电子科技大学 格拉斯哥 学院

UOG-UESTC Joint School of UESTC

标 准 实 验 报 告

Lab Report

（实验）课程名称： 信号与系统

(LAB) Course Name： Signals and Systems

电子科技大学教务处制表

UoG-UESTC Joint School

Lab-1 Report

Student Name：蓝心悦
Student No. :2017200601018
Instructor：许渤
Location：
Date：3/20/2019

一、 Laboratory name：

Signals and Systems

二、 Project name：

Represent signals using MATLAB

三、 Lab hours：4

四、 Theoretical background：

1. The basic concepts of signals and systems arise in a variety of contexts, from engineering design to financial analysis. In this lab1, you will learn how to represent, manipulate, and analyze basic signals and systems in MATLAB.
2. Some basic MATLAB commands for representing signals including zeros, ones, cos, sin, exp, real, imag, abs, angle, linspace, plot, stem, subplot, xlabel, ylabel, title,…
3. Some useful commands in Symbolic Math Toolbox are as: sym, subs, ezplot.

五、 Objective：

1. Be familiar with some basic MATLAB commands to represent and plot continuous-time and discrete-time signals.
2. Perform operations, including transformation, on signals using MATLAB.
3. Analyze period of signals using MATLAB.
4. Calculate energy and power of signals using MATLAB.
5. Learn to use command window and script.

六、 Description：

The following exercises are from the book, “John R.Buck, Michael M. Daniel, Andrew C. Singer. Computer Exploration in Signals and Systems —— Using MATLAB.”

1. Plot the discrete time signals and determine the period. 1.2(d)

2. Perform the transformation of signals. 1.3 (a)(b)(c)
3. Analyze the properties of systems. 1.4(a)(b)(c)(f)
4. Plot signals using Symbolic Math toolbox. 1.6(a)
5. Calculate energy and power of signals. 1.8(a)(b)(c)(d)(e)(f)

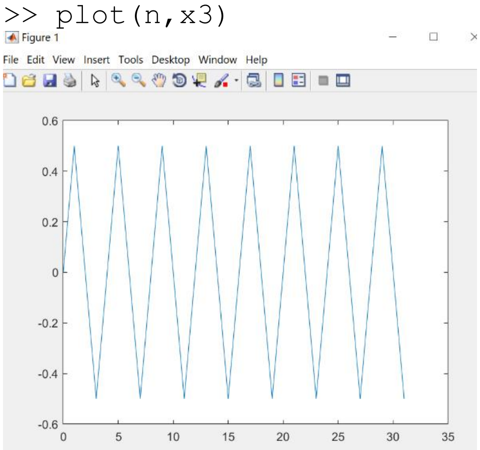
七、 Required instruments:

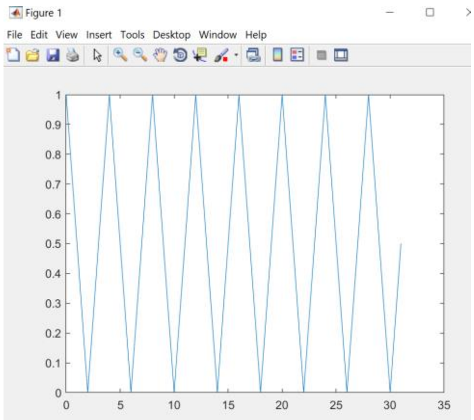
Computer, MATLAB

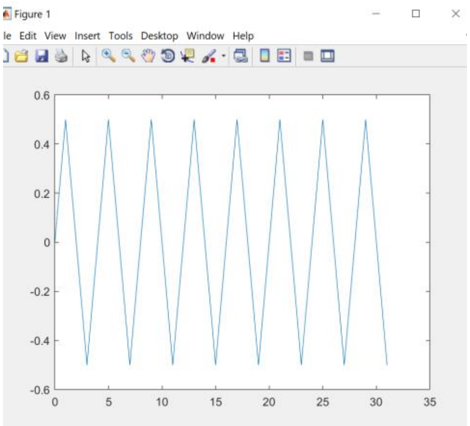
八、 Procedures, Analysis of Lab data & result and Conclusion:

1.2(d)

```
>> n=[0:31];
>> a=sin(pi*n/4);
>> b=cos(pi*n/4);
>> c=cos(pi*n/4);
>> x1=a.*b;
>> x2=b.*b;
>> x3=a.*c;
>> plot(n,x1)
>> plot(n,x2)
>> plot(n,x3)
```

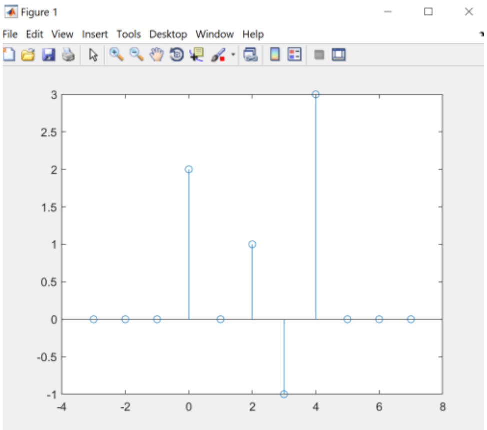






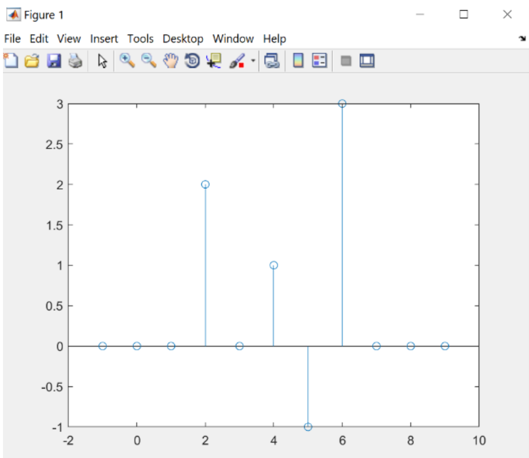
1.3(a)

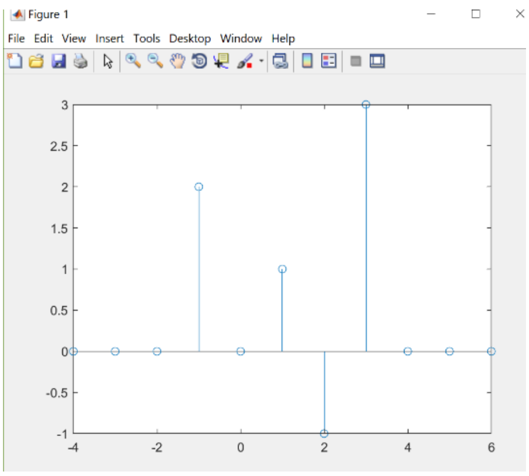
```
>> nx=[-3:7];
>> x=[zeros(1,3) 2 0 1 -1 3 zeros(1,3)]
>> stem(nx,x)
```

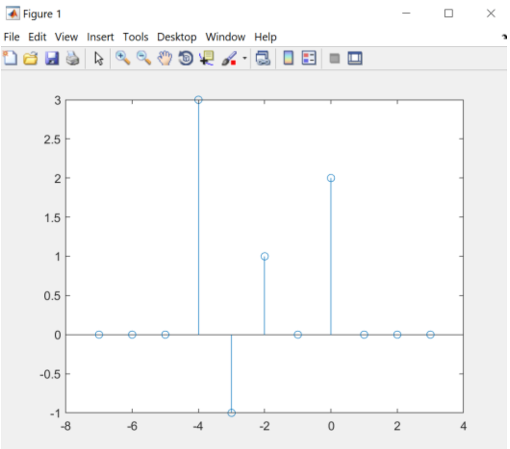


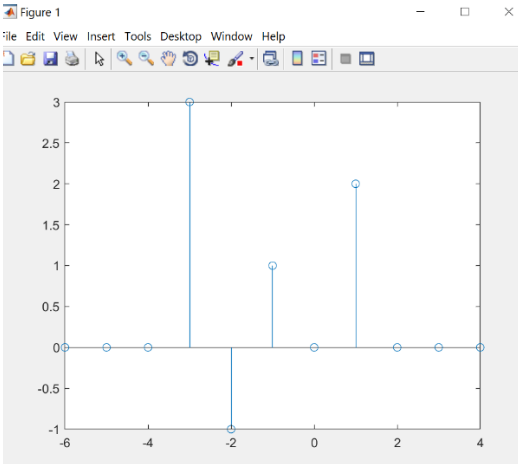
1.3(b)(c)

```
>> y1=x;
>> y2=x;
>> y3=x;
>> y4=x;
>> ny1=nx+2;
>> ny2=nx-1;
>> ny3=-nx;
>> ny4=-(nx-1);
>> stem(ny1,y1)
>> stem(ny2,y2)
>> stem(ny3,y3)
>> stem(ny4,y4)
```





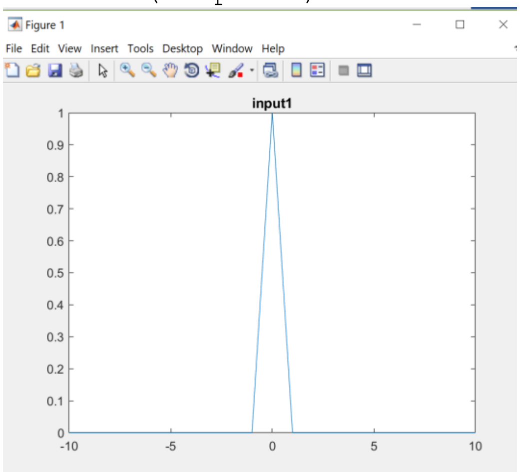




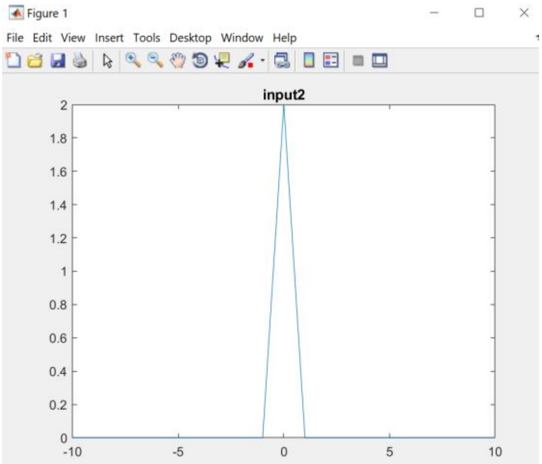
Y1 is delayed by 2, y2 is advanced by 1, y3 is simply flipped and y4 is flipped then delayed by 1.

1.4(a)

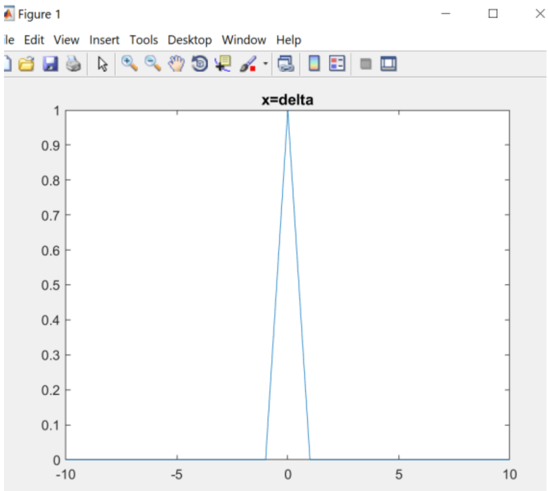
```
>> n=[-10:10];
>> x1=[zeros(1,10) 1 zeros(1,10)];
>> plot(n,x1)
>> title('input1')
```

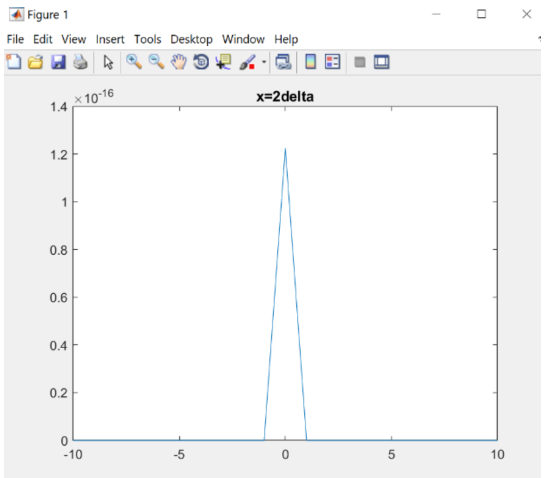



```
>> y=sin(pi*x/2);
>> plot(n,y)
>> hold on
>> title('x=delta')
>> x2=[zeros(1,10) 2 zeros(1,10)];
>> plot(n,x2);
>> title('input2')
```




```
>> y=sin(pi*x/2);
>> plot(n,y)
```

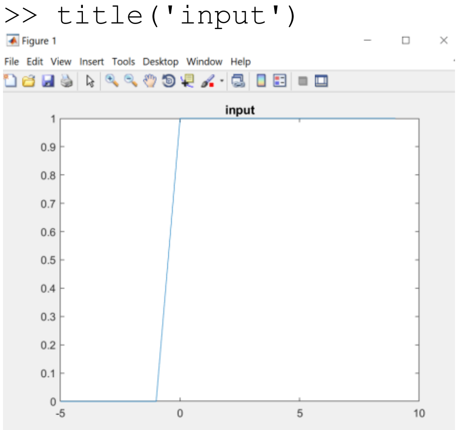




When the x becomes twice of its original value, y does not become twice of its first value, therefore, this system is not linear.

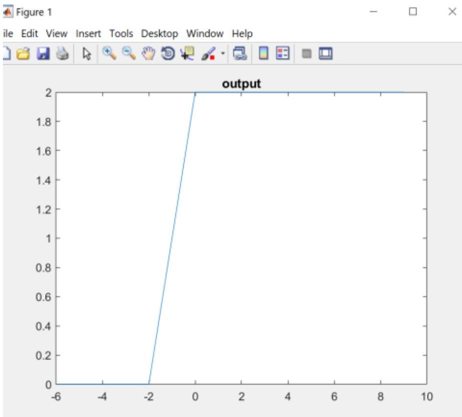
(b)

```
>> n=[-5:9];
>> x=[zeros(1,5) ones(1,10)]
>> plot(n,x)
>> title('input')
```




```
>> n2=[-6:9];
>> x1=[zeros(1,6) ones(1,10)]
>> x2=[zeros(1,5) ones(1,11)];
```

```
>> y=x1+x2;
>> plot(n2,y)
>> title('output')
```



The output not only depends on the value of x[n], it also depends on x[n+1]. So it is not causal.

(c)

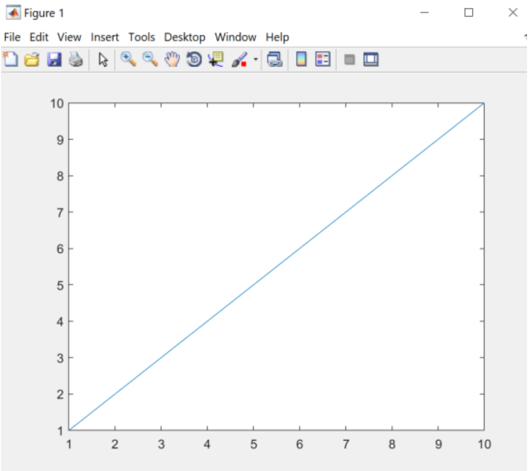
```
>> n=[-10:10];
>> x=[zeros(1,10) 1 zeros(1,10)]
x =

  Columns 1 through 9

     0     0     0     0     0     0     0     0     0

  Columns 10 through 18

     0     1     0     0     0     0     0     0     0

  Columns 19 through 21

     0     0     0

>> y=log(x)

y =

  Columns 1 through 9

  -Inf  -Inf  -Inf  -Inf  -Inf  -Inf  -Inf  -Inf  -Inf

  Columns 10 through 18

  -Inf     0  -Inf  -Inf  -Inf  -Inf  -Inf  -Inf  -Inf

  Columns 19 through 21

  -Inf  -Inf  -Inf
```

Y is not bounded while x is bounded. Therefore, this system is not stable.

(f)

Not causal, not stable and not invisible.

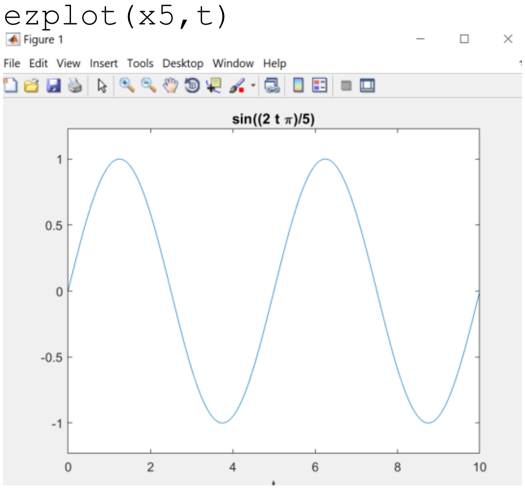
```
n=[1:10];
x=ones(1,10);
y=n.*x(1,n);
plot(n,y)
```



From the result, we can see when x=1, y also depends on the value of n and it is not bounded. Furthermore, n is not equal to x, so it is not invertible.

1.6(a)

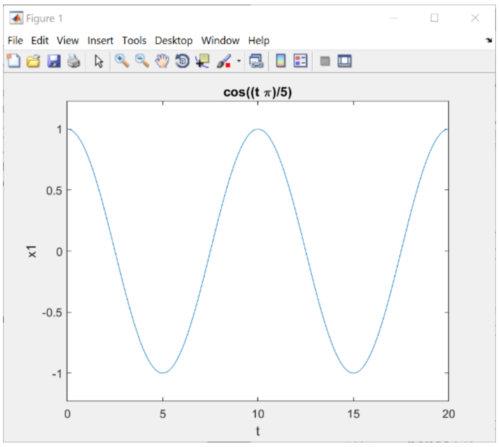
```
t=[0:10];
x=str2sym('sin(2*pi*t/T)');
x5=subs(x,'T',5)
ezplot(x5,t)
```

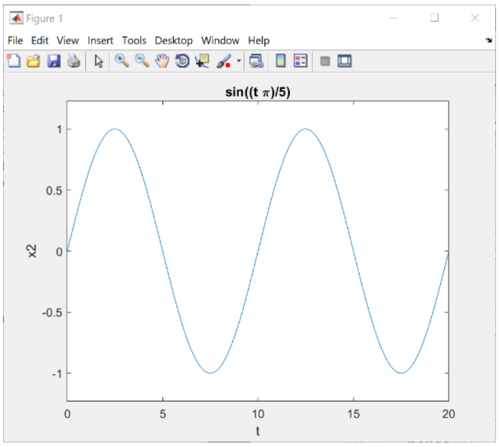


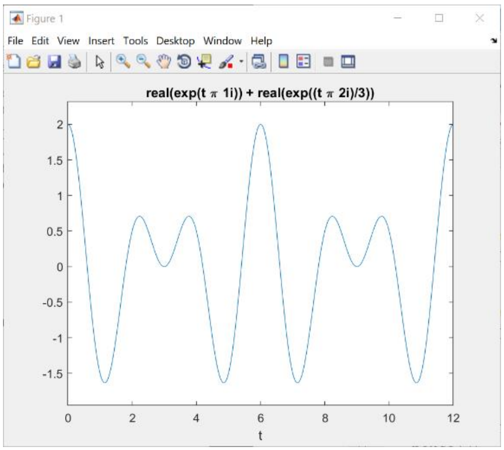
1.8(a)(b)

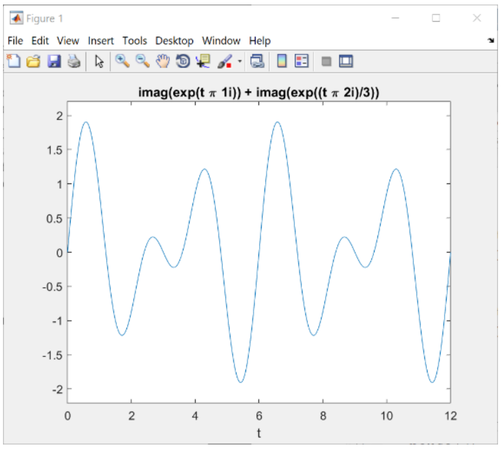
```
t=[0:20];
x1=str2sym('cos(pi*t/5)');
x2=str2sym('sin(pi*t/5)');
ezplot(x1,t);
xlabel('t');
ylabel('x1');
pause(3)
ezplot(x2,t)
xlabel('t');
ylabel('x2');
pause(3)
t=[0:12];
x3=str2sym('exp(i*pi*2*t/3)+exp(i*pi*t)');
ezplot(real(x3),t)
pause(3)
```

```
ezplot(imag(x3),t)
pause(3)
xlabel('t');
ylabel('x3');
```









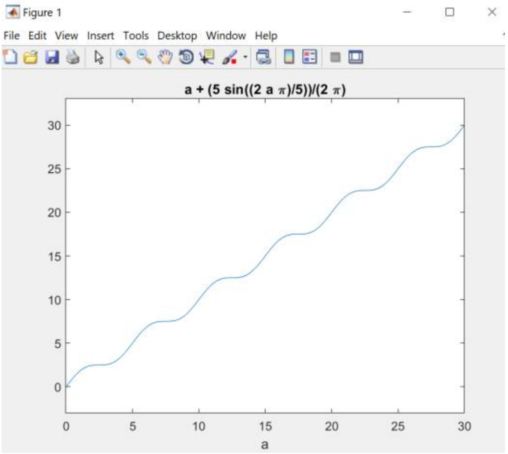
(c)

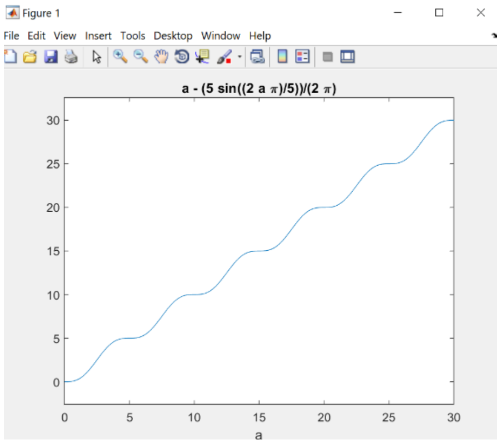
```
p1=x1*x1;
p2=x2*x2;
p31=real(x3)*real(x3);
p32=imag(x3)*imag(x3);
lim1=str2sym('-a');
lim2=str2sym('a');
E1=int(p1,lim1,lim2);
E2=int(p2,lim1,lim2);
E3=int(p31,lim1,lim2)+int(p32,lim1,lim2)
```

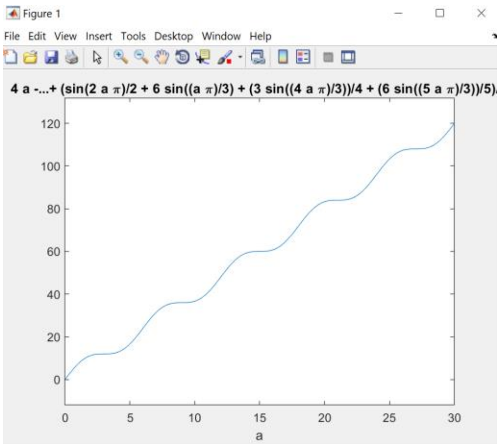
(d)

```
p1=x1*x1;
p2=x2*x2;
p31=real(x3)*real(x3);
p32=imag(x3)*imag(x3);
lim1=-5;
lim2=5;
E1=int(p1,lim1,lim2)
E2=int(p2,lim1,lim2)
```

```
lim1=-3;
lim2=3;
E3=int(p31,lim1,lim2)+int(p32,lim1,lim2)
>> testcdef
E1 =5
E2 =5
E3 =12
p1=x1*x1;
p2=x2*x2;
p31=real(x3)*real(x3);
p32=imag(x3)*imag(x3);
lim1=str2sym('-a');
lim2=str2sym('a');
a=[0:30];
E1=int(p1,lim1,lim2);
E2=int(p2,lim1,lim2);
ezplot(E1,a)
pause(3)
ezplot(E2,a)
pause(3)
E3=int(p31,lim1,lim2)+int(p32,lim1,lim2)
ezplot(E3,a)
```



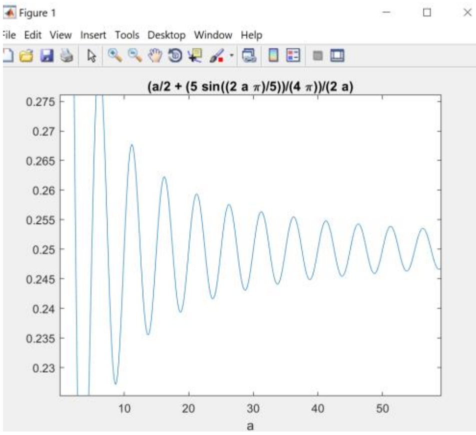


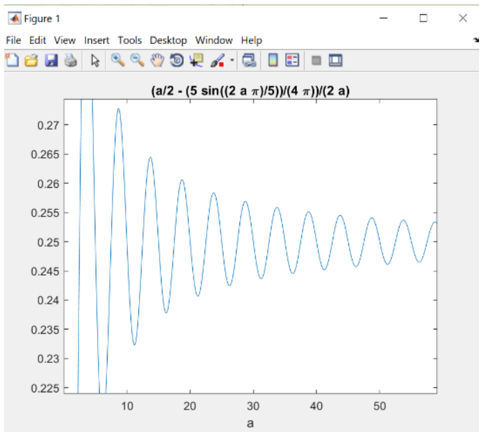


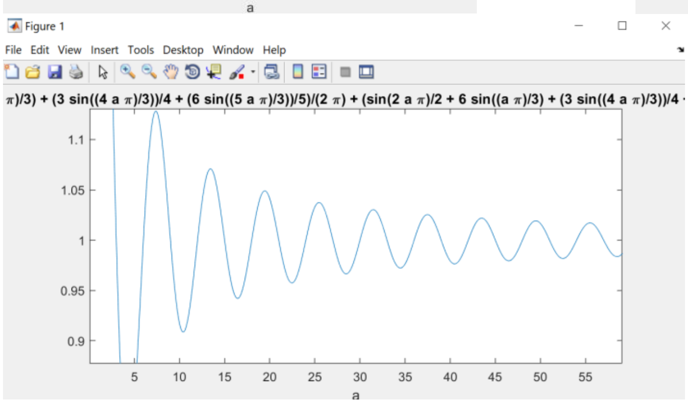
The energy increases with the increase of time interval. When the interval length goes to infinity, the energy also goes to infinity.

(e)

```
p1=x1*x1;
p2=x2*x2;
p31=real(x3)*real(x3);
p32=imag(x3)*imag(x3);
lim1=str2sym('-a');
lim2=str2sym('a');
a=[0.1:60];
E1=int(p1,lim1,lim2)
P1=(E1/2)./(lim2-lim1);
ezplot(P1,a)
pause(3)
E2=int(p2,lim1,lim2);
P2=(E2/2)./(lim2-lim1);
ezplot(P2,a)
pause(3)
E3=int(p31,lim1,lim2)+int(p32,lim1,lim2);
P3=(E3/2)./(lim2-lim1);
ezplot(P3,a)
```







When a goes to infinity, P converges to different values. When a is a small value, there is large difference between P_∞ and $E_{T/2}/T$. The larger a is, the smaller the difference is.

(f)

```
simplify(P1+P2)
ans = 1/2
```

P1 and P2 have the same period and similar development tendency, so they converges to the same value. They both converges to 0.25 from the plot we got, therefore, when we

```
simplify the result, it becomes 0.5.
```

九、 **Summary and comments：**

From this lab, I learned the expressions of signals in MATLAB. I got to know how to use it as a tool to calculate energy and power of signals, and how to proof the relative properties of a signal. I also found that I am not very familiar with the operations on MATLAB, in which aspect I should make more effort.

十、 **Suggestion for this lab：**

I suggest to correct the functions which were abandoned in the latest version of MATLAB in advance to give us more convenience while studying.

Score:

Instructor: