Bangladesh Army University of Engineering and Technology
Qadirabad Cantonment, Natore-6431

Department of Information and Communication Engineering

LAB Manual

Subject: Digital Signal Processing Sessional

Subject Code: ICE 3122

Prepared By

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Experiment NO.:01

Experiment Name: Use the MATLAB command "roots" to determine the poles and zeros of the following systems-

$$\mathbf{H(s)=}\frac{s^2+2}{S^3+2S^2-S+1}$$

Program :

```
clc
clear
z=roots([1,0,2])
p=roots([1,2,-1,1])
```

Output :

```
z =

        0 + 1.4142i

        0 - 1.4142i

p =

     -2.5468

      0.2734 + 0.5638i

              0.2734    - 0.5638i
```

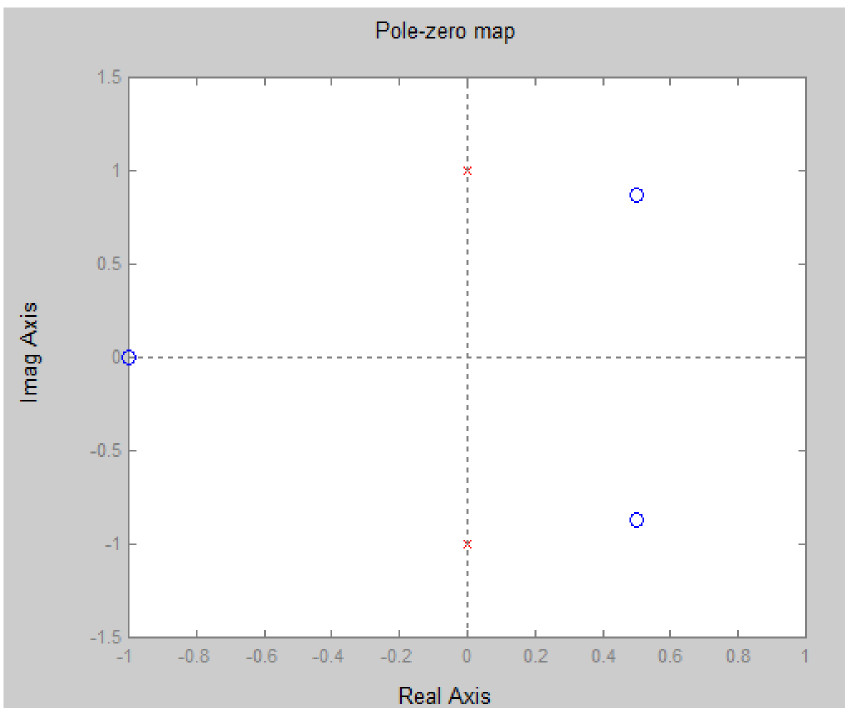
Experiment NO.:02

Experiment Name: Use the MATLAB command "pzmap" to plot the poles and zeros of the following systems-

$$H(s)= \frac{S^3+1}{S^4+2S^2+1}$$

Program :

```
clc
clear
num=[1,0,0,1];
den=[1,0,2,0,1];
systf=tf(num,den)
pzmap(systf)
```



Experiment NO.:03

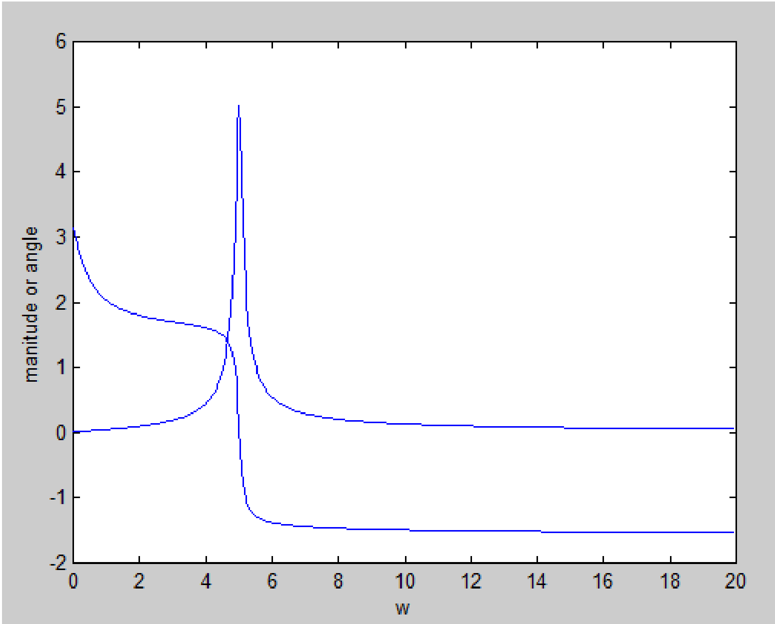
Experiment Name: Use the MATLAB command “freqresp” to evaluate and plot the magnitude and phase responses of the following system-

$$H(S)= \frac{(S-0.5)}{(S+0.1-5j)(S+0.1+5j)}$$

Program :

```
clc
clear
num=[1,-0.5];
den=[1,0.2,25.01];
systf=tf(num,den)
pzmap(systf);
w=(0:499)*(20/500);
H=freqresp(systf,w);
Hmag=abs(squeeze(H));
plot(w,Hmag);
hold on;
Hang=angle(squeeze(H));
plot(w,Hang);
ylabel('manitude or angle');
xlabel('w');
```

Output :



Experiment NO.:04

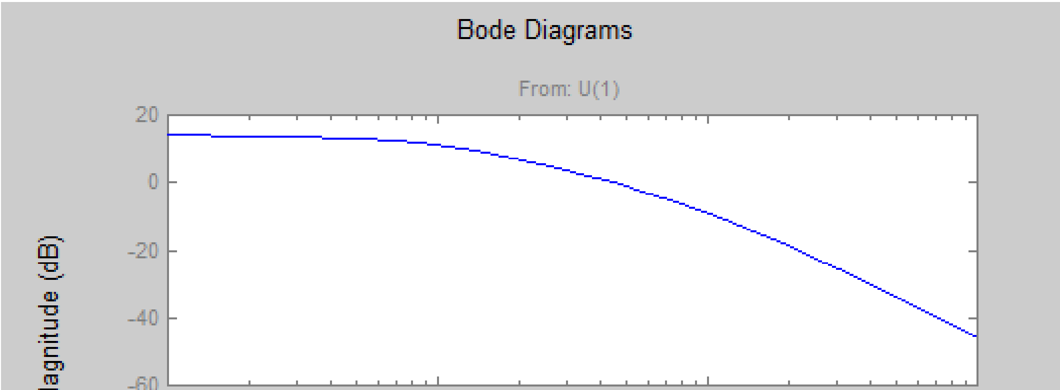
Experiment Name: Use the MATLAB command "bode" to find the Bode-diagrams for the following systems-

$$H(S)= \frac{50}{(S+1)(S+10)}$$

Program :

```
clc
clear
z=roots([50]);
p=roots([1,11,10]);
k=50;
sys=zpk(z,p,k)
bode(sys)
```

Output:



Experiment NO.:05

Experiment Name: Use the MATLAB command “ss” to find state-variable descriptions for the following systems-

$$H(S)= \frac{1}{S(S+3)}$$

Program :

```
clc
clear
num=[1];
den=[1,3,0];
[A,B,C,D]=tf2ss(num,den)
```

Output:

```
A =

   -3     0

    1     0

B =

    1
```

0

C =

0 1

D =

0

Experiment NO.:06

Experiment Name: Use the MATLAB command " tf " to find transfer-function descriptions for the following systems-

A= $\begin{matrix} -1 & 1 \\ 0 & -2 \end{matrix}$ B= $\begin{matrix} 3 \\ -1 \end{matrix}$ C= $\begin{matrix} 1 & 2 \end{matrix}$ D=0

Program :

```
clc
clear
a=[-1 1 ,
    0 -2];
b=[3,
    -1];
c=[1 2];
d=[0];
[NUM,DEN]=ss2tf(a,b,c,d);
systf=tf(NUM,DEN)
```

Output :

Transfer function:

```
    s + 3

-------------

s^2 + 3 s + 2s
```

Experiment NO.:07

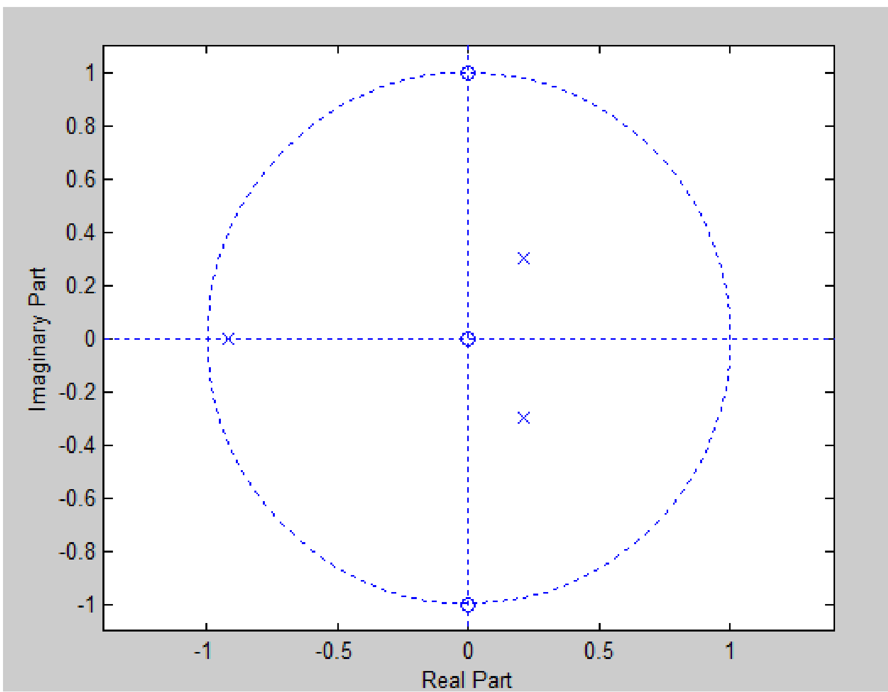
Experiment Name: Use the MATLAB command "zplane" to obtain a pole-zero plots for the following systems –

$$H(z)= \frac{1+z^{-2}}{2+z^{-1}-0.5z^{-2}+0.25z^{-3}}$$

Program :

```
clc
clear
b=[1,0,1];
a=[2,1,-0.5,0.25];
zplane(b,a)
```

Output:



Experiment NO.:08

Experiment Name: Use the MATLAB command “residues” to obtain the partial-fraction expansions required to solve–

$$\mathbf{X(z)=}\ \frac{z^2-3z}{z^2+\left(\frac{3}{2}\right)z-1}$$

Program :

```
clc
clear
num=[1,-3,0];
den=[1,1.5,-1];
[r,p,k]=residuez(num,den)
```

Output:

```
r =

    2

   -1

p =

  -2.0000

   0.5000

k =  0
```

Experiment NO.: 09

Experiment Name: Determine the co-efficient of a linear-phase FIR filter of length N=15 which has a symmetric unit sample response and a frequency that satisfies the condition—

$$H_r\left(\frac{2\pi k}{15}\right) = \begin{matrix} 1 & k=0,1,2,3 \\ 0.4 & k=4 \\ 0 & k=5,6,7 \end{matrix}$$

Program :

```
clc
clear
N=input('ENTER THE Filter Length N= ');
Fs=input('ENTER THE Sampling frequency Fs= ');
Fs=Fs/2;
f=[0,1/7,2/7,3/7,4/7,5/7,6/7,1];
h=[1,1,1,1,0.4,0,0,0];
hn=fir2((N-1),f,h);
i=0:1:N-1;
   y=[i;hn];
   fprintf(' h(%4.1f)= %12.8f\n',y);
[H,f]=freqz(hn,1,1024,Fs);
plot(f,abs(H));
xlabel('frequency');
ylabel('Manitude');
```

Output :

ENTER THE Filter Length N= 15

ENTER THE Sampling frequency Fs= 2

h(0.0)= -0.00045124

h(1.0)= -0.00080207

h(2.0)=   0.00453931

h(3.0)=   0.01166837

h(4.0)= -0.04358245

h(5.0)= -0.03930321

h(6.0)=   0.28941244

h(7.0)=   0.55644531

h(8.0)=   0.28941244

h(9.0)= -0.03930321

h(10.0)= -0.04358245

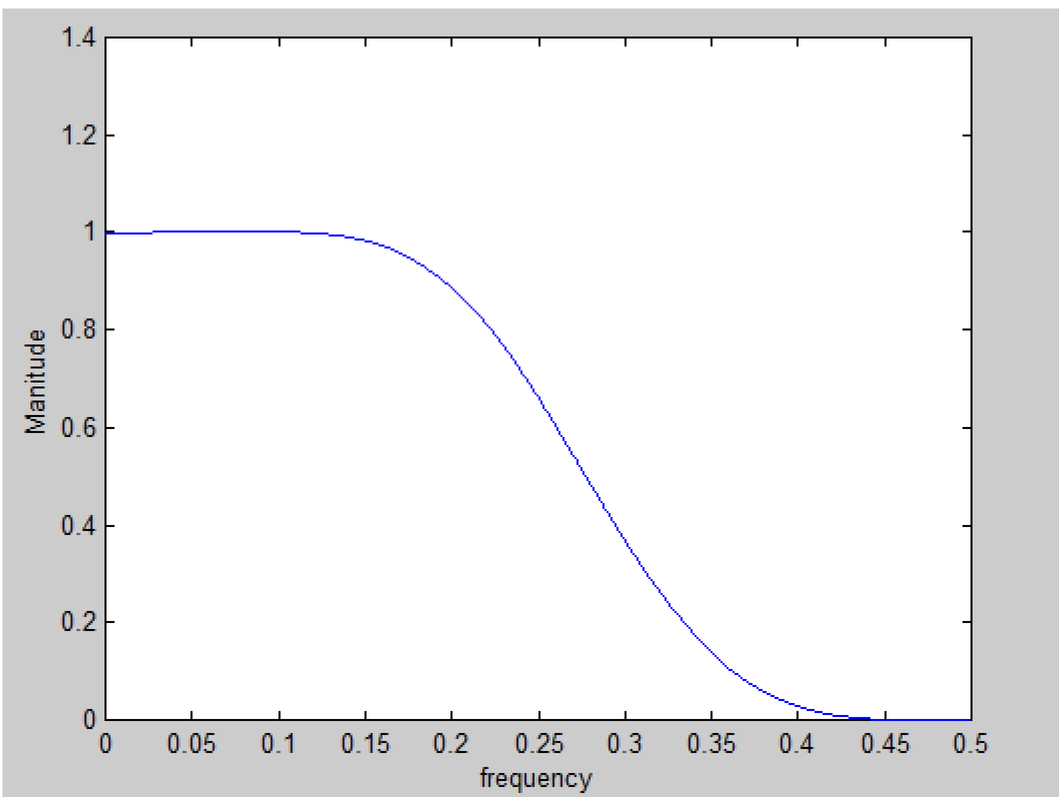
h(11.0)=   0.01166837

h(12.0)=   0.00453931

h(13.0)= -0.00080207

h(14.0)= -0.00045124

Figure :



Experiment NO.: 10

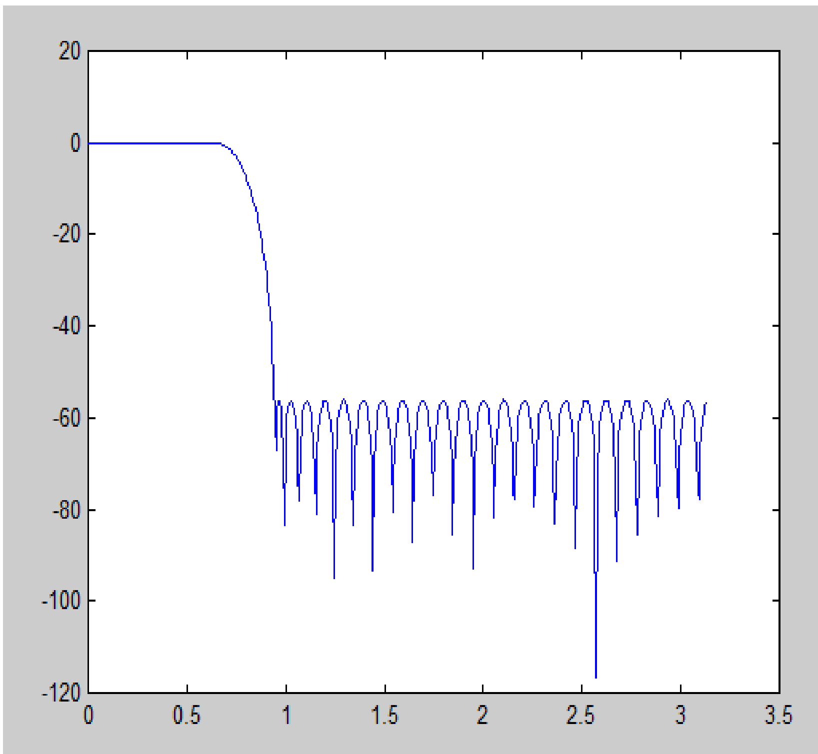
Experiment Name: Design a low pass filter of length M=61 with a pass band edge frequency f_p=0.1 and a stop nband edge frequency f_s=0.15.

Program :

```
clc
clear
N=61;
f=[0,0.2,0.3,1];
m=[1,1,0,0];
b=remez((N-1),f,m);
[H,w]=freqz(b,1,512);
db=20*log10(abs(H));
plot(w,db)
for i=1:1:31
   fprintf('\nH(%2.0f) = % 1.10f = H(%2.0f)',i,b(i),62-i)

end
```

Output :



H(1) = -0.0012109407 = H(61)
H(2) = -0.0006727060 = H(60)
H(3) = 0.0000980921 = H(59)
H(4) = 0.0013536719 = H(58)
H(5) = 0.0022969819 = H(57)
H(6) = 0.0019963504 = H(56)
H(7) = 0.0000970225 = H(55)
H(8) = -0.0026466751 = H(54)
H(9) = -0.0045133151 = H(53)
H(10) = -0.0037704939 = H(52)
H(11) = 0.0000130849 = H(51)
H(12) = 0.0051791440 = H(50)
H(13) = 0.0084883516 = H(49)
H(14) = 0.0069532092 = H(48)
H(15) = 0.0000710286 = H(47)
H(16) = -0.0090407990 = H(46)
H(17) = -0.0147230524 = H(45)
H(18) = -0.0119589393 = H(44)
H(19) = -0.0000297893 = H(43)
H(20) = 0.0157134338 = H(42)
H(21) = 0.0256571552 = H(41)
H(22) = 0.0210573667 = H(40)
H(23) = 0.0000686251 = H(39)
H(24) = -0.0289020676 = H(38)
H(25) = -0.0491185435 = H(37)
H(26) = -0.0427139614 = H(36)

$H(27) = -0.0000500992 = H(35)$
$H(28) = \ 0.0735742268 = H(34)$
$H(29) = \ 0.1578204075 = H(33)$
$H(30) = \ 0.2246551132 = H(32)$
$H(31) = \ 0.2500699818 = H(31)$

Experiment NO.:11

Experiment Name: Design a bandpass filter of length M=32 with passband edge frequencies f_{p1}=0.2 and f_{p2}=0.35 & stopband edge frequencies f_{s1}=.1 & f_{s2}=0.425.

Program :

```
clc
clear
N=32;
f=[0,0.2,0.4,0.7,0.85,1];
m=[0,0,1,1,0,0];
wt=[1,0.1,1];
b=remez((N-1),f,m,wt);
[H,w]=freqz(b,1,512);
db=20*log10(abs(H));
plot(w,db)
for i=1:1:16
   fprintf('\nH(%2.0f) = % 1.10f = H(%2.0f)',i,b(i),33-i)
end
```

Output :

H(1) = -0.0057534118 = H(32)

H(2) = 0.0009902730 = H(31)

H(3) = 0.0075733537 = H(30)

H(4) = -0.0065141202 = H(29)

H(5) = 0.0139605256 = H(28)

H(6) = 0.0022951463 = H(27)

H(7) = -0.0199940650 = H(26)

H(8) = 0.0071369578 = H(25)

H(9) = -0.0396573634 = H(24)

H(10) = 0.0112601135 = H(23)

H(11) = 0.0662336402 = H(22)

H(12) = -0.0104972214 = H(21)

H(13) = 0.0851361372 = H(20)

H(14) = -0.1202499281 = H(19)

H(15) = -0.2967857661 = H(18)