MATLAB CODES

1) Eigen values and Eigen vectors of a matrix.

CODE:

```
clc
clear
A=input('Enter a square matrix A: ');
lamda=eig(A);
disp('Eigenvalues are Lamda: ')
disp(lamda)
[X,D]=eig(A);
disp('Eigenvalues are D(i,i): ')
disp(diag(D))
disp('Eigenvectors are X: ')
disp(X)
```

Solved example:

```
Enter a square matrix A:
[2,3,4;6,4,1;9,4,1]
Eigenvalues are Lamda:
   10.7542
   -4.5511
    0.7968

Eigenvalues are D(i,i):
   10.7542
   -4.5511
    0.7968

Eigenvectors are X:
   -0.4958   -0.5979    0.3435
   -0.5410    0.3343   -0.7980
   -0.6793    0.7285    0.4952
```

2) Eigen values and Eigen vectors of a matrix(Diagonalisation)

CODE:

```
clc
clear
A = input('Enter a square matrix : ');
[X,D] = eig(A);
disp('Eigen values are D(i,i) : ')
disp(diag(real(D)))
disp('Eigen vectors are X : ')
disp(X)
option = input('Enter 1 to perform diagonalization with similarity
transformation or enter other number for orthogonal transformation : ');
if (option ==1)
P = X;
disp('the modal matrix P is: ')
disp(P)
disp('D1 = inv(P)*A*P : ')
D1 = inv(P)*A*P;
disp(D1)
else
M = X;
disp('The orthogonal matrix is : ')
disp(M)
disp('D2 = transpose(M)*A*M')
D2 = M'*A*M;
disp(D2)
end
```

Solved example:

```
Enter a square matrix :
[2,3,5;0,8,4;2,4,1]
Eigen values are D(i,i) :
   -2.3246
    3.0000
   10.3246

Eigen vectors are X :
    0.6375   -0.8971   -0.5229
    0.2783    0.2760   -0.7370
   -0.7184   -0.3450   -0.4283
```

```
Enter 1 to perform diagonalization with similarity transformation or enter
other number for orthogonal transformation :
1
the modal matrix P is:
    0.6375   -0.8971   -0.5229
    0.2783    0.2760   -0.7370
   -0.7184   -0.3450   -0.4283

D1 = inv(P)*A*P :
   -2.3246    0.0000    0.0000
   -0.0000    3.0000   -0.0000
   -0.0000    0.0000   10.3246
```

3) Quadratic Forms and Canonical Form.

CODE:

```
clc
clear
syms x1 x2 x3 y1 y2 y3
q = input("enter the quadratic form in terms of x1 x2 x3 : ");
a11 = (1/2)* diff(diff(q,x1),x1);
a22 = (1/2)* diff(diff(q,x2),x2);
a33 = (1/2)* diff(diff(q,x3),x3);
a12 = (1/2)* diff(diff(q,x1),x2);
a13 = (1/2)* diff(diff(q,x1),x3);
a23 = (1/2)* diff(diff(q,x2),x3);
A = [a11,a12,a13;a12,a22,a23;a13,a23,a33];
[M,D] = eig(A);
disp('The eigen values of A are : ')
disp(D)
disp("The orthogonal matrix : ")
disp(M)
disp("The canonical form of Q is : ")
disp(D(1,1)*y1^2+D(2,2)*y2^2+D(3,3)*y3^2)
```

Solved example:

```
enter the quadratic form in terms of x1 x2 x3 :
```

```
3*x1^2 + 4*x1*x2 + 4*x2^2 + 9*x3^2
The eigen values of A are :
[9,                0,                0]
[0, 7/2 - 17^(1/2)/2,                0]
[0,                0, 17^(1/2)/2 + 7/2]

The orthogonal matrix :
[0, - 17^(1/2)/4 - 1/4, 17^(1/2)/4 - 1/4]
[0,                  1,                1]
[1,                  0,                0]

The canonical form of Q is :

9*y1^2 + (7/2 - 17^(1/2)/2)*y2^2 + (17^(1/2)/2 + 7/2)*y3^2
```

4) Differential Equations

PART - I

CODE:

```
clc
clear


syms t C1 C2;

A = input('Enter the matrix A :  ');
G = input('Enter the non hom function as col matrix as fun of t: ');
[P,D] = eig(A);
H = inv(P) * G;

z1 = C1*exp(D(1,1)*t) * int(exp(-D(1,1)*t)*H(1));
z2 = C2*exp(D(2,2)*t) * int(exp(-D(2,2)*t)*H(2));

Z = [z1;z2];

X = P*Z;

disp(Z)

disp('THE GEN SOLN OF COUPLED ODE IS ')

disp(X)
```

Solved example:

```
Enter the matrix A :
[2,4;5,10]
Enter the non hom function as col matrix as fun of t:
[t;1]
  -(5^(1/2)*C1*t*(5*t - 4))/24
(29^(1/2)*C2*(12*t + 25))/1728

THE GEN SOLN OF COUPLED ODE IS
     (C1*t*(5*t - 4))/12 - (C2*(12*t + 25))/864
- (5*C2*(12*t + 25))/1728 - (C1*t*(5*t - 4))/24
```

PART - II

CODE:

```
clc
clear

syms C1 C2 C3 C4 t

A = input('Enter A  ');
[P,D] = eig(A);

z1 = C1*exp(sqrt(D(1,1)*t)) + C2*exp(-sqrt(D(1,1)*t))

z2 = C3*exp(sqrt(D(2,2)*t)) + C2*exp(-sqrt(D(2,2)*t))
```

Solved example:

```
Enter A
[4,2;3,3]

z1 =
C1*exp(6^(1/2)*t^(1/2)) + C2*exp(-6^(1/2)*t^(1/2))
z2 =
C2*exp(-t^(1/2)) + C3*exp(t^(1/2))
```

5) Differential Equations Using Laplace Transforms

PART - I

CODE:

```
clc
clear
syms  t s Y y(t) Dy(t)
Dy = diff(y, t);
D2y = diff(Dy, t);
LS = input('Enter function in terms of t ');

a = input('Enter value of a ');
b = input('Enter value of b ');
c = input('Enter value of c ');

yofzero = 1;
ydashzero = 1;


EQN=a*D2y+b*Dy+c*y-LS;

LEQN=laplace(EQN,t,s);

LT_Y=subs(LEQN,laplace(y,t,s),Y);
LT_Y=subs(LT_Y, y(0),yofzero);                            %  y(0) = 1
LT_Y=subs(LT_Y, subs(diff(y(t), t), t, 0), ydashzero);  %  dy(0)= 1

ys=solve(LT_Y,Y);
```

Solved example:

```
Enter function in terms of t

exp(-t)

Enter value of a

1

Enter value of b

4

Enter value of c

3


y =


(7*exp(-t))/4 - (3*exp(-3*t))/4 + (t*exp(-t))/2
```

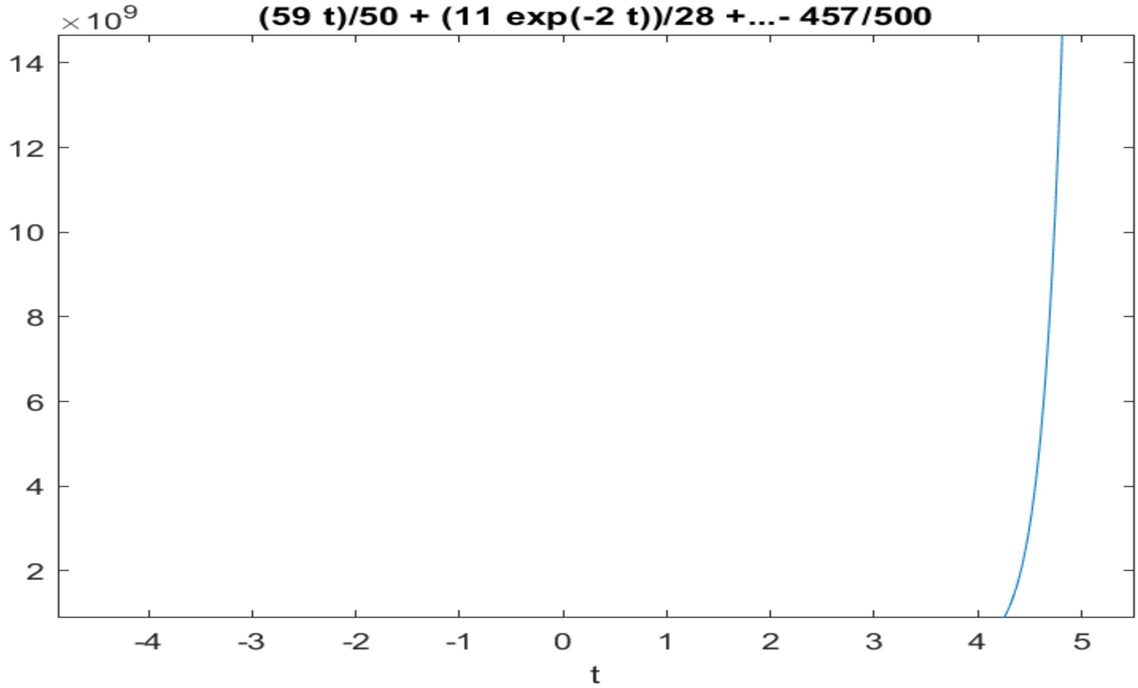
PART – II

CODE:

```
clc
clear
syms t s
a1 = input("Enter the coeff of x1 in eq1 : ");
a2 = input("Enter the coeff of x2 in eq1 : ");
b1 = input("Enter the coeff of x1 in eq2 : ");
b2 = input("Enter the coeff of x2 in eq2 : ");
f1 = input("Enter the first non-homo part as a function of t : ");
f2 = input("Enter the second non-homo part as a function of t : ");
F1 = laplace(f1);
F2 = laplace(f2);
c1 = input("Enter the initial value x1(0) : ");
c2 = input("Enter the initial value x2(0) : ");
G1 = c1+F1;
G2 = c2+F2;
A = [s-a1 -a2 ; -b1 s-b2];
X = A\[G1;G2];
x1 = ilaplace(X(1));
x2 = ilaplace(X(2));
ezplot(x1)
ezplot(x2)
```

Solved example:

```
Enter the coeff of x1 in eq1 : 2

Enter the coeff of x2 in eq1 : 4

Enter the coeff of x1 in eq2 : 3

Enter the coeff of x2 in eq2 : 1

Enter the first non-homo part as a function of t : t^2

Enter the second non-homo part as a function of t : 5*t

Enter the initial value x1(0) : 1

Enter the initial value x2(0) : 0

x1 =

(608*exp(5*t))/875 - (11*exp(-2*t))/28 - (113*t)/50 + t^2/10 + 349/500

x2 =

(59*t)/50 + (11*exp(-2*t))/28 + (456*exp(5*t))/875 - (3*t^2)/10 - 457/500
```



6) Fourier Series :

PART – I

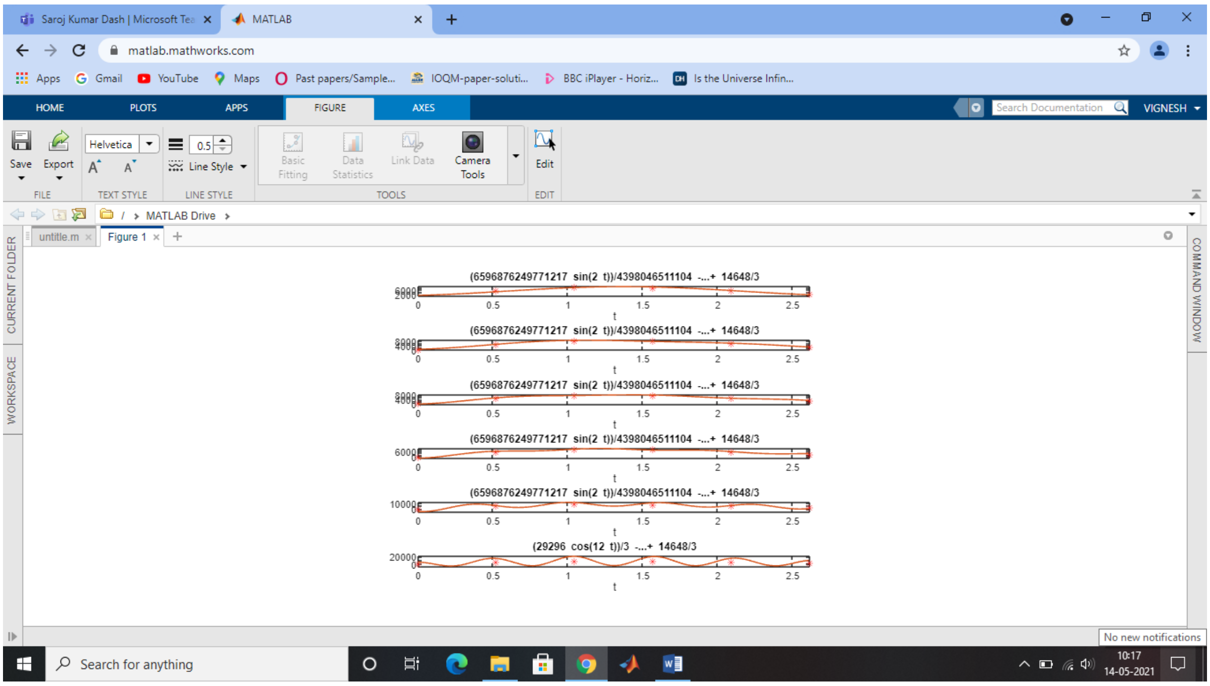
CODE:

```
clc
clear
syms t
n= input('Enter the number of data points n : ');
x_0= input('Enter the starting value of x : ');
count = input('type 0 if the unit of x is deg. type a non-zero number otherwise');
s=input('Enter the length of the spacing between successive values of x :');
n1= input('Enter the number of harmonic of the series n1 : ');
 for i=1:n
 x(i)=x_0+(i-1)*s;
 end
if (count == 0) x=x*pi/180;
s=s*pi/180;
end
```

```
y = input('Enter the y values (as a row vector) :');
l=0.5*(x(n)+s-x(1));
 % l=pi if it is degree
 a_0= (2/n)*sum(y);
 F_s=a_0/2;
 for i=1:n1
yc=y.*cos(i*pi*x/l);
ys=y.*sin(i*pi*x/l);
a(i)=(2/n)*sum(yc);
b(i)=(2/n)*sum(ys);
subplot(n1,1,i);
plot(x,y,'r*');
hold on
F_s = F_s+a(i)*cos(i*pi*t/l)+b(i)*sin(i*pi*t/l);
subplot(n1,1,i);
ezplot(F_s, [x(1) x(n)]);
end
disp('Fourier series :')
```

Solved example:

```
Enter the number of data points n :
6
Enter the starting value of x :
0
type 0 if the unit of x is deg. type a non-zero number otherwise
2
Enter the length of the spacing between successive values of x :
pi/6
Enter the number of harmonic of the series n1 :
6
Enter the y values (as a row vector) :
[0,5224,8097,7850,5499,2626]
Fourier series :
```



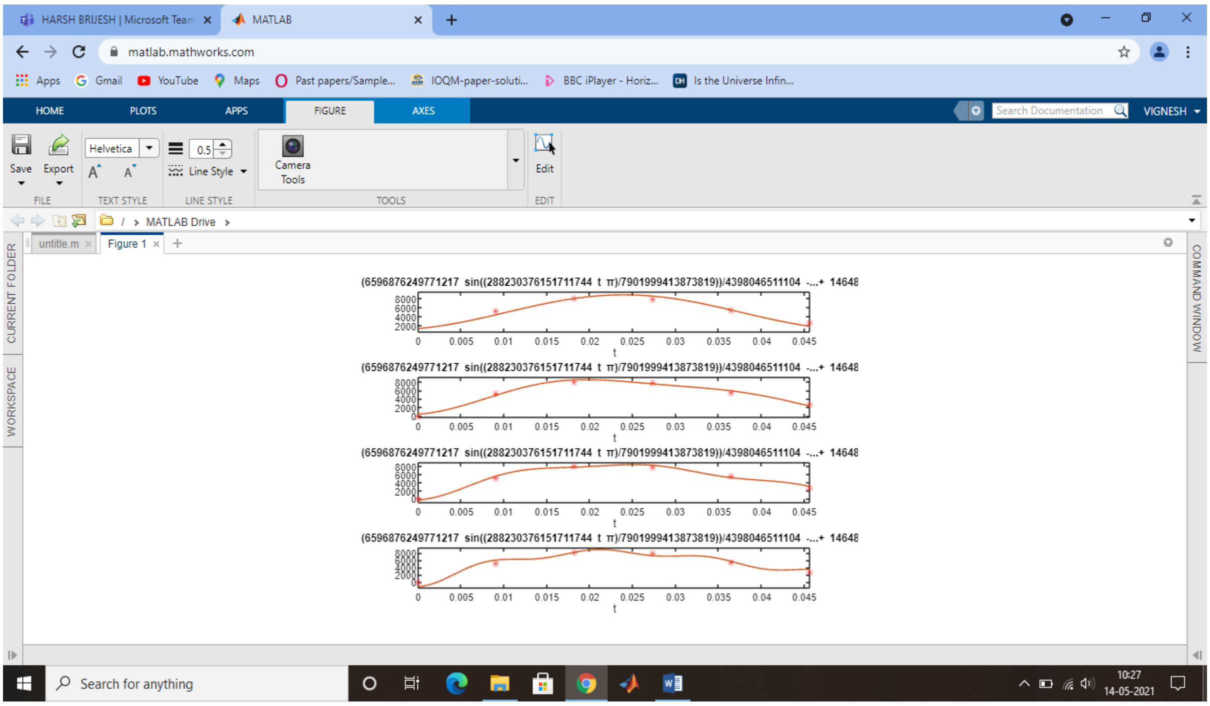
PART – II

```
clc
clear all
syms t;
N=input('Number of data points:');
x_0=input('The starting value of x:');
s=input("the step length of the x variable is:");
for i=1:N
x(i)=x_0+(i-1)*s;
end
y=input('The outcome as a row matrix:');
count=input('Enter 0(zero) for degree measurement otherwise any non-zero
number:');
if count==0
s=s*pi/180;
x=x*pi/180;
end
L=0.5*(x(N)+s-x_0);
a_0=(2/N)*sum(y);
N1=input('Enter a number to compute the maximum harmonics:');
F_s=a_0/2;
for i=1:N1
yc=y.*cos(i*pi*x/L);
ys=y.*sin(i*pi*x/L);
a(i)=(2/N)*sum(yc);
b(i)=(2/N)*sum(ys);
subplot(N1,1,i)
```

```
plot(x,y,'r*')
hold on
F_s=F_s+a(i)*cos(i*pi*t/L)+b(i)*sin(i*pi*t/L);
subplot(N1,1,i)
ezplot(F_s,[x(1),x(N)])
end
disp("the Fourier series of the given data:");
disp(F_s)
```

Solved example:

```
Number of data points:
6
The starting value of x:
0
the step length of the x variable is:
pi/6
The outcome as a row matrix:
[0,5224,8097,7850,5499,2626]
Enter 0(zero) for degree measurement otherwise any non-zero number:
0
Enter a number to compute the maximum harmonics:
4
the Fourier series of the given data:
```



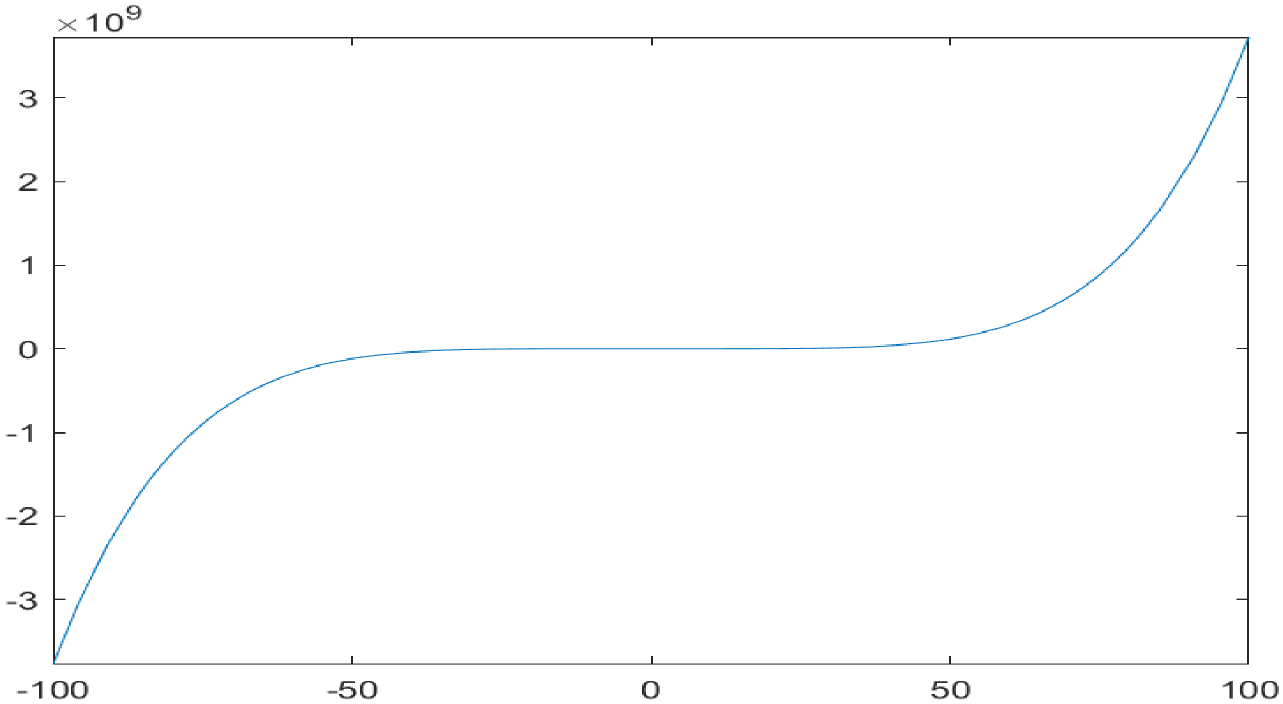
7) Power Series:

CODE:

```
clc
clear
syms x c_0 c_1 c_2 c_3 c_4 c_5 ;
p1=input('Coefficient of D2y: ') ;
p2=input('Coefficient of Dy: ') ;
p3=input('Coefficient of y: ') ;
c=[c_0, c_1, c_2, c_3, c_4, c_5];
y=sum(c.*(x).^(0:5)) ;
dy=diff(y) ;
d2y=diff(dy);
ode=p1*d2y+p2*dy+p3*y ;
ps=collect(ode,x) ;
d=coeffs(ps,x) ;
[c_2,c_3,c_4,c_5]=solve(d(1),d(2),d(3),d(4),{c_2,c_3,c_4,c_5}) ;
z=subs(y) ;
disp('The general solution of the given ode around x=0 is given by:') ;
disp(z) ;
i1=input('Enter y(0) :') ;
i2=input('Enter Dy(0):') ;
zz=subs(z,[c_0,c_1],[i1,i2]) ;
disp(' The Particular solution of the given ode around x=0 is given by:') ;
disp(zz) ;
fplot(zz,[-100 100]) ;
```

Solved example:

```
Coefficient of D2y: x^2 + 1

Coefficient of Dy: x

Coefficient of y: x

The general solution of the given ode around x=0 is given by:

((3*c_0)/40 + (3*c_1)/40)*x^5 - (c_1*x^4)/12 + (- c_0/6 - c_1/6)*x^3 + c_1*x +
c_0


Enter y(0) :2

Enter Dy(0):3

 The Particular solution of the given ode around x=0 is given by:

(3*x^5)/8 - x^4/4 - (5*x^3)/6 + 3*x + 2
```



8) Z TRANSFORMS:

```
clc
clear
syms n z Yz y(n)

assume(n>=0 & in(n,'integer'));
a = input('The coefficient of y(n+2) = ');
b = input('The coefficient of y(n+1) = ');
c = input('The coefficient of y(n) = ');

nh = input('The non homogeneous part in terms of n');

eq = a*y(n+2) + b*y(n+2) + c*y(n) - nh;
Zeq = ztrans(eq,n,z);
Zeq = subs(Zeq,ztrans(y(n),n,z),Yz);
Yz = solve(Zeq,Yz);

ysol = iztrans(Yz,z,n);
ysol = simplify(ysol);

if a==0
    d = input('The initial value y(0) =  ');
    ysol = subs(ysol,y(0),d);
else
    d = input('The initial value y(0) =  ');
    e = input('The initial value y(1) =  ');
    ysol = subs(ysol,[y(0),y(1)],[d,e]);
```

```
end

m = 0:20;
y = subs(ysol,n,m);
stem(y);
title('Difference equation');
xlabel('n');
ylabel('y(n)');
```

SOLUTION:

```
The coefficient of y(n+2) =
2
The coefficient of y(n+1) =
1
The coefficient of y(n) =
3
The non homogeneous part
n
The initial value y(0) =
0
The initial value y(1) =
0
```