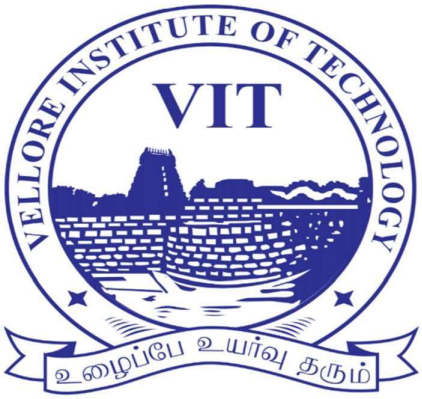

MAT 2002-ADDE

LAB

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Z-Transform

Code-

```
clc
clear all
format compact
syms p(n) z pZT
assume(n>=0 & in(n,'integer'))
a=input('Enter the coefficient of p_n+2:')
b=input('Enter the coefficient of p_n+1:')
c=input('Enter the coefficient of p_n:')
G=input('Enter the RHS function:') %non homogeneous part
f=a*p(n+2)+b*p(n+1)+c*p(n)-G
fZT = ztrans(f,n,z)
fZT = subs(fZT,ztrans(p(n),n,z),pZT)
pZT = solve(fZT,pZT)
pSol = iztrans(pZT,z,n)
pSol = simplify(pSol)
a=input('Enter the value of p_0:');
b=input('Enter the value of p_1:');
disp('Solution of the difference equation is given by:')
pSol= subs(pSol,[p(0) p(1)],[a b])
nValues = 1:10;
pSolValues = subs(pSol,n,nValues);
pSolValues = double(pSolValues);
pSolValues = real(pSolValues);
stem(nValues,pSolValues)
grid on
```

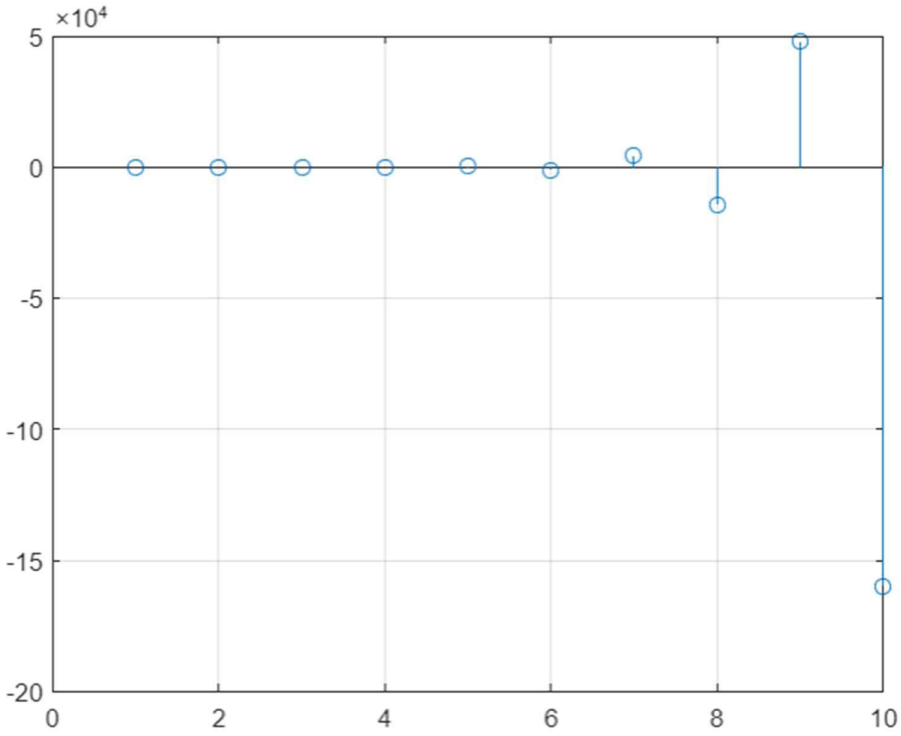
Using Z-Transforms, solve the following difference equations:

1. Solve $y_{n+2} + 6y_{n+1} + 9y_n = (2)^n$ with $y(0) = 0, y(1) = 1$.

Output-

```
Command Window
2^n
G =
2^n
f =

6*p(n + 1) + p(n + 2) + 9*p(n) - 2^n

fZT =
6*z*ztrans(p(n), n, z) - z/(z - 2) - 6*z*p(0) - z*p(1) + z^2*ztrans(p(n), n, z) - z^2*p(0) + 9*ztrans(p(n), n, z)
fZT =
9*pZT - z/(z - 2) - 6*z*p(0) - z*p(1) + 6*pZT*z - z^2*p(0) + pZT*z^2

pZT =
(z/(z - 2) + 6*z*p(0) + z*p(1) + z^2*p(0))/(z^2 + 6*z + 9)

pSol =
p(0)*kroneckerDelta(n, 0) + 2^n/25 - kroneckerDelta(n, 0)/25 - (kroneckerDelta(n, 0)/9 + ((-3)^n*(n - 1))/9)*(9*p(0) + 3*p(1) - 3/5) -
((-3)^n/3 - kroneckerDelta(n, 0)/3)*(p(1) - 2/25)
pSol =

((-3)^n*n)/15 + (-3)^n*p(0) + 2^n/25 - (-3)^n/25 - (-3)^n*n*p(0) - ((-3)^n*n*p(1))/3
Enter the value of p_0:

0
Enter the value of p_1:

1
Solution of the difference equation is given by:
pSol =
2^n/25 - (4*(-3)^n*n)/15 - (-3)^n/25
```

Plot-

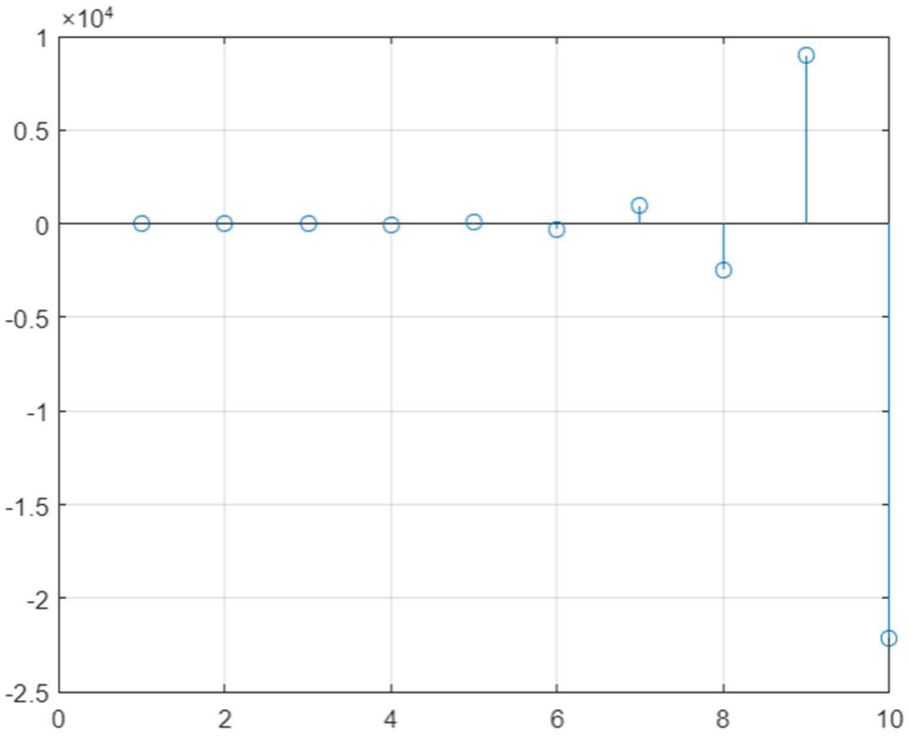


2. Solve $y_{n+2} + 4y_{n+1} + 3y_n = (3)^n$ with $y(0) = 0, y(1) = 1$.

Output-

```
Command Window
3^n
G =
3^n
f =
4*p(n + 1) + p(n + 2) + 3*p(n) - 3^n
fZT =
4*z*ztrans(p(n), n, z) - z/(z - 3) - 4*z*p(0) - z*p(1) + z^2*ztrans(p(n), n, z) - z^2*p(0) + 3*ztrans(p(n), n, z)
fZT =
3*pZT - z/(z - 3) - 4*z*p(0) - z*p(1) + 4*pZT*z - z^2*p(0) + pZT*z^2
pZT =
(z/(z - 3) + 4*z*p(0) + z*p(1) + z^2*p(0))/(z^2 + 4*z + 3)
pSol =
p(0)*kroneckerDelta(n, 0) - ((-3)^n/3 - kroneckerDelta(n, 0)/3)*((3*p(0))/2 + (3*p(1))/2 - 1/4) + ((-1)^n - kroneckerDelta(n, 0))*((3*p(0))/2 +
p(1)/2 - 1/8) + 3^n/24 - kroneckerDelta(n, 0)/24
pSol =
(3*(-1)^n*p(0))/2 + ((-1)^n*p(1))/2 - ((-3)^n*p(0))/2 - ((-3)^n*p(1))/2 - (-1)^n/8 + (-3)^n/12 + 3^n/24
Enter the value of p_0:
0
Enter the value of p_1:
1
Solution of the difference equation is given by:
pSol =
(3*(-1)^n)/8 - (5*(-3)^n)/12 + 3^n/24
```

Plot-



3. Solve $y_{n+2} + y_{n+1} + 2y_n = 5^n$ with $y(0) = 0, y(1) = 1$.

Output-

```
Command Window
5^n
G =
5^n
f =

4*p(n + 1) + p(n + 2) + 3*p(n) - 5^n

fZT =
4*z*ztrans(p(n), n, z) - z/(z - 5) - 4*z*p(0) - z*p(1) + z^2*ztrans(p(n), n, z) - z^2*p(0) + 3*ztrans(p(n), n, z)
fZT =
3*pZT - z/(z - 5) - 4*z*p(0) - z*p(1) + 4*pZT*z - z^2*p(0) + pZT*z^2

pZT =
(z/(z - 5) + 4*z*p(0) + z*p(1) + z^2*p(0))/(z^2 + 4*z + 3)

pSol =
p(0)*kroneckerDelta(n, 0) - ((-3)^n/3 - kroneckerDelta(n, 0)/3)*((3*p(0))/2 + (3*p(1))/2 - 3/16) + ((-1)^n - kroneckerDelta(n, 0))*((3*p(0))/2
+ p(1)/2 - 1/12) + 5^n/48 - kroneckerDelta(n, 0)/48

pSol =
(3*(-1)^n*p(0))/2 + ((-1)^n*p(1))/2 - ((-3)^n*p(0))/2 - ((-3)^n*p(1))/2 - (-1)^n/12 + (-3)^n/16 + 5^n/48
Enter the value of p_0:

0

Enter the value of p_1:

1
Solution of the difference equation is given by:
pSol =
(5*(-1)^n)/12 - (7*(-3)^n)/16 + 5^n/48
```

Plot-