# Task 2

**Name:** Sparsh Arya

**Registration number:** 17BEC0656

**Slot**: L35 + L36

a. **Using MATLAB, perform the convolution between input x(n) and impulse response h(n) to obtain the response of LTI system y(n) in the time domain without using the inbuilt function 'conv' and also verify the same using 'conv'.**

**Algorithm**:

1) clc

2) clear all

3) Input the functions X and H, use a and b to calculate the length of X and H. Reform functions X and H by adding 'b-1' and 'a-1' no. of zeros. Take p=1

4) Form a loop from from 1 to a+b-1, in which take t=I & F(p)=0 initially, form another loop inside it to form the function F(p)=F(p)+X(t)*H(j) if j<i ;

5) In this whenever j>i, loop will not. Decrement the value of t and in first loop increment the value of p hence we can add subsequent diagonal values to form F(t).

6) Use disp function to display the convolution function and compare it with 'conv' command to verify answer

7) p=1;

for i=1:c

F(p)=0;

t=i; for j=1:c

```
    if(j<=i)

    F(p)=F(p)+X(t)*H(j);  t=t-1;

     else

         end

    end
```

**Code:**

```
clc
clear all
X=input('X: ');
H=input('H: ');
a=length(X);
b=length(H);
X=[X,zeros(1,b-1)];
H=[H,zeros(1,a-1)];
c=a+b-1;
p=1;

for i=1:c

F(p)=0;
t=i;
for j=1:c
if(j<=i)
F(p)=F(p)+X(t)*H(j);
t=t-1;
else
end

end
p=p+1;
end

disp(F);
z=conv(X,H);
disp(z);
```

**OUTPUT :**


**b. A causal LTI system is characterized by the following difference equation. y(n) – 1.3y(n-1) + 1.04y(n-2) – 0.222y(n-3) = x(n-1) – 1.2x(n-2) + x(n-3)**

**Using MATLAB,**

**i. Compute and plot its poles & zeros and also check the stability of the given systems. Find the various ROC.**

**ii. ii. Also find the frequency response of the given system.**

**Algorithm/Procedure:**

1. Input coefficients of numerator and denominator in the form of vectors.
2. Use *fvtool* to Open Filter Visualization Tool
3. Equalize lengths of transfer function's numerator and denominator using *eqtlength* function.
4. Convert transfer function filter parameters to zero-pole-gain form *tf2zp*
5. Plot frequency response of transfer function using freqz

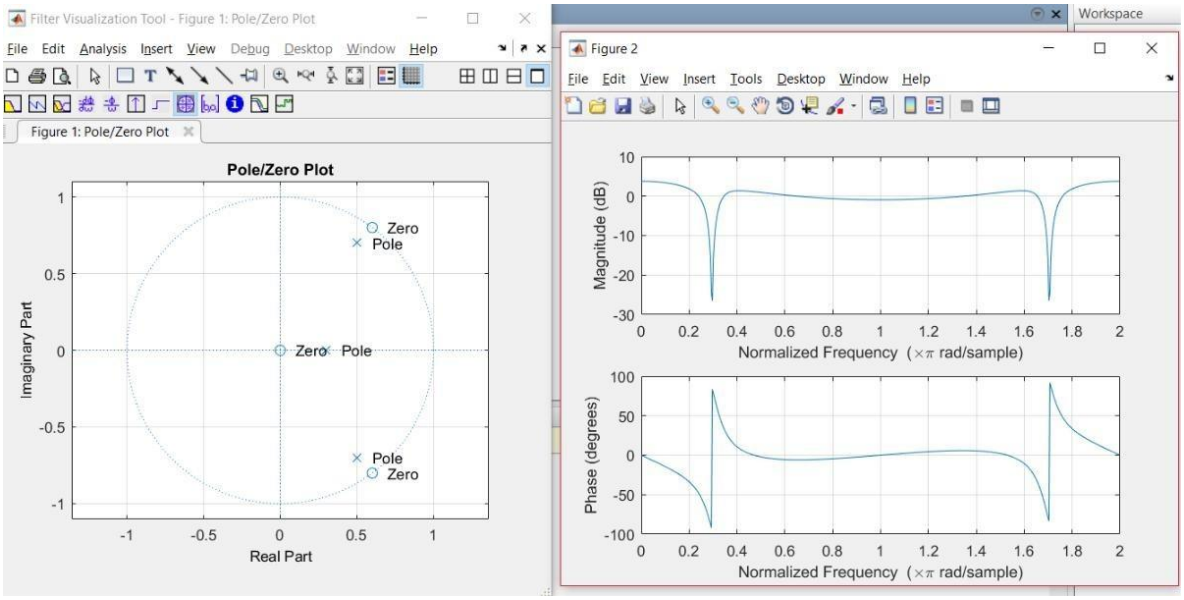
**Program:**

```
clc
clear all
b = [1 -1.2 1];
a = [1 -1.3 1.04 -0.222];
fvtool(b,a,'polezero') [b,a] =
eqtflength(b,a); [z,p,k] = tf2zp(b,a)
```

```
text(real(z)+.1,imag(z),'Zero')
text(real(p)+.1,imag(p),'Pole')

freqz(b,a,'whole')
[r,p,k] = residue(b,a)
```

## Experimental result and Inference:



```
r =

  -0.1566 - 0.0876i
  -0.1566 + 0.0876i
   0.4132 + 0.0000i


p =

   0.5000 + 0.7000i
   0.5000 - 0.7000i
   0.3000 + 0.0000i


k =

     1
```

**b. Using the long division method and partial fraction expansion, find x(n) for the following Z Transform.**

$$X(Z) = \frac{18z^3}{18z^3 + 3z^2 - 4z - 1}$$

**Verify the same using MATLAB.**

**Algorithm/Procedure:**

***Partial fraction Method:***

1. Represent X(Z) in the form of vectors
2. Z-transform partial-fraction expansion using residuez function

**Program :**

***Partial fraction Method:***

```
clc
clear all
close all
num=[18];
den=[18 3 -4 -1];
[r,p,k]=residuez(num,den)
```

**Experimental Result Inference:**

***Partial fraction Method:***

```
r =

    0.3600
    0.2400
    0.4000


p =

    0.5000
   -0.3333
   -0.3333


k =

     []
```

**VERIFICATION:**

DSP Lab

b. $y(n) - 1.3y(n-1) + 1.04(y(n-2)) - 0.222y(n-3) = x(n-1) - 1.2x(n-2) + x(n-3)$

A causal LTI system is characterized by the following difference equation

Using Matlab.

1) Compute & plot its poles & zeros & also check the stability of given system. Find the various ROC

2) Also find frequency response for given system.

Manual calculation.

Taking z transform on both sides.

$$y(z) - 1.3z^{-1}y(z) + 1.04z^{-2}y(z) - 0.222z^{-3}y(z) = x(z)z^{-1} - 1.2z^{-2}x(z) + x(z)z^{-3}.$$

$$\Rightarrow \frac{y(z)}{x(z)} = \frac{z^{-1} - 1.2z^{-2} + z^{-3}}{1 - 1.3z^{-1} + 1.04z^{-2} - 0.222z^{-3}}$$

$$= \frac{z^2 - 1.2z + 1}{z^3 - 1.3z^2 + 1.04z - 0.222}$$

OP verified 13/11/2020.

$$\text{Zeros} = \frac{+1.2 \pm \sqrt{(1.2)^2 - 4(1)(1)}}{2}$$

By solving cubic eq. roots: 0.5+0.7i, 0.5-0.7i, 0.3.

c. Using partial fraction expansion find x(n) for the following z transform.

$$X(z) = \frac{18z^3}{18z^3 + 3z^2 - 4z - 1}$$

Verify same using matlab.

o/p verified

A B 1/1/2000.

$$x(n) = (9*(1/2)^{\wedge}n)/25 + 26*(-1/3)^{\wedge}n/25 + \frac{2*(-1/3)^{\wedge}n*u(n-1)}{5.}$$

Date YOUVA

# DSP Lab (Task 2) 17BEC0656

Using MATLAB perform convolution between input x(n) and impulse response of LTI system y(n) in time domain without using inbuilt function conv verify the same using conv.

Code

```
clc
clear all
k = [-10: 1 :10]
x = [zeros(1,5) ones(1,5) 1 zeros(1,5) ones(1,5)]
y = [zeros(1,21)]

for n = drange(-10:10)
    h = [zeros(1,10-n) 1 zeros(1, 10+n)]
    y = x.*h + y
end
stem(k,y)
```

Verified