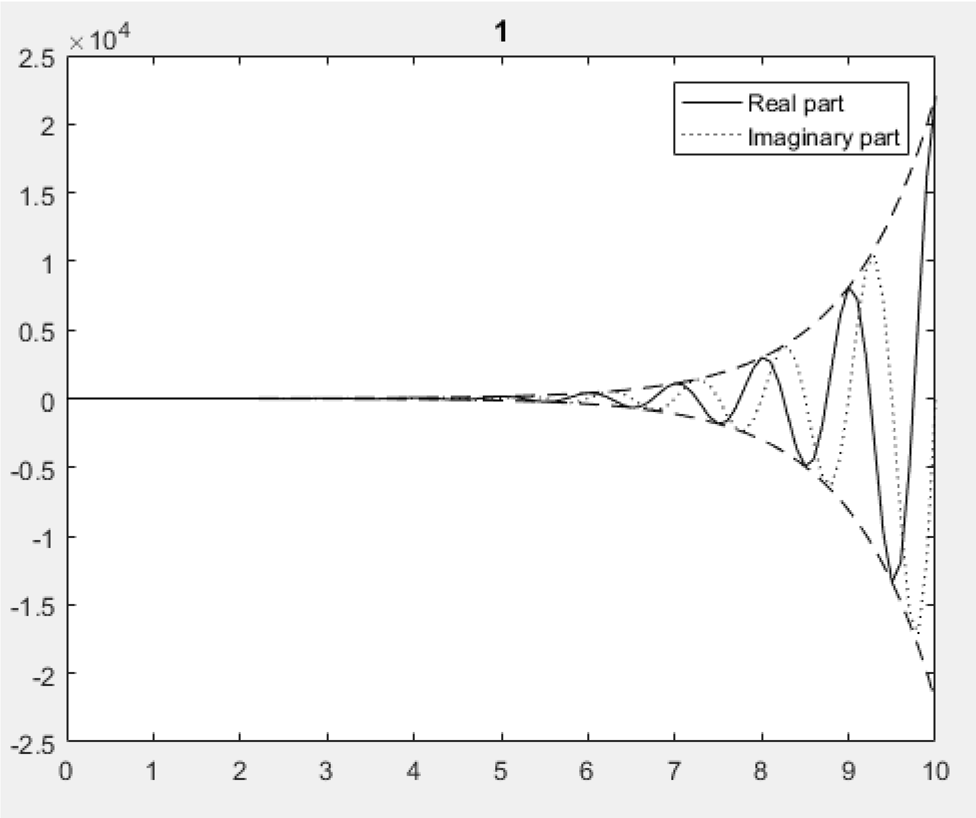
periodic $\qquad$ periodic

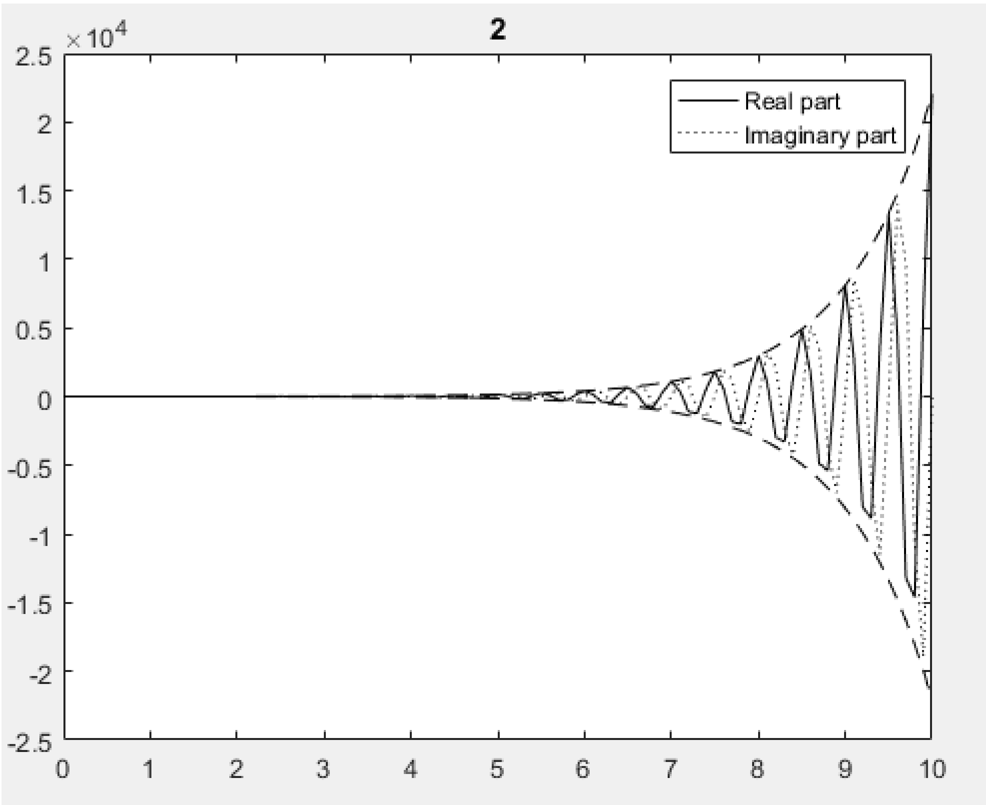
$T_1 = 2\pi \qquad T_2 = 2$

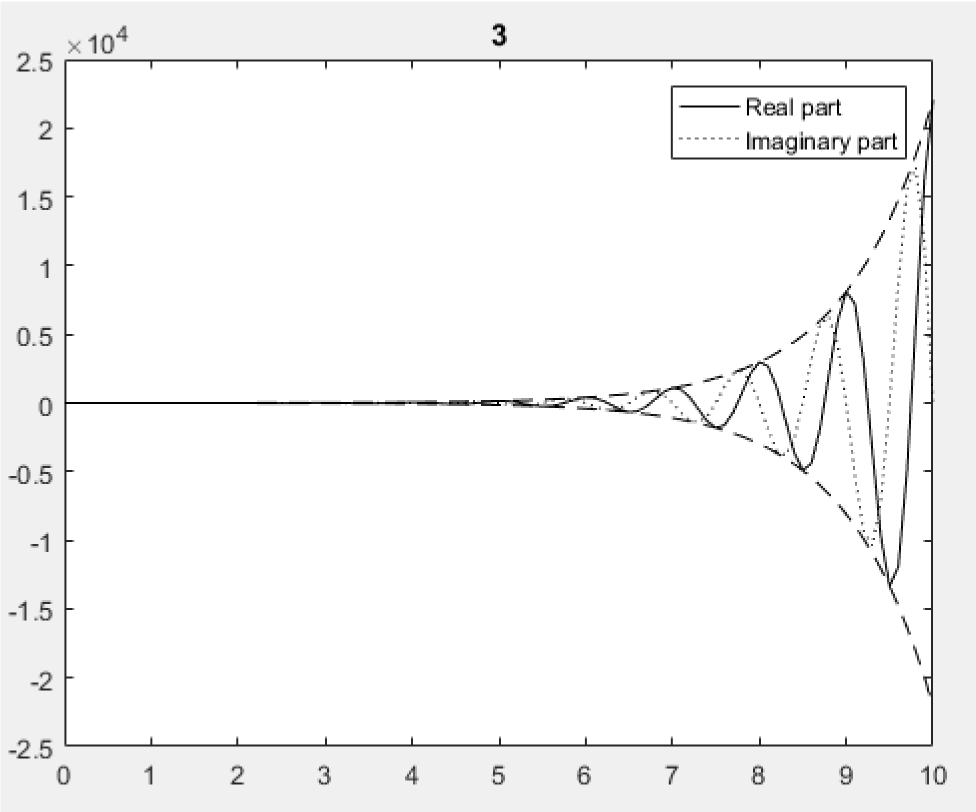
ratio $\dfrac{T_1}{T_2} = \dfrac{2\pi}{2} = \pi$ not rational

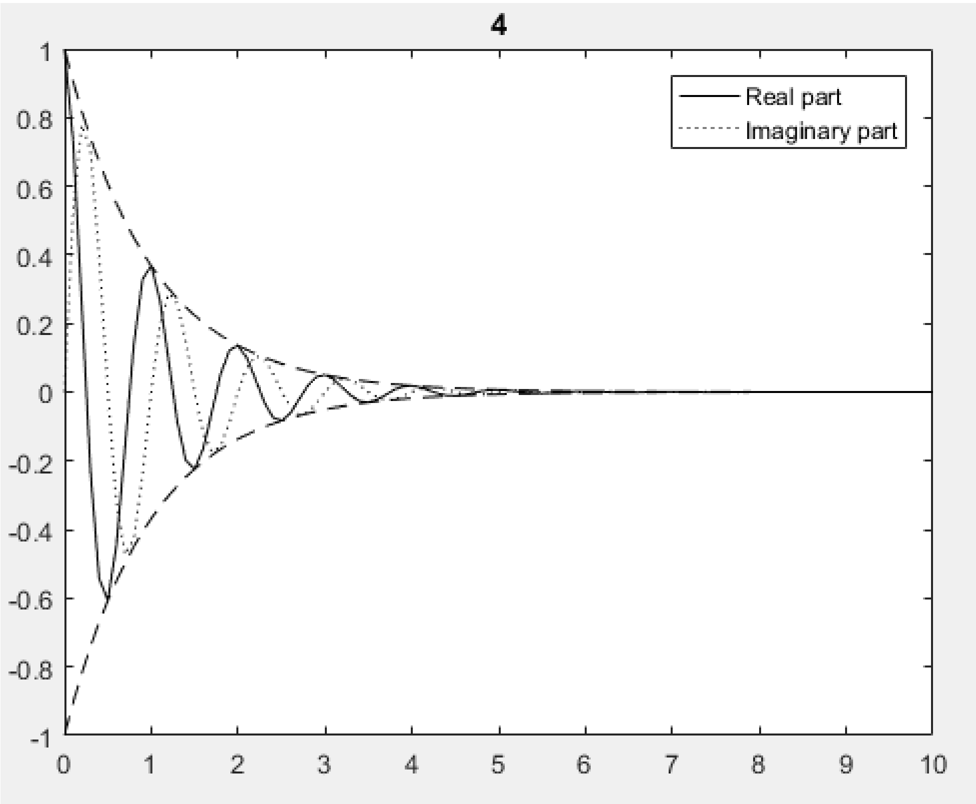
not periodic

3)


1
×10^4
Real part
Imaginary part
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
0
1
2
3
4
5
6
7
8
9
10


2
×10^4
Real part
Imaginary part
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
0
1
2
3
4
5
6
7
8
9
10


3
×10^4
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
0
1
2
3
4
5
6
7
8
9
10
Real part
Imaginary part


4
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
0
1
2
3
4
5
6
7
8
9
10
Real part
Imaginary part

Since ID_4 has negative r value it isa decreasing function, with positive r values ID_1, ID_2, ID_3 are increasing functions.

ID_3 having negative omega0 value its real part is faster than imaginary part. With positive omega0 values ID_1, ID_2, ID_4 have their imaginary part faster than their real part.

Since ID_1, ID_3, ID_4 has |omega0| values equal they share the same period T=1, and ID_2 has T=1/2.

Matlab script SaS_Q3.m is used for plotting the signals.

```
absC=1;
omega0=[2*pi 4*pi -2*pi 2*pi];
r=[1 1 1 -1];
t=0:.1:10;
theta=2*pi;
for z = 1:4
     C=absC*exp(j.*theta);
    a=r(z)+j*omega0(z);
    xenvu=abs(C)*exp(r(z)*t);
    xenvd=-abs(C)*exp(r(z)*t);
    func= C.*exp(a.*t);
    figure(z)
 plot(t,real(func),'k',t,imag(func),'k:',t,xenvu,'k--',t,xenvd,'k--')
    title([num2str(z)])
    legend('Real part','Imaginary part')

    title([num2str(z)])
end
```

4)

a) $x_1(t) \rightarrow t\, u(t)\, x_1(t) \rightarrow y_1(t)$

$x_2(t) \quad t\, u(t)\, x_2(t) \rightarrow y_2(t)$

$x_3(t) = x_1(t) + x_2(t)$

$$y_3(t) = t.u(t)\ \underbrace{[x_1(t) + x_2(t)]}_{x_3(t)} = \underbrace{t\, u(t)\, x_1(t)}_{y_1(t)} + \underbrace{t\, u(t).x_2(t)}_{y_2(t)}$$

$\Downarrow$

linear

b) $y(t) = t.\, u(t)\, x(t)$

y does not depend on

a previous valu of $t, (t - \dots)$

so system is memoryless

c) $y(t) = t.\, u(t).\, x(t)$

for $t = 1$

$y(1) = 1.\, u(1).\, x(1)$

output y depends on the

meantime of input x

since they are on the same

time period system is casual

d) $y(t) = t.\, u(t).\ x(t) = T[x(t)]$,

$T[x(t - T_0)] = t.\ u(t).\ x(t - T_0)$

$\neq y(t - T_0) = (t - T_0)\ u(t - T_0).\ x(t - T_0)$

system is time varying.

5) Matlab script SaS_Q5.m is used for this problem.

```
[y, Fs] = audioread('Frank_C_Stanley_-_08_-
_When_The_Mockingbirds_Are_Singing_In_The_Wildwood.wav');

yx = zeros(size(y,1),2);

for i=2:size(y,1)
   yx(i,1) = exp(y(i,1)/2.5);
   yx(i,2) = exp(y(i,2)/2.5);
end

audiowrite('signal_div_a.wav',yx,Fs,'BitsPerSample',64)

[ww,Fs] = audioread('signal_div_a.wav');

y2 = zeros(size(ww,1),2);

for i=1:size(ww,1)
   y2(i,1) = log(ww(i,1))*2.5;
   y2(i,2) = log(ww(i,2))*2.5;
end

audiowrite('signal_reinverted_a.wav',y2,Fs,'BitsPerSample',64);



[y, Fs] = audioread('Frank_C_Stanley_-_08_-
_When_The_Mockingbirds_Are_Singing_In_The_Wildwood.wav');

yx = zeros(size(y,1),2);

for i=2:size(y,1)
     yx(i,1) = y(i,1)+yx(i-1,1);
   yx(i,2) = y(i,2)+yx(i-1,1);
end

audiowrite('signal_div_b.wav',yx,Fs,'BitsPerSample',64)


[ww,Fs] = audioread('signal_div_b.wav');

y2 = zeros(size(ww,1),2);

for i=1:size(ww,1)
   y2(i,1) = ww(i,1)-y2(i+1,1);
   y2(i,2) = ww(i,2)-y2(i+1,2);
end

audiowrite('signal_reinverted_b.wav',y2,Fs,'BitsPerSample',64);
```