MATLAB ASSIGNMENT 10

NAME: ANSHIL SETH
REG NO. : - 18BCI0173
FACULTY: - PROF. POORNIMA T
SLOT: - L 15+16

DATE: - 27 March 2019

QUESTIONS:-

Exercise

1. Solve $y_{n+2}-5y_{n+1}+6y_n=5^n, n\geq 0,\ y_0=1$ and $y_1=1$.
2. Solve $y(n+2)-y(n)=2^n, n\geq 0,\ y_0=0$ and $y_1=1$.
3. Solve $y(n+2)+2y(n+1)+y(n)=n, n\geq 0,\ y_0=0$ and $y_1=0$.
4. Solve $y(n+2)-4y(n+1)+3y(n)=n.2^n, n\geq 0,\ y_0=0$ and $y_1=0$.
5. Formulate the difference equation for Fibonacci numbers and hence solve by Z-transforms.

Soln :-

1.

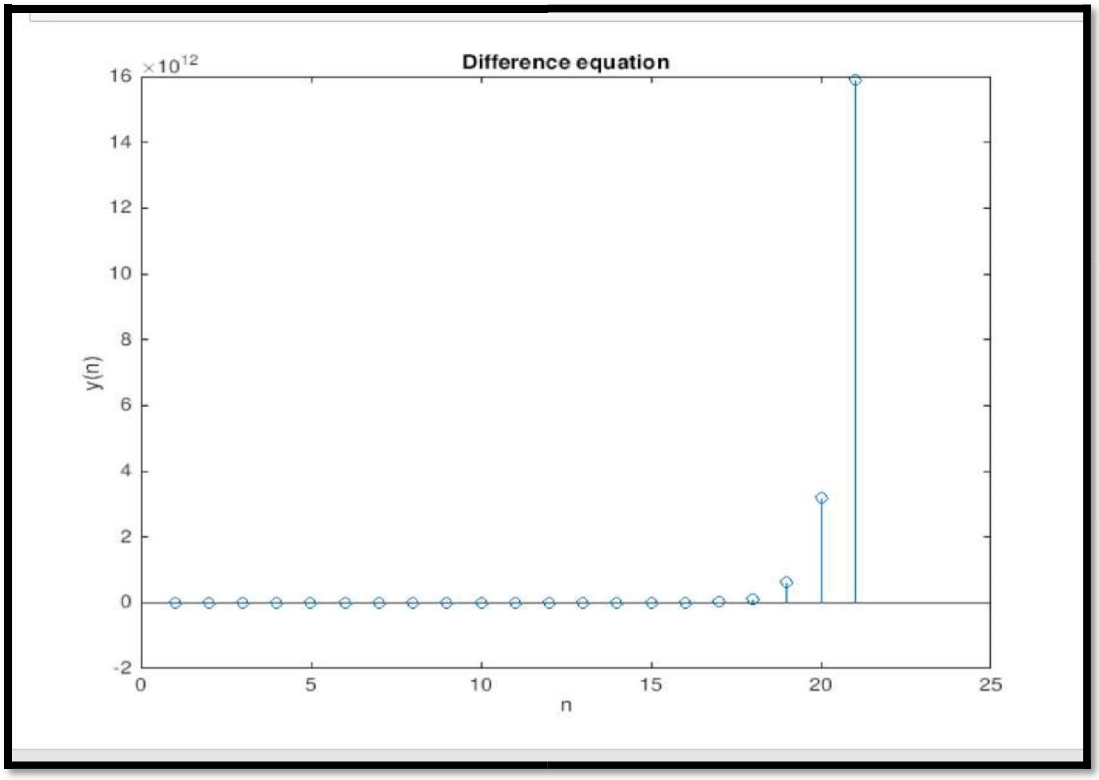
```
nh = input('Enter the non-homogenous part f(n): ');
eqn=a*yn2+b*yn1+c*yn-nh;
ZTY=ztrans(eqn);
IC=input('Enter the initial conditions in the form
[y0,y1]:'); y0=IC(1);y1=IC(2);
ZTY=subs(ZTY,{ztrans(y(n),n,z),y(0),y(1)},{Y,y0,y1}); eq=collect(ZTY,Y);
Y=simplify(solve(eq,Y)); yn=simplify(iztrans(Y));
disp('The solution of the difference equation yn=') disp(yn); m=0:20;
y=subs(yn,n,m); stem(y)
title('Difference equation'); xlabel('n'); ylabel('y(n)');
```

OUTPUT:-

```
22 -    stem(y)
23 -    title('Difference equation');
24 -    xlabel('n'); ylabel('y(n)');
```

```
COMMAND WINDOW

Input the coefficients [a,b,c]:
[1 -5 6]
Enter the non-homogenous part f(n):
5^n
Enter the initial conditions in the form [y0,y1]:
[1 1]
The solution of the difference equation yn=
(7*2^n)/3 - (3*3^n)/2 + 5^n/6

>>
```

Plot stem:



2.

Code:

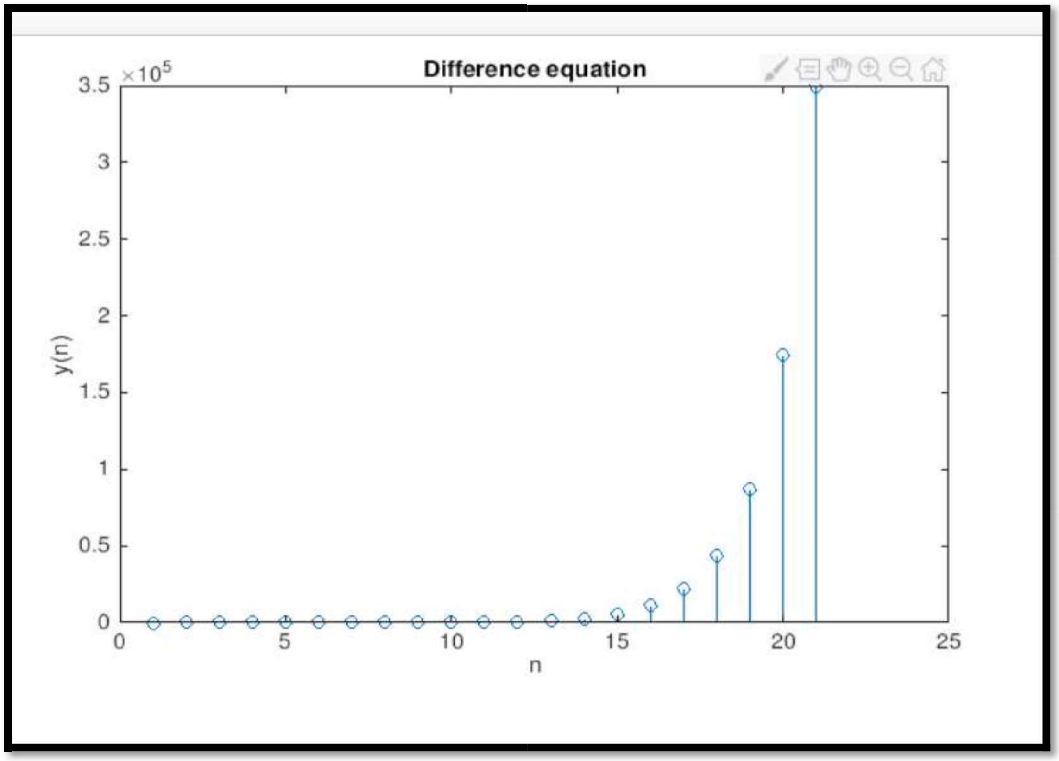
```
clear all clc syms n z y(n) Y
yn=y(n); yn1=y(n+1);
yn2=y(n+2);
F = input('Input the coefficients [a,b,c]: '); a=F(1);b=F(2);c=F(3);
nh = input('Enter the non-homogenous part f(n): ');
eqn=a*yn2+b*yn1+c*yn-nh;
ZTY=ztrans(eqn);
IC=input('Enter the initial conditions in the form
[y0,y1]:'); y0=IC(1);y1=IC(2);
ZTY=subs(ZTY,{ztrans(y(n),n,z),y(0),y(1)},{Y,y0,y1});
eq=collect(ZTY,Y); Y=simplify(solve(eq,Y));
yn=simplify(iztrans(Y));
disp('The solution of the difference equation yn=') disp(yn); m=0:20;
y=subs(yn,n,m); stem(y)
title('Difference equation'); xlabel('n'); ylabel('y(n)');
```

Output and Input:

```
Input the coefficients [a,b,c]:
[1 0 -1]
Enter the non-homogenous part f(n):
2^n
Enter the initial conditions in the form [y0,y1]:
[0 1]
The solution of the difference equation yn=
2^n/3 - (-1)^n/3
```

```
COMMAND WINDOW

Input the coefficients [a,b,c]:
[1 0 -1]
Enter the non-homogenous part f(n):
2^n
Enter the initial conditions in the form [y0,y1]:
[0 1]
The solution of the difference equation yn=
2^n/3 - (-1)^n/3

>>
```

Stem plot:



3.

Code:

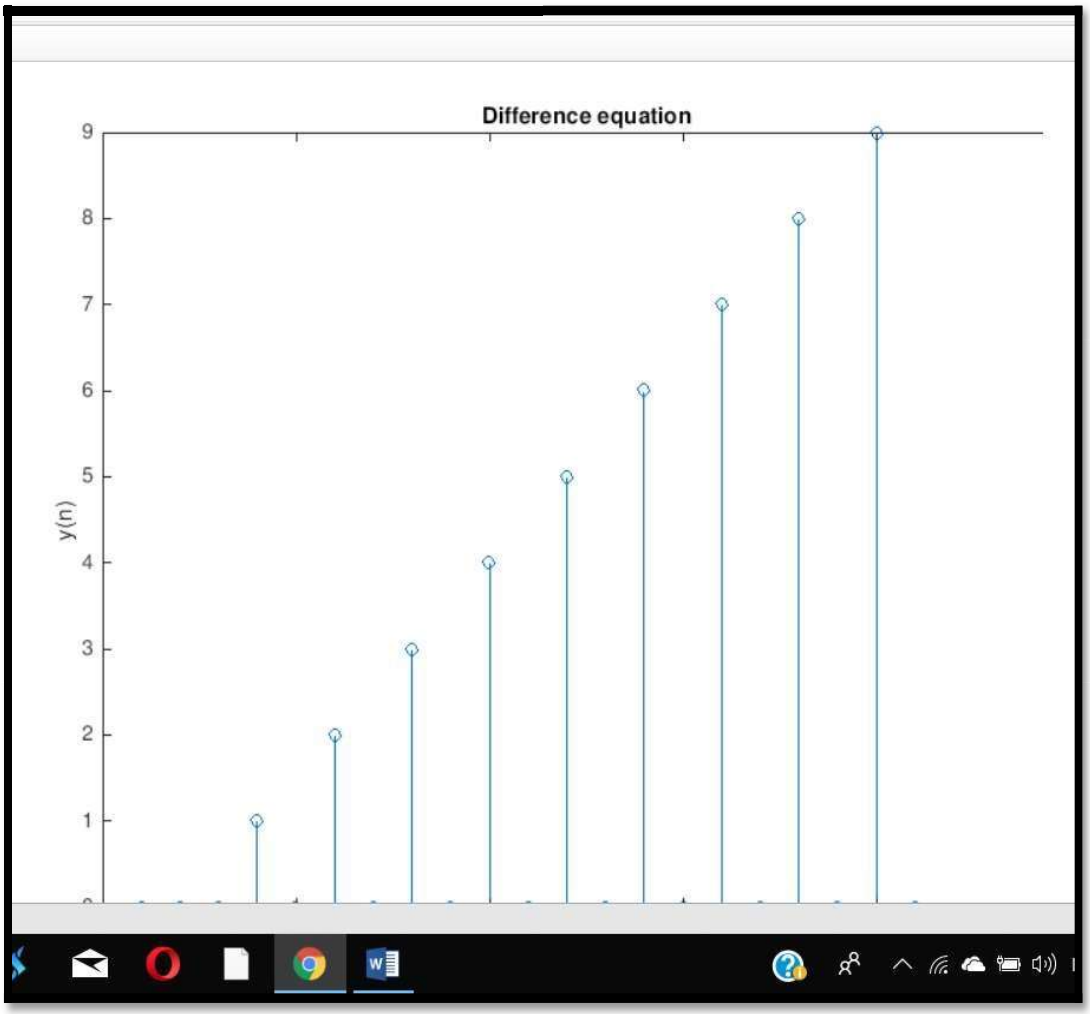
```
clear all
clc
syms n z y(n)
Y
yn=
y(n); yn1=y(n+1);
yn2=y(n+2);
F = input('Input the coefficients [a,b,c]: '); a=F(1);b=F(2);c=F(3);
nh = input('Enter the non-homogenous part f(n): '); eqn=a*yn2+b*yn1+c*yn-nh;
ZTY=ztrans(eqn);
IC=input('Enter the initial conditions in the form [y0,y1]:');
y0=IC(1);
y1=IC(2);
ZTY=subs(ZTY,{ztrans(y(n),n,z),y(0),y(1)},{Y,y0,y1});
eq=collect(ZTY,Y);
Y=simplify(solve(eq,Y));
yn=simplify(iztrans(Y));
disp('The solution of the difference equation yn=') disp(yn);
m=0:20;
y=subs(yn,n,m);
stem(y)
title('Difference equation');
xlabel('n');
ylabel('y(n)');
```

Inputs and Outputs:

```
Input the coefficients [a,b,c]:
[1 2 1]
Enter the non-homogenous part f(n):  n
Enter the initial conditions in the form [y0,y1]:
[0 0]
The solution of the difference equation yn=
-(((-1)^n - 1)*(n - 1))/4
```

```
14 -    ZTY=subs(ZTY,{ztrans(y(n),n,z),y(0),y(1)},{Y,y0,y1})
COMMAND WINDOW
Input the coefficients [a,b,c]:
[1 2 1]
Enter the non-homogenous part f(n):
n
Enter the initial conditions in the form [y0,y1]:
[0 0]
The solution of the difference equation yn=
-(((-1)^n - 1)*(n - 1))/4

>>
```

Stem plot:



4.

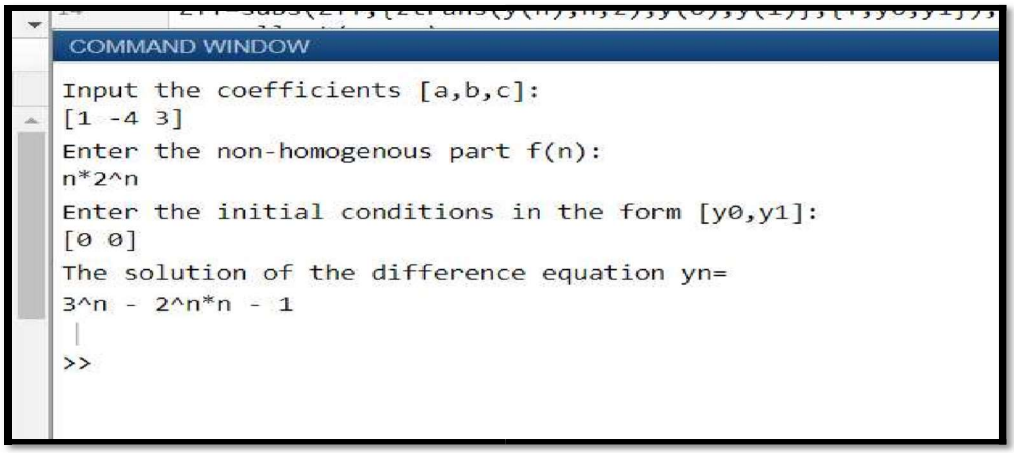
Code:

```
clear all

clc

syms n z y(n) Y

yn=y(n);

yn1=y(n+1);

yn2=y(n+2);

F = input('Input the coefficients [a,b,c]: ');
a=F(1);b=F(2);c=F(3);
nh = input('Enter the non-homogenous part f(n): ');
eqn=a*yn2+b*yn1+c*yn-nh;
ZTY=ztrans(eqn);
IC=input('Enter the initial conditions in the form
[y0,y1]:');
y0=IC(1);y1=IC(2);
ZTY=subs(ZTY,{ztrans(y(n),n,z),y(0),y(1)},{Y,y0,y1});
eq=collect(ZTY,Y);
Y=simplify(solve(eq,Y));
yn=simplify(iztrans(Y));
disp('The solution of the difference equation yn=') disp(yn);
m=0:20;
y=subs(yn,n,m);
stem(y)
title('Difference equation');
xlabel('n');
ylabel('y(n)');
```

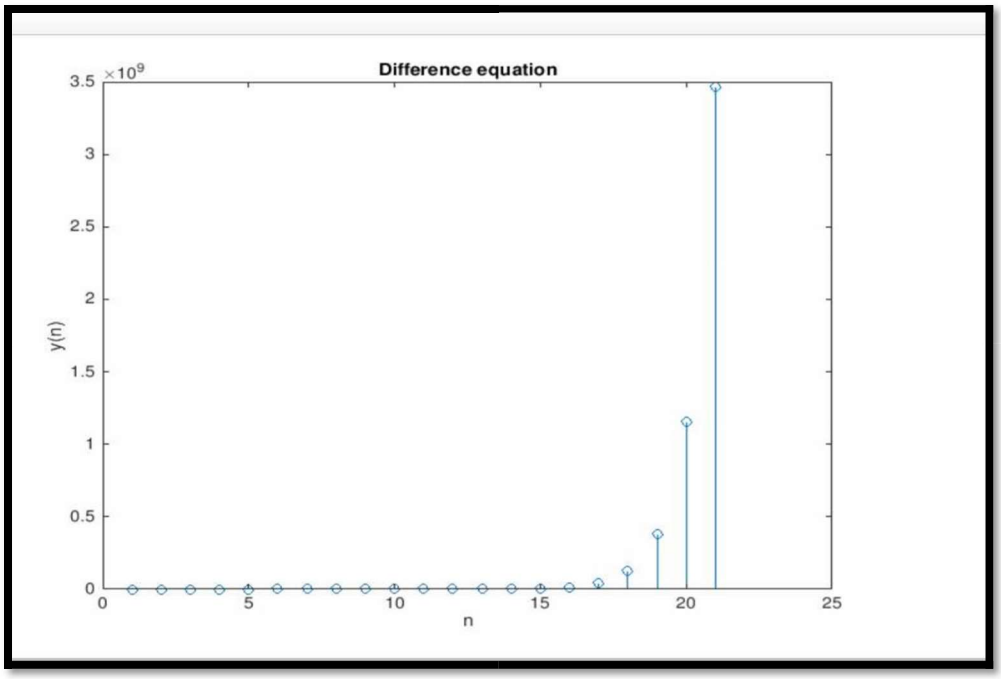
Input and Output:

```
Input the coefficients [a,b,c]:
[1 -4 3]
Enter the non-homogenous part f(n):
```

n*2^n
Enter the initial conditions in the form [y0,y1]:
[0 0]
The solution of the difference equation yn=
3^n - 2^n*n - 1



Stem plot:



5.

Code:

```
clear all
clc
syms n z y(n) Y
yn=y(n);
yn1=y(n+1);
yn2=y(n+2);
F = input('Input the coefficients [a,b,c]: ');
a=F(1);b=F(2);c=F(3);
nh = input('Enter the non-homogenous part f(n): ');
eqn=a*yn2+b*yn1+c*yn-nh;
ZTY=ztrans(eqn);
IC=input('Enter the initial conditions in the form
[y0,y1]:');
y0=IC(1);
y1=IC(2);
ZTY=subs(ZTY,{ztrans(y(n),n,z),y(0),y(1)},{Y,y0,y1});
eq=collect(ZTY,Y);
Y=simplify(solve(eq,Y)); yn=simplify(iztrans(Y));
disp('The solution of the difference equation yn=') disp(yn);
m=0:20; y=subs(yn,n,m);
stem(y)
title('Difference equation');
xlabel('n');
ylabel('y(n)');
```

Inputs and Output:

```
Input the coefficients [a,b,c]:
[1 -1 -1]
Enter the non-homogenous part f(n):
0
Enter the initial conditions in the form [y0,y1]:
[0 1]
The solution of the difference equation yn=
2*(-1)^(n/2)*cos(n*(pi/2 + asinh(1/2)*1i)) +
```

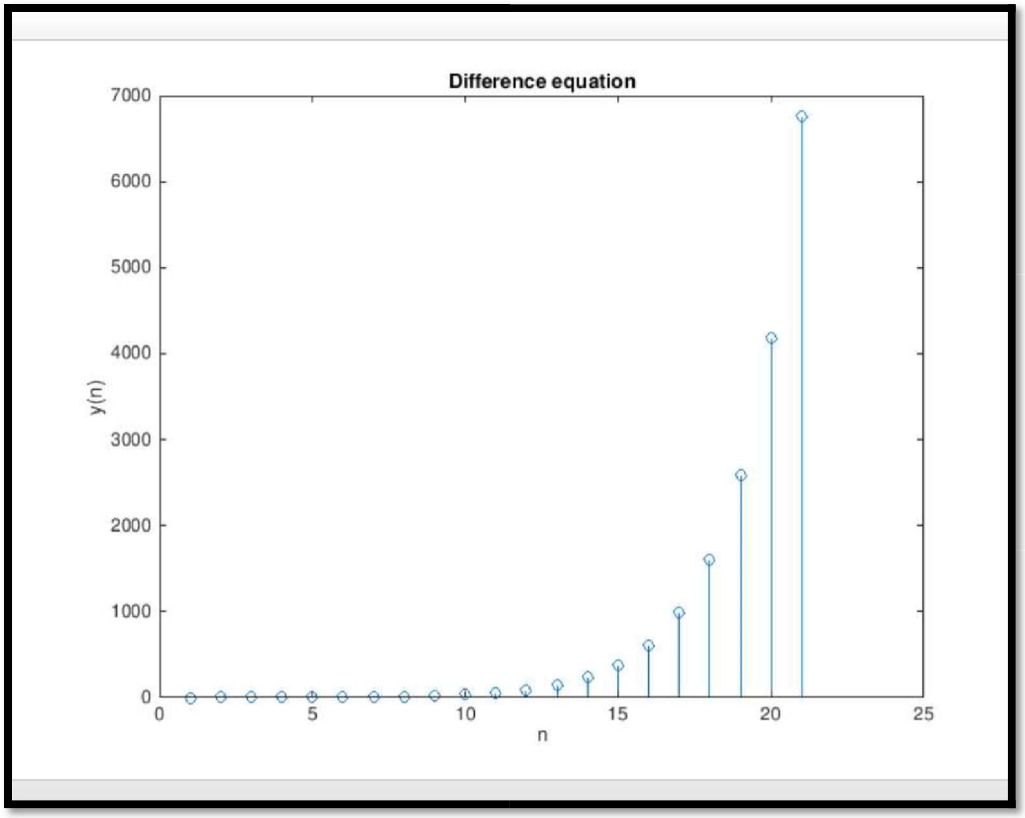
1/2^n*(5^(1/2)/5 - 1)*(5^(1/2) + 1)^n - 1/2^n*(5^(1/2)/5 + 1)*(1 - 5^(1/2))^n

```
14 -  ZTY=subs(ZTY,{ztrans(y(n),n,z),y(0),y(1)},{Y,y0,y1});
```

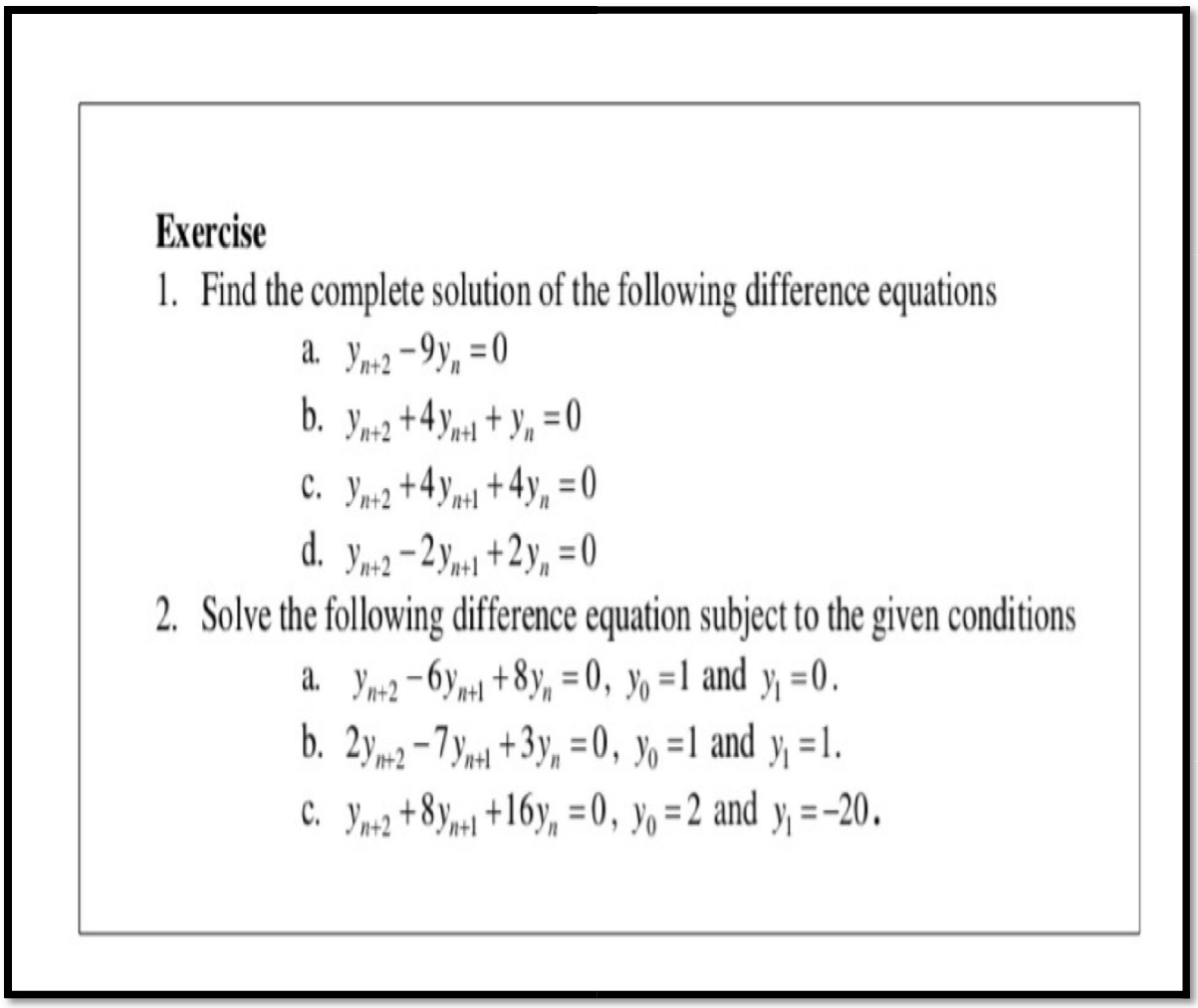
COMMAND WINDOW

```
Input the coefficients [a,b,c]:
[1 -1 -1]
Enter the non-homogenous part f(n):
0
Enter the initial conditions in the form [y0,y1]:
[0 1]
The solution of the difference equation yn=
2*(-1)^(n/2)*cos(n*(pi/2 + asinh(1/2)*1i)) + 1/2^n*(5^(1/2)/5 - 1)*(5^(1/2) + 1)^n - 1/2^n*(5^(1/2)/5 + 1)*(1 - 5^(1/2))^n

Warning: Using only the real component of complex data.
> In getRealData (line 52)
  In stem (line 40)
```

Stem plot:



Questions for Z transforms using undetermined coeff.:



Exercise

1. Find the complete solution of the following difference equations
   a. $y_{n+2} - 9y_n = 0$
   b. $y_{n+2} + 4y_{n+1} + y_n = 0$
   c. $y_{n+2} + 4y_{n+1} + 4y_n = 0$
   d. $y_{n+2} - 2y_{n+1} + 2y_n = 0$
2. Solve the following difference equation subject to the given conditions
   a. $y_{n+2} - 6y_{n+1} + 8y_n = 0,\ y_0 = 1$ and $y_1 = 0$.
   b. $2y_{n+2} - 7y_{n+1} + 3y_n = 0,\ y_0 = 1$ and $y_1 = 1$.
   c. $y_{n+2} + 8y_{n+1} + 16y_n = 0,\ y_0 = 2$ and $y_1 = -20$.

1.

Code:

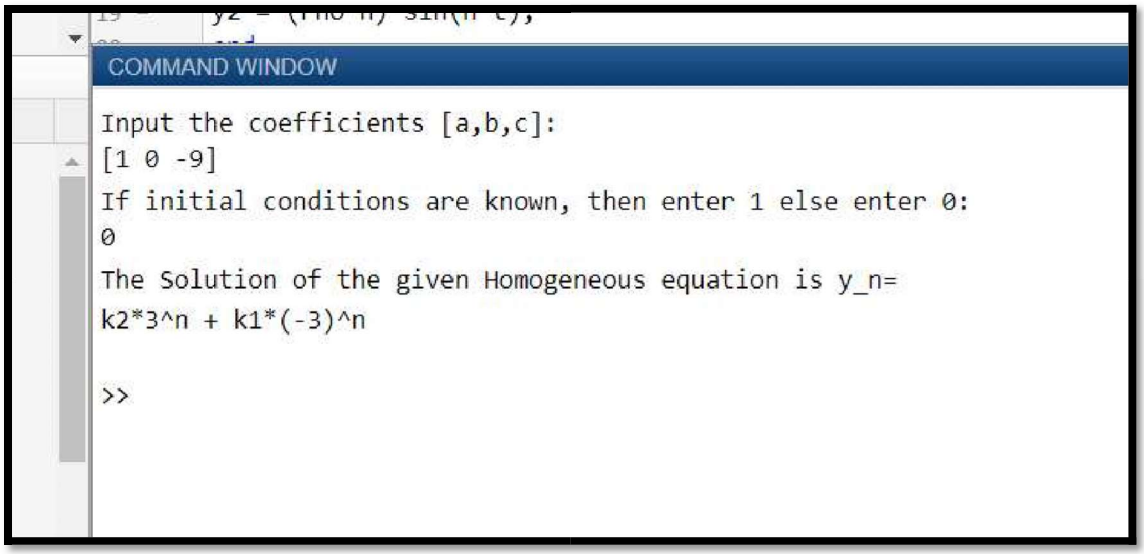
```
clear all

clc

syms n k1 k2 L

F = input('Input the coefficients [a,b,c]: ');
a=F(1);
b=F(2);
c=F(3);
ch_eqn=a*L^2+b*L+c; %Characteristic equation
L=solve(ch_eqn);
```

```
L1=L(1);
L2=L(2);
D=b^2-4*a*c;
if(D>0) % Roots are real and different
y1=L1^n;
y2=L2^n;
elseif (D==0)% Roots are real and equal y1=L1^n;
y2=n*L1^n;
else % Roots are complex rho=abs(L1);
t=angle(L1);
y1 = (rho^n)*cos(n*t); y2 = (rho^n)*sin(n*t); end yn =
k1*y1+k2*y2;
check=input('If initial conditions are known, then enter 1 else enter 0: '); if (check ==
1)
IC=input('Enter the initial conditions [y(0),y(1)]');
eq1=(subs(yn,n,0)-IC(1));
eq2=(subs(yn,n,1)-IC(2));
[k1,k2]=solve(eq1,eq2);
yn=simplify(subs(yn));
m=0:20;
y=subs(yn,n,m);
stem(y)
title('Difference equation');
xlabel('n');
ylabel('y(n)');
end
disp('The Solution of the given Homogeneous equation is y_n= ');
disp(collect(collect(yn,y1),y2))
```

Output:

```
Input the coefficients [a,b,c]:
[1 0 -9]
If initial conditions are known, then enter 1 else enter 0:
0
```

The Solution of the given Homogeneous equation is y_n= k2*3^n + k1*(-3)^n



2.

Code:

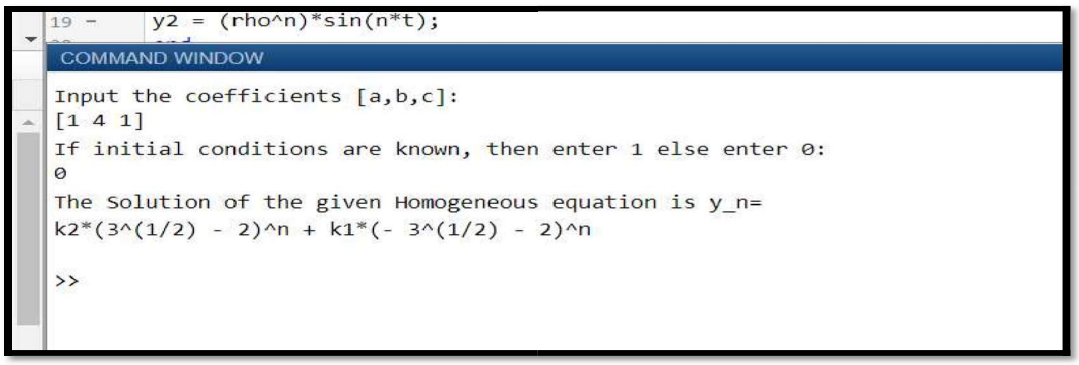
```
clear all

clc

syms n k1 k2 L

F = input('Input the coefficients [a,b,c]: ');
a=F(1);b=F(2);c=F(3);
ch_eqn=a*L^2+b*L+c; %Characteristic equation
L=solve(ch_eqn);
L1=L(1);L2=L(2);
D=b^2-4*a*c;
if(D>0) % Roots are real and different
y1=L1^n;
y2=L2^n;
elseif (D==0)% Roots are real and equal
y1=L1^n;
y2=n*L1^n; else % Roots are complex
rho=abs(L1);
t=angle(L1);
y1 = (rho^n)*cos(n*t);
```

```
y2 = (rho^n)*sin(n*t);
end yn = k1*y1+k2*y2;
check=input('If initial conditions are known, then enter 1 else enter 0: ');
if (check == 1)
IC=input('Enter the initial conditions [y(0),y(1)]');
eq1=(subs(yn,n,0)-IC(1));
eq2=(subs(yn,n,1)-IC(2));
[k1,k2]=solve(eq1,eq2);
yn=simplify(subs(yn));
m=0:20;
y=subs(yn,n,m);
stem(y)
title('Difference equation');
xlabel('n');
ylabel('y(n)');
end
disp('The Solution of the given Homogeneous equation is y_n= ');
disp(collect(collect(yn,y1),y2))
```

Output: -

```
Input the coefficients [a,b,c]:
[1 4 1]
If initial conditions are known, then enter 1 else enter 0:
0
```

The Solution of the given Homogeneous equation is y_n= k2*(3^(1/2) - 2)^n + k1*(- 3^(1/2) - 2)^n



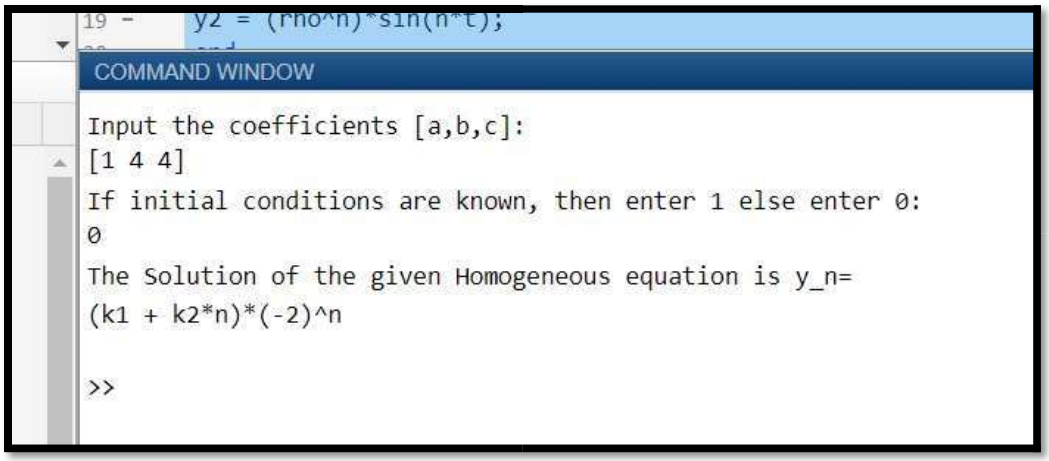
3.

Code:

```
clear all
clc syms n k1 k2 L
F = input('Input the coefficients [a,b,c]: ');
a=F(1);b=F(2);c=F(3);
ch_eqn=a*L^2+b*L+c; %Characteristic equation
L=solve(ch_eqn);
L1=L(1);L2=L(2); D=b^2-4*a*c;
if(D>0) % Roots are real and different
y1=L1^n;
y2=L2^n;
elseif (D==0)% Roots are real and equal
y1=L1^n;
y2=n*L1^n; else % Roots are complex
rho=abs(L1);
t=angle(L1);
y1 = (rho^n)*cos(n*t);
y2 = (rho^n)*sin(n*t);
end yn = k1*y1+k2*y2;
check=input('If initial conditions are known, then enter 1 else enter 0: ');
if (check == 1)
IC=input('Enter the initial conditions [y(0),y(1)]');
eq1=(subs(yn,n,0)-IC(1));
eq2=(subs(yn,n,1)-IC(2));
[k1,k2]=solve(eq1,eq2);
yn=simplify(subs(yn));
m=0:20;
y=subs(yn,n,m);
stem(y)
title('Difference equation');
xlabel('n');
ylabel('y(n)');
end
disp('The Solution of the given Homogeneous equation is y_n= ');
disp(collect(collect(yn,y1),y2))
```

Output:

Input the coefficients [a,b,c]:
[1 4 4]
If initial conditions are known, then enter 1 else enter 0:
0
The Solution of the given Homogeneous equation is y_n=
(k1 + k2*n)*(-2)^n



4.

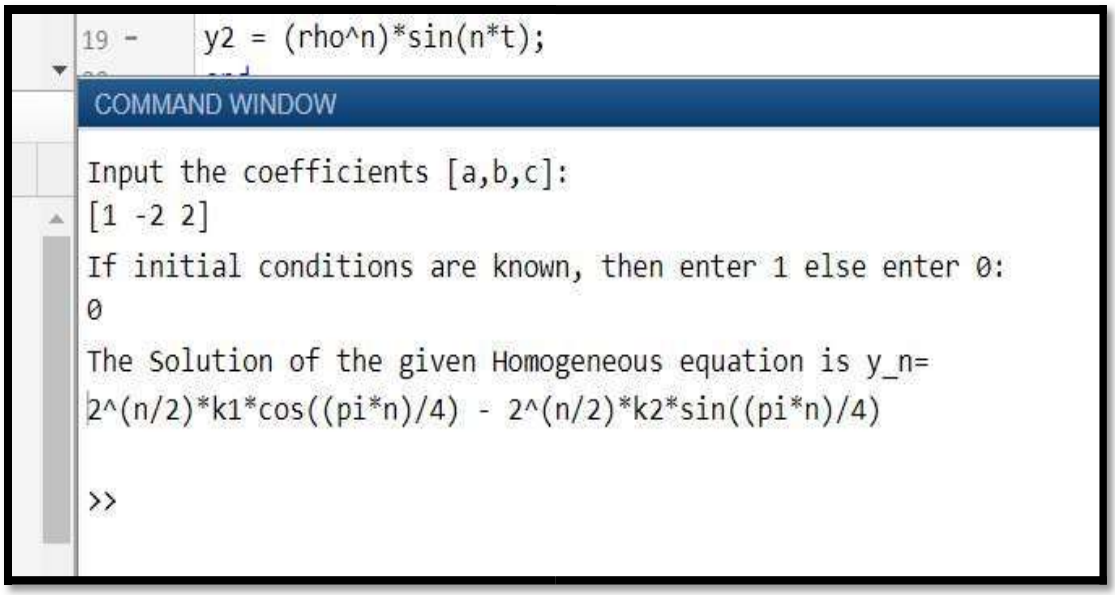
Code:

```
clear all
clc
syms n k1 k2 L
F = input('Input the coefficients [a,b,c]: ');
a=F(1);b=F(2);c=F(3);
ch_eqn=a*L^2+b*L+c; %Characteristic equation
L=solve(ch_eqn);
L1=L(1);L2=L(2);
D=b^2-4*a*c;
if(D>0) % Roots are real and different
y1=L1^n;
y2=L2^n;
elseif (D==0)% Roots are real and equal
```

```
y1=L1^n;
y2=n*L1^n;
else % Roots are complex rho=abs(L1);
t=angle(L1);
y1 = (rho^n)*cos(n*t);
y2 = (rho^n)*sin(n*t);
end yn = k1*y1+k2*y2;
check=input('If initial conditions are known, then enter 1 else enter 0: ');
if (check == 1)
IC=input('Enter the initial conditions [y(0),y(1)]');
eq1=(subs(yn,n,0)-IC(1));
eq2=(subs(yn,n,1)-IC(2));
[k1,k2]=solve(eq1,eq2);
yn=simplify(subs(yn));
m=0:20;
y=subs(yn,n,m);
stem(y)
title('Difference equation');
xlabel('n');
ylabel('y(n)');
end
disp('The Solution of the given Homogeneous equation is y_n= ');
disp(collect(collect(yn,y1),y2))
```

Output: -

```
Input the coefficients [a,b,c]:
[1 -2 2]
If initial conditions are known, then enter 1 else enter 0:
0
The Solution of the given Homogeneous equation is y_n=
2^(n/2)*k1*cos((pi*n)/4) - 2^(n/2)*k2*sin((pi*n)/4)
```



5.

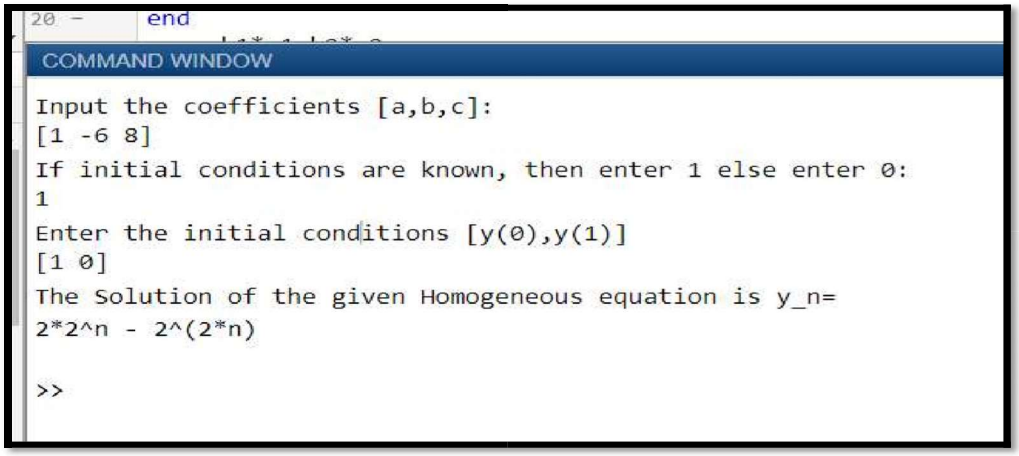
Code:

```
clear all
clc syms n k1 k2 L
F = input('Input the coefficients [a,b,c]: ');
a=F(1);b=F(2);c=F(3);
ch_eqn=a*L^2+b*L+c; %Characteristic equation
L=solve(ch_eqn);
L1=L(1);L2=L(2);
D=b^2-4*a*c;
if(D>0) % Roots are real and different
y1=L1^n; y2=L2^n;
elseif (D==0)% Roots are real and equal
y1=L1^n;
y2=n*L1^n; else % Roots are complex
rho=abs(L1);
t=angle(L1);
y1 = (rho^n)*cos(n*t);
y2 = (rho^n)*sin(n*t);
end
yn = k1*y1+k2*y2;
check=input('If initial conditions are known, then enter 1 else enter 0: ');
```

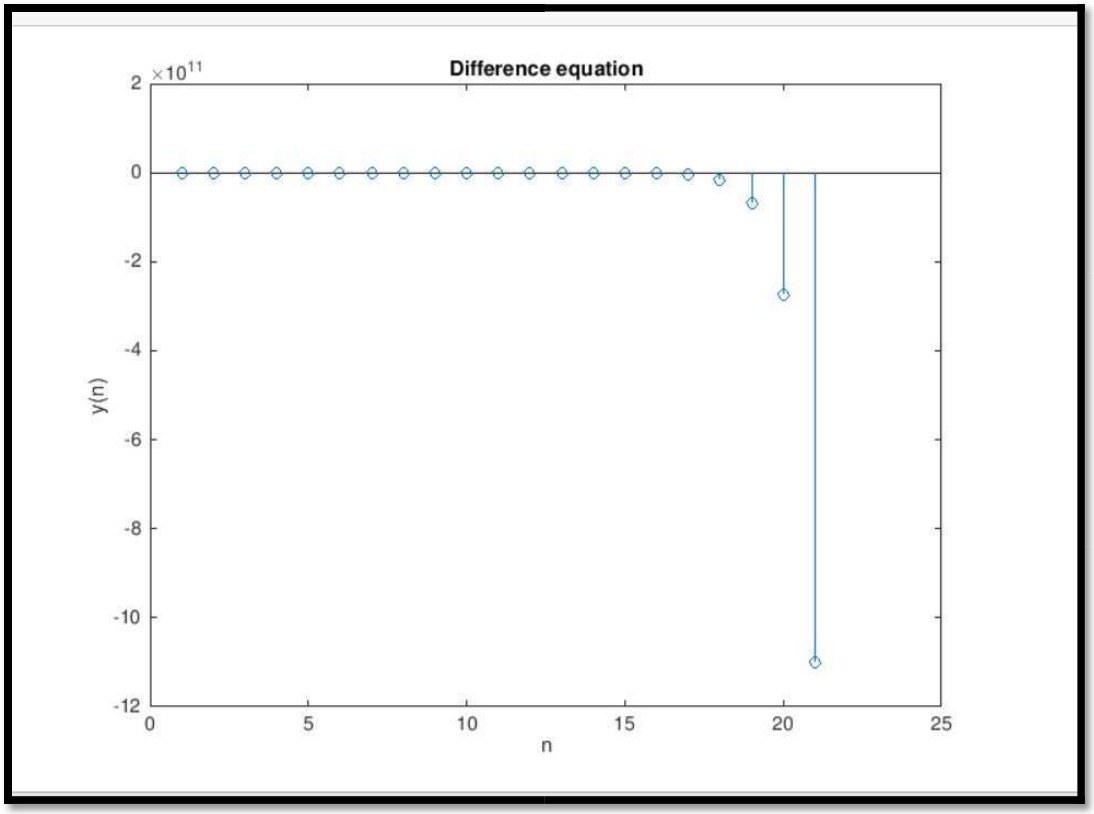
```
if (check == 1)
IC=input('Enter the initial conditions [y(0),y(1)]');
eq1=(subs(yn,n,0)-IC(1));
eq2=(subs(yn,n,1)-IC(2));
[k1,k2]=solve(eq1,eq2);
yn=simplify(subs(yn));
m=0:20;
y=subs(yn,n,m);
stem(y)
title('Difference equation'); xlabel('n');
ylabel('y(n)');
end
disp('The Solution of the given Homogeneous equation is y_n= ');
disp(collect(collect(yn,y1),y2))
```

Outputs:

```
Input the coefficients [a,b,c]:
[1 -6 8]
If initial conditions are known, then enter 1 else enter 0:
1
Enter the initial conditions [y(0),y(1)]
[1 0]
The Solution of the given Homogeneous equation is y_n=
2*2^n - 2^(2*n)
```



Stem plot:



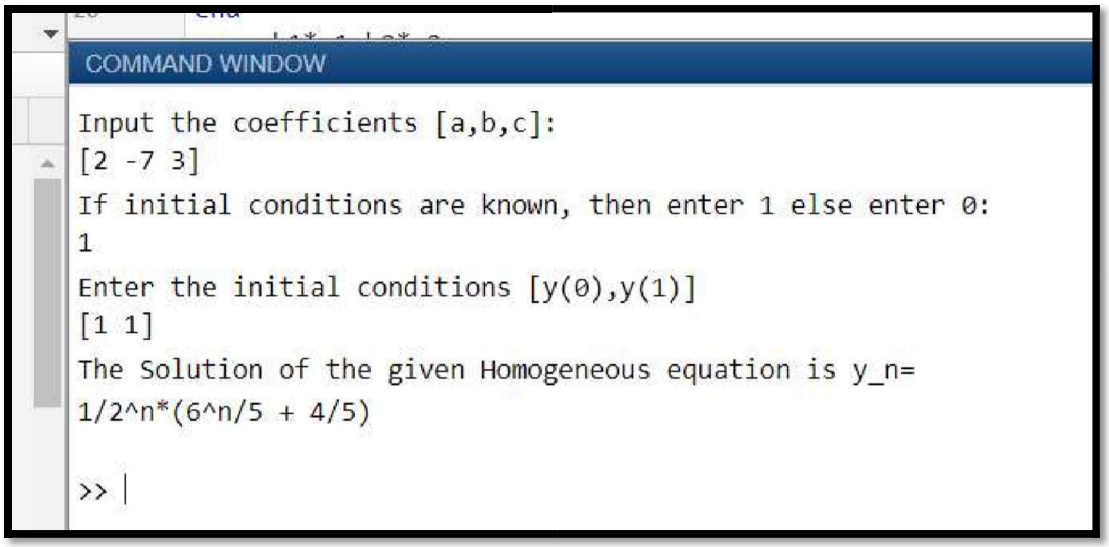
6.

Code:

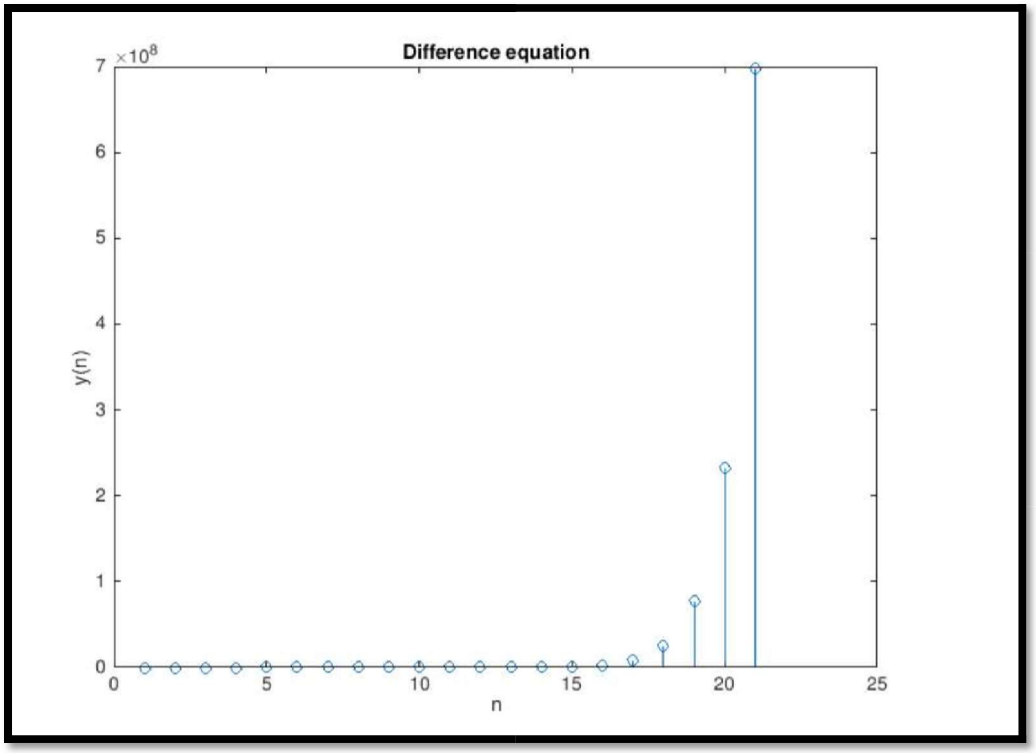
```
clear all
clc syms n k1 k2 L
F = input('Input the coefficients [a,b,c]: ');
a=F(1);b=F(2);c=F(3);
ch_eqn=a*L^2+b*L+c; %Characteristic equation
L=solve(ch_eqn);
L1=L(1);L2=L(2);
D=b^2-4*a*c;
if(D>0) % Roots are real and different y1=L1^n;
y2=L2^n;
elseif (D==0)% Roots are real and equal y1=L1^n;
y2=n*L1^n;
else % Roots are complex rho=abs(L1);
t=angle(L1); y1 = (rho^n)*cos(n*t);
```

```
y2 = (rho^n)*sin(n*t);
end yn = k1*y1+k2*y2;
check=input('If initial conditions are known, then enter 1 else enter 0: ');
if (check == 1)
IC=input('Enter the initial conditions [y(0),y(1)]'); eq1=(subs(yn,n,0)-IC(1));
eq2=(subs(yn,n,1)-IC(2)); [k1,k2]=solve(eq1,eq2); yn=simplify(subs(yn));
m=0:20;
y=subs(yn,n,m);
stem(y)
title('Difference equation');
xlabel('n');
ylabel('y(n)');
 end
disp('The Solution of the given Homogeneous equation is y_n= ');
disp(collect(collect(yn,y1),y2))
```

Output :



Stem plot:



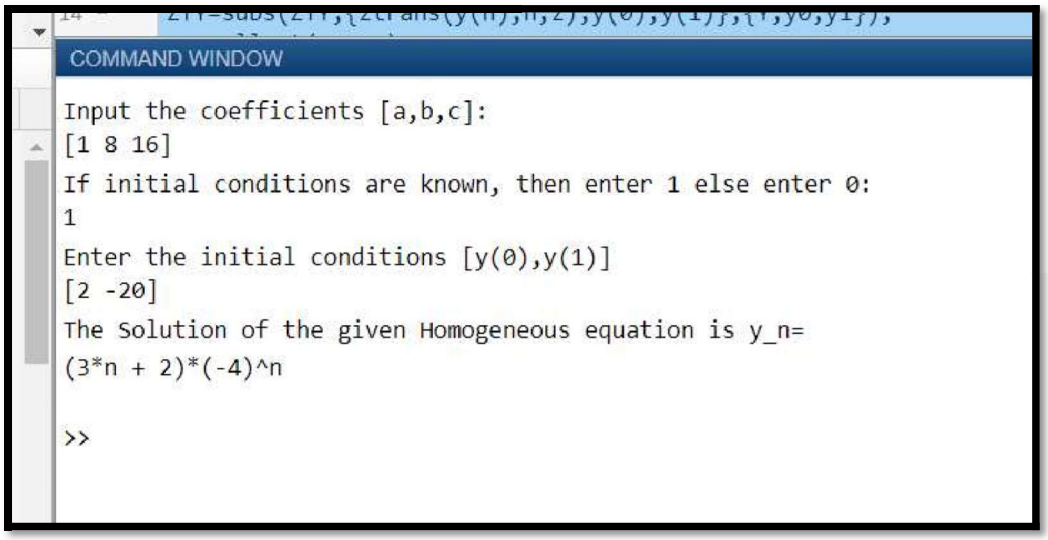
7.

Code:

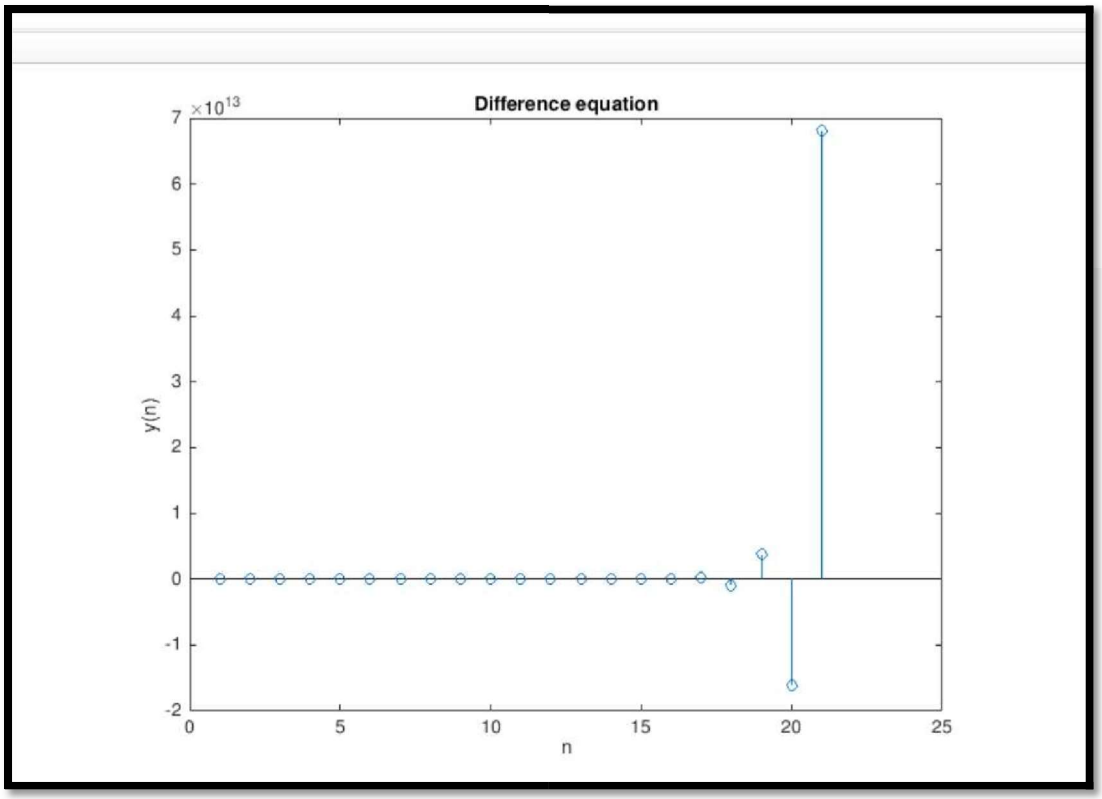
```
clear all
clc
syms n k1 k2 L
F = input('Input the coefficients [a,b,c]: ');
a=F(1);b=F(2);c=F(3);
ch_eqn=a*L^2+b*L+c; %Characteristic equation
L=solve(ch_eqn);
L1=L(1);L2=L(2);
D=b^2-4*a*c;
if(D>0) % Roots are real and different y1=L1^n; y2=L2^n;
elseif
(D==0)% Roots are real and equal
```

```
y1=L1^n; y2=n*L1^n;
else % Roots are complex
rho=abs(L1);
t=angle(L1);
y1 = (rho^n)*cos(n*t);
y2 = (rho^n)*sin(n*t);
end
yn = k1*y1+k2*y2;
check=input('If initial conditions are known, then enter 1 else enter 0: '); if (check ==
1)
IC=input('Enter the initial conditions [y(0),y(1)]');
eq1=(subs(yn,n,0)-IC(1));
eq2=(subs(yn,n,1)-IC(2));
[k1,k2]=solve(eq1,eq2);
yn=simplify(subs(yn));
m=0:20;
y=subs(yn,n,m);
stem(y)
title('Difference equation');
xlabel('n');
ylabel('y(n)');
end
disp('The Solution of the given Homogeneous equation is y_n= ');
disp(collect(collect(yn,y1),y2))
```

Output:



Stem plot:



----------THANK YOU----------