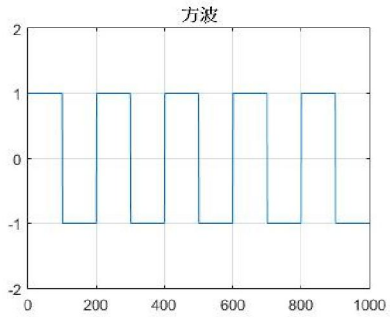
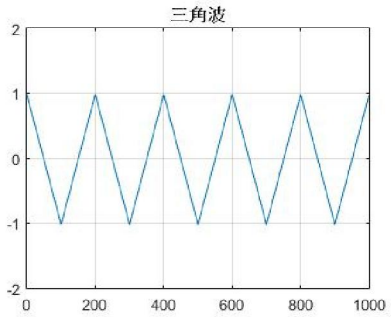
Code

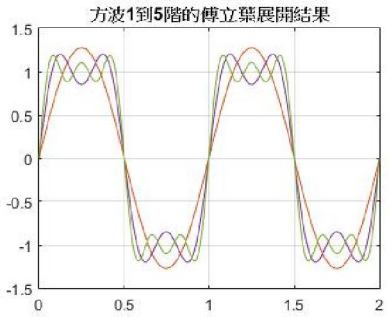
```
%the part of doing the Q1-1&Q1-2
%finding the square wave and triangle wave with sampling rate of 100Hz
x1=0;
yelement=1;
ytriangle=1;
for t=1:1:1000

    if sin(x1*pi*0.01)>=0    %the part of sine wave from 0 to pi
        ysquare=yelement*1;
        ytriangle=ytriangle-0.02;   %0.02 is the gradient
    end

    if sin(x1*pi*0.01)<0     %the part of sine wave from pi to 2pi
        ysquare=yelement*-1;
        ytriangle=ytriangle+0.02;
    end

   Xarray(t)=x1;
   Y1array(t)=ysquare;  %array to store the data of square wave
   Y2array(t)=ytriangle;    %array to store the data of triangle wave
   x1=x1+1;
end
subplot(2,3,1);
plot(Xarray,Y1array),grid on,hold on
title('方波')
axis([0 1000 -2 2]);
subplot(2,3,2);
plot(Xarray,Y2array),grid on,hold on
title('三角波')
axis([0 1000 -2 2]);

%the part of doing the Q2&Q3
%finding the square wave from first to firth order
 %the initial definition is used
 Po=1;
syms x2;
syms x3;
 syms n;

    %the initial definition of fourier series of square wave
    a0=2./Po*int(1*cos(2*pi*0*x2./Po),x2,0,1./2)+2./Po*int(-
1*cos(2*pi*0*x2./Po),1./2,1);
    a(n)=2./Po*int(1*cos(2*pi*n*x2./Po),x2,0,1./2)+2./Po*int(-
1*cos(2*pi*n*x2./Po),1./2,1);
    b(n)=2./Po*int(1*sin(2*pi*n*x2./Po),x2,0,1./2)+2./Po*int(-
1*sin(2*pi*n*x2./Po),1./2,1);
    x2=0:0.01:2;

    %the initial definition of fourier series of triangle wave
    A0=2./Po*int((-4*x3+1).*cos(2*pi*0*x3./Po),x3,0,1./2)+2./Po.*int((4*x3-
3)*cos(2*pi*0*x3./Po),1./2,1);
```

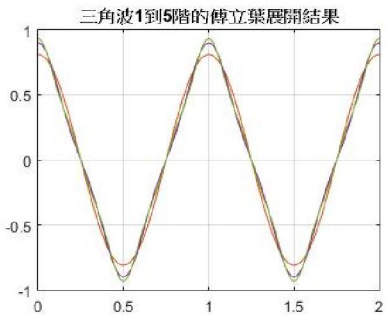
```
    A(n)=2./Po*int((-4*x3+1).*cos(2*pi*n*x3./Po),x3,0,1./2)+2./Po.*int((4*x3-
3)*cos(2*pi*n*x3./Po),1./2,1);
    B(n)=2./Po*int((-4*x3+1).*sin(2*pi*n*x3./Po),x3,0,1./2)+2./Po.*int((4*x3-
3)*sin(2*pi*n*x3./Po),1./2,1);
    x3=0:0.01:2;

    Y2=0;
    Y3=0;
    for  n=1:1:5    %from first to firth-order
    if rem(n,2)==1  %since all even harmonies are 0, only the odd numbers
will did the work
          Y2=Y2+a(n)*cos(2*pi*n*x2./Po)+b(n)*sin(2*pi*n*x2./Po);
          Y3=Y3+A(n)*cos(2*pi*n*x3./Po)+B(n)*sin(2*pi*n*x3./Po);
    end
    Ysquarewave2=a0./2+Y2;
    subplot(2,3,3);
    plot(x2,Ysquarewave2),grid on,hold on;
    title('方波1到5阶的傅里叶展开结果)
    subplot(2,3,4);
    Ysquarewave3=A0./2+Y3;
    plot(x3,Ysquarewave3),grid on,hold on;
    title('三角波1到5阶的傅里叶展开结果')

    end

%the part of doing the Q4
%finding the Fourier expansion results by using the basic definition
clear all;
syms x4;
FFF=0;
 ddd=0;
  x4=0:0.001:5;
 N=5;
 hold on;
for n=1:1:N

 FFF=FFF+(2./((n.*pi).^2)).*(((-1).^n)-1).*cos(n.*pi.*(x4+1))-
(2./(n.*pi)).*((-1).^n).*sin(n.*pi.*(x4+1));

 lll=-1./2+FFF;
    hold on;
 subplot(2,3,5);
    plot(x4,lll);,grid on,hold on;
   title('Q4: 1到5阶的傅里叶展开结果')

end
```

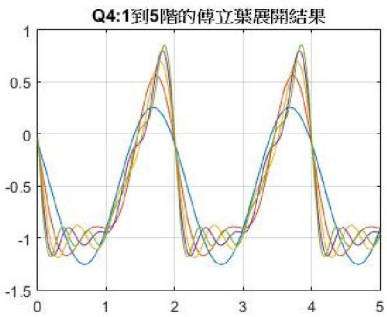
Graph

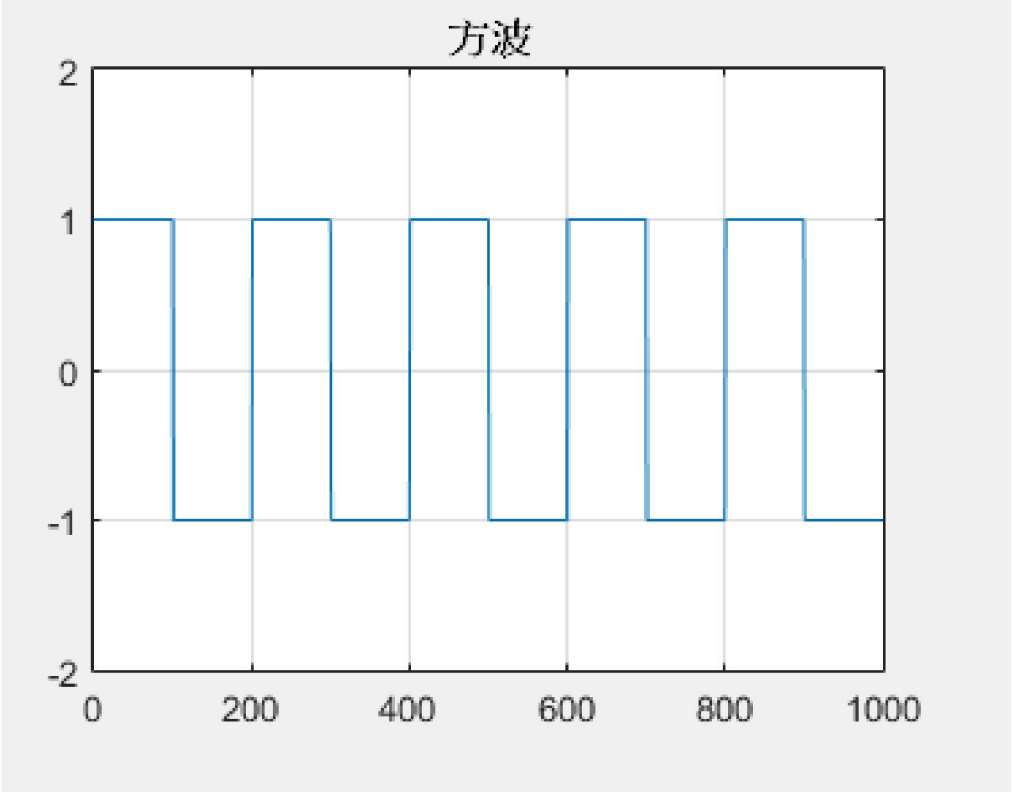

方波
2
1
0
-1
-2
0
200
400
600
800
1000

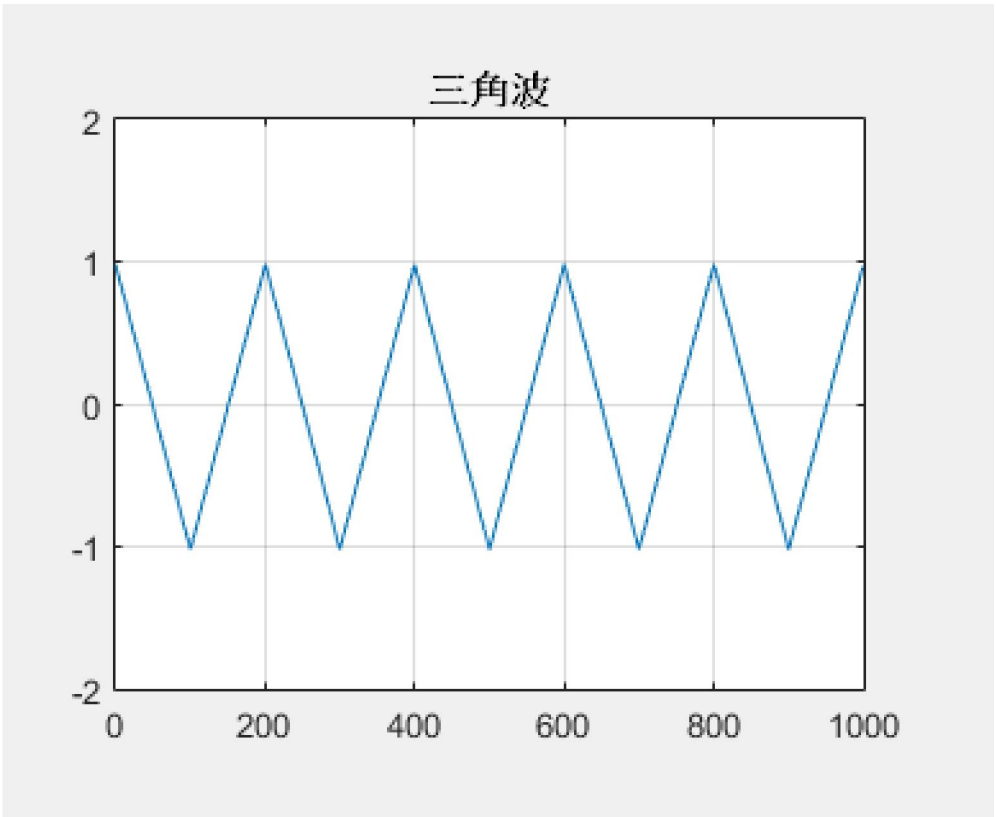

三角波
2
1
0
-1
-2
0
200
400
600
800
1000

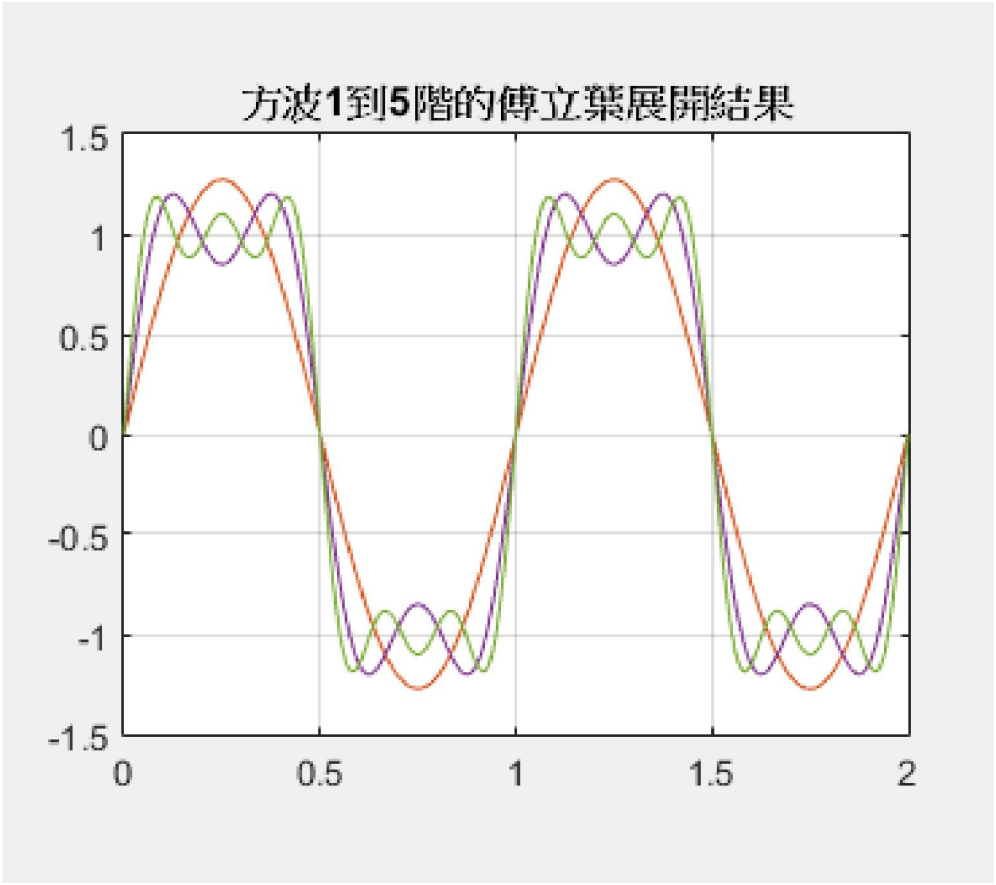

方波1到5階的傅立葉展開結果
1.5
1
0.5
0
-0.5
-1
-1.5
0
0.5
1
1.5
2

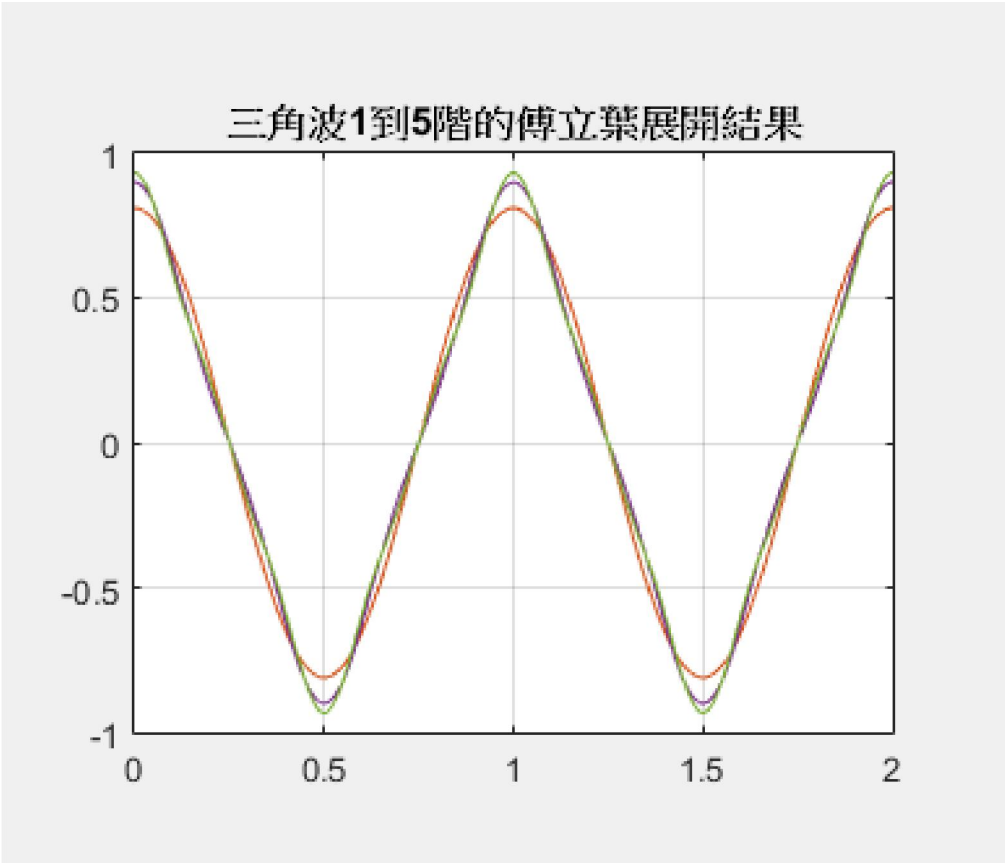

三角波1到5階的傅立葉展開結果
1
0.5
0
-0.5
-1
0
0.5
1
1.5
2

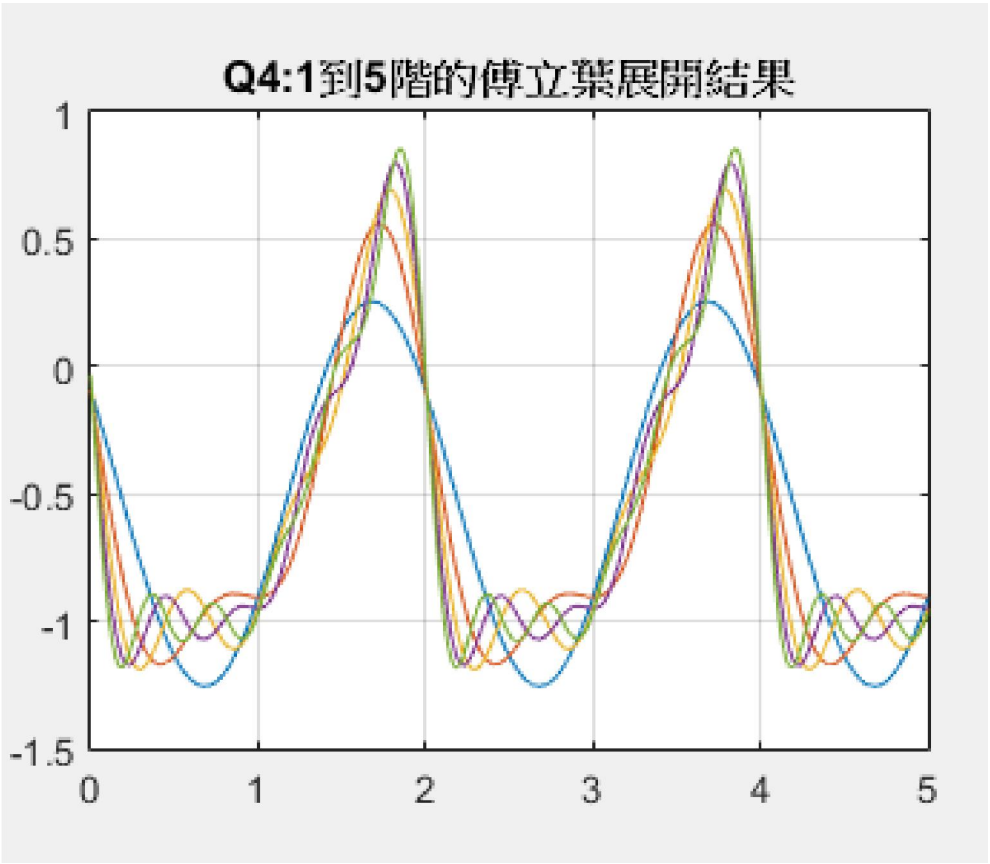

Q4:1到5階的傅立葉展開結果
1
0.5
0
-0.5
-1
-1.5
0
1
2
3
4
5


方波
2
1
0
-1
-2
0
200
400
600
800
1000

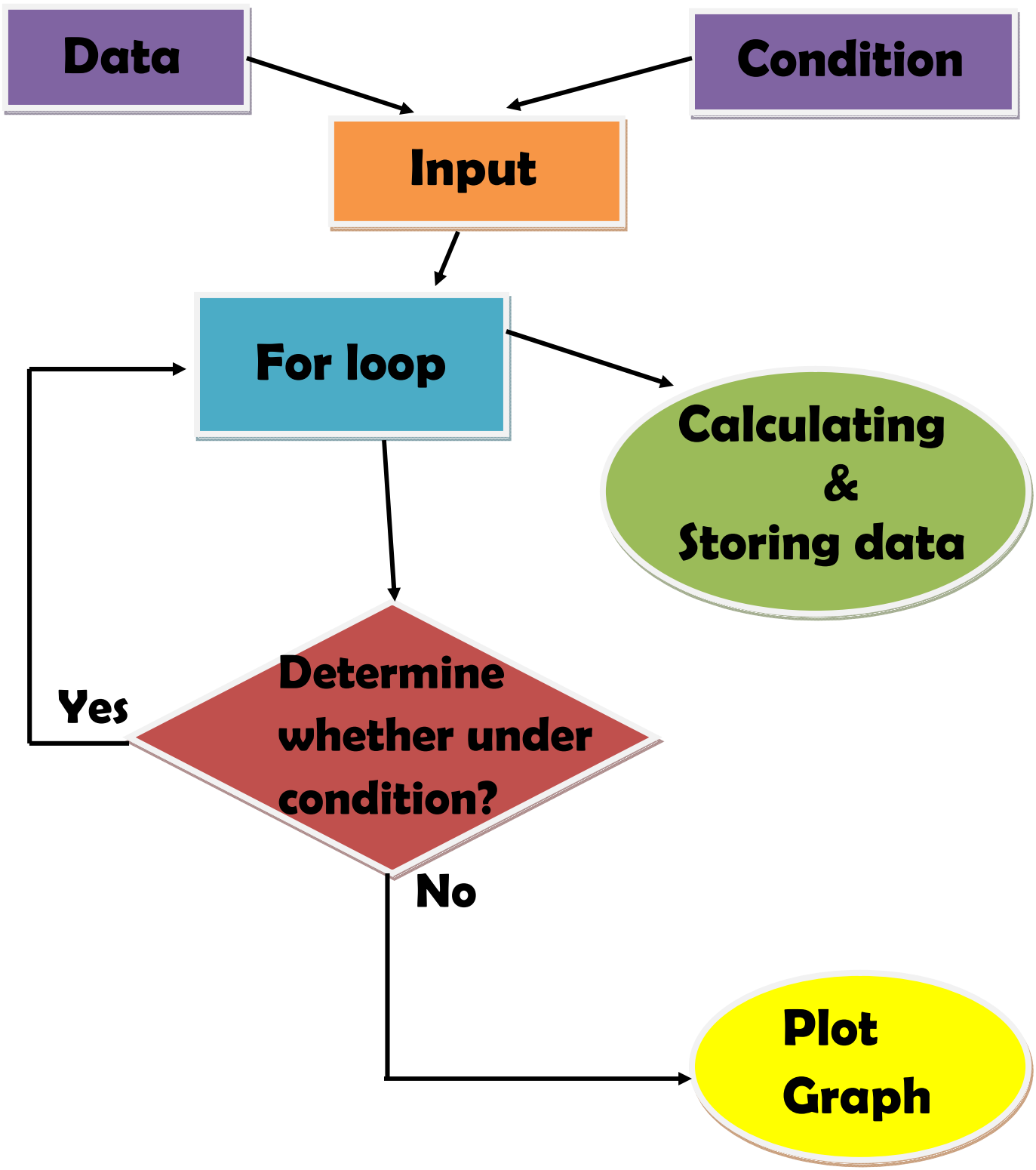

三角波
2
1
0
-1
-2
0
200
400
600
800
1000


方波1到5階的傅立葉展開結果
1.5
1
0.5
0
-0.5
-1
-1.5
0
0.5
1
1.5
2


三角波1到5階的傅立葉展開結果
1
0.5
0
-0.5
-1
0
0.5
1
1.5
2


Q4:1到5階的傅立葉展開結果
1
0.5
0
-0.5
-1
-1.5
0
1
2
3
4
5

Flow Chart


Data
Condition
Input
For loop
Calculating
&
Storing data
Determine
whether under
condition?
Yes
No
Plot
Graph