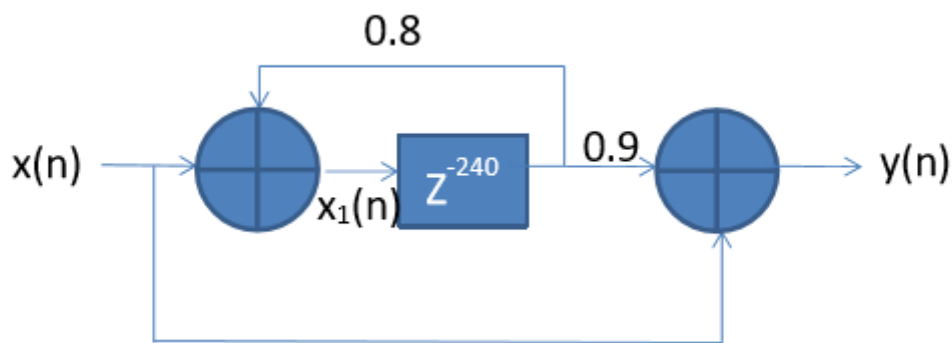


Experiment-3

(i) Reverberation is similar to the echo effect we can hear when we shout across an open valley or canyon, or in a large empty room. The following figure gives one such model of reverberation. Find the transfer function and frequency response. Write a program to display its frequency response and impulse response.



```

B = input('Numerator coefficient :');
A = input('Denominator coefficient :');

[z,p,k] = tf2zpk(B,A);

disp('value of z : ');
disp(z);
disp('value of p : ');
disp(p);
disp('value of k : ');
disp(k);

figure(1)
zplane(B,A);

N = input('length of bounded input : ');

[H,n] = impz(B,A,N);
figure(2)
subplot(2,1,1);
stem(n,H);
title('impulse response');
xlabel('number of samples');
ylabel('Amplitude');

[S,n]= stepz(B,A,N);
subplot(2,1,2);
stem(n,S);
title('step response');
  
```

```
xlabel('number of samples');
ylabel('Amplitude');

f = isstable(B,A);
if(f==0)
    disp('system is unstable');
else
    disp('system is stable');
    W = -pi:pi/255:pi;
    H = freqz(B,A,W);

    figure(3)

    subplot(2,1,1);
    plot(W,abs(H));
    title('frequency response');
    xlabel('omega');
    ylabel('magnitude');

    subplot(2,1,2);
    plot(W,angle(H));
    title('frequency response');
    xlabel('omega');
    ylabel('phase');

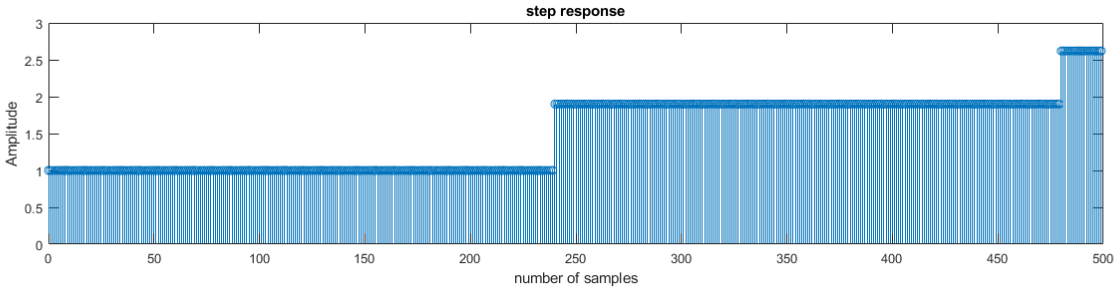
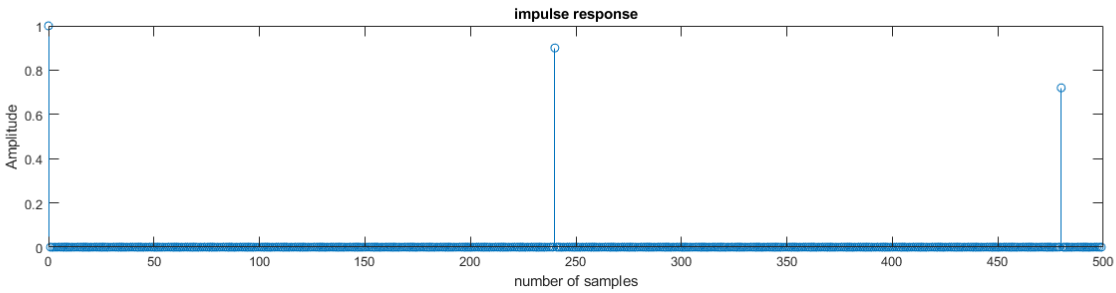
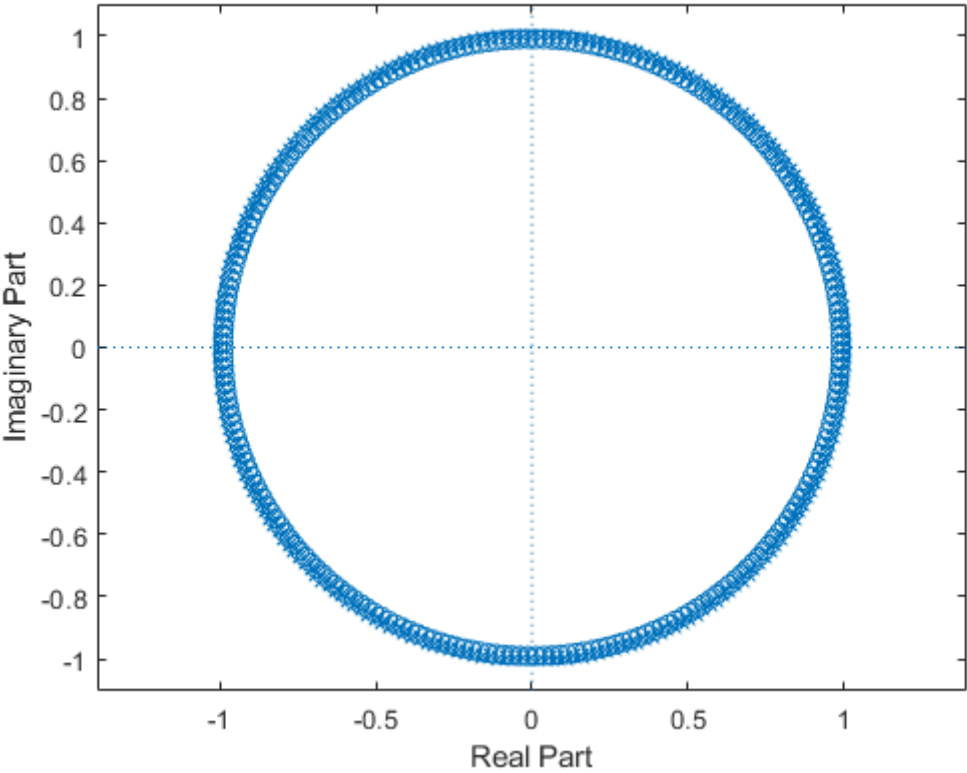
end
```

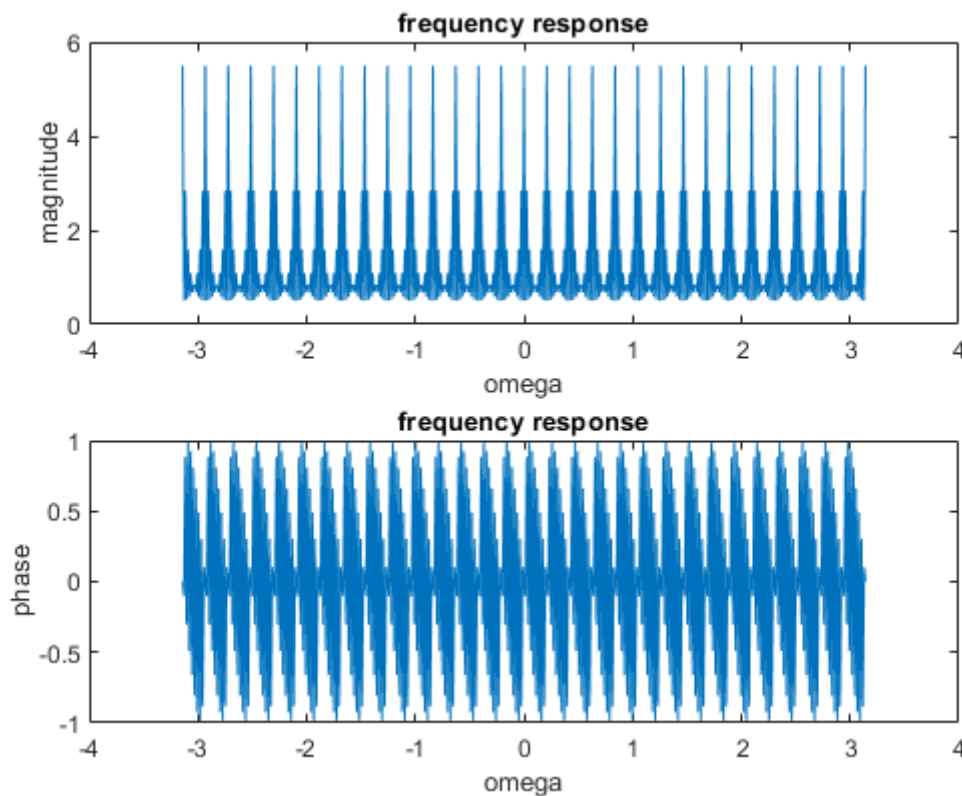
Input :

Numerator coefficient : [1 zeros(1,239) 0.1]

Denominator coefficient : [1 zeros(1,239) -0.8]

Output :





Note: Use inbuilt function: `impz`, `freqz`.

(ii) Apply an audio signal of suitable length to this filter containing mixture of tones at 126Hz, 277Hz, 1050Hz, 2277Hz and 3400Hz with equal relative magnitudes and sampled at 8000Hz. Plot and hear its input and output using headphone/ear phone/speaker.

Method-1 (Convolution)

```
clc;
clear all;
close all;
ampl = input('Enter sin Wave amplitude :');
%freq = input('Enter sin Wave Frequency(Hz) :');
phase = input('Enter sin Wave Phase in radian(ex: pi/2) :');
sam_freq = input('Enter sin Wave Sampling frequency(samples par sec) :');
length_of_sequence = input('Enter sin Wave length of the sequence :');
B = input('Numerator coefficient :');
A = input('Denometer coefficient :');
N = input('Enter the lenght of h(z)');
%f = freq/sam_freq;
n = 0:1:length_of_sequence-1;
x = ampl*sin(2*pi*(126/8000)*n+phase)+ampl*sin(2*pi*
(277/8000)*n+phase)+ampl*sin(2*pi*(1050/8000)*n+phase)+ampl*sin(2*pi*
(2277/8000)*n+phase)+ampl*sin(2*pi*(3400/8000)*n+phase);
x_n= x/max(abs(x));
[H,n] = impz(B,A,N);
```

```

y=conv(H,x_n);
y_n=y/max(abs(y));
audiowrite('exp1c.wav',y_n,sam_freq,'Bitspersample',16);
a = audioread('exp1c.wav');
p = audioplayer(a,sam_freq);
play(p);
figure(1)
subplot(2,1,1);
stem(n(1:2000),y_n(1:2000));
subplot(2,1,2);
stem(n(1:2000),x_n(1:2000));

```

Input :

```

Enter sin Wave amplitude :100
Enter sin Wave Phase in radian(ex: pi/2 ):0
Enter sin Wave Sampling frequency(samples par sec) :8000
Enter sin Wave length of the sequence :50000
Numerator cofficient :[1 zeros(1,239) 0.1]
Denometer cofficient :[1 zeros(1,239) -0.8]
Enter the length of h(z)4000

```

Output:

[Generated waw file](#)

Method-2 (Filter)

```

clc;
clear all;
close all;
A=input('Enter the amplitude:');
Ph=input('Enter the phase in radian: ');
%F=input('Enter the frequency in Hz: ');
%Fs=input('Enter the samling frequency: ');
k=input('Enter no. of bits per sample: ');
%f=F/8000;
Fs=8000;
N=input('Length of no of sample: ');
n=0:N-1;
x = A*sin(2*pi*(126/8000)*n+Ph) +A*sin(2*pi*(277/8000)*n+Ph) +A*sin(2*pi*(1050/8000)*n+Ph) + A*sin(2*pi*(2277/8000)*n+Ph) + A*sin(2*pi*(3400/8000)*n+Ph);
x_n = x/max(abs(x));
audiowrite('try.wav',x_n,Fs,'BitsPerSample',k);
a=audioread('try.wav');

```

```
p=audioplayer(a,Fs);
%play(p);
B = [1 zeros(1,239) 0.1];
A = [1 zeros(1,239) -0.8];
N1 = 3000;
[h, t] = impz(B,A,N1);
y = conv(h,x_n);
y_n = y/max(abs(y));
audiowrite('try1.wav',y_n,Fs,'BitsPerSample',k);
a1=audioread('try1.wav');
p1=audioplayer(a1,Fs);
play(p1);
%figure(1);
%subplot(2,1,1);
%stem(n,x_n);
```