MAWLANA BHASHANI SCIENCE AND TECHNOLOGY UNIVERSITY

SANTOSH, TANGAIL-1902

DEPARTMENT OF INFORMATION AND COMMUNICATION TECHNOLOGY

Lab Report

Lab Report No : 07

Lab Report on : Design and analysis of FIR digital filters using window techniques.

Course Title : Digital Signal Processing Lab

Course Code : ICT-3206

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Date of Performance: 12/01/26 Date of Submission: 17/01/26

Introduction:

FIR filters are always stable and have linear phase characteristics, making them suitable for many DSP applications. Window techniques such as Rectangular, Bartlett, and Hamming windows are commonly used to design FIR filters. This experiment demonstrates FIR filter design using different window functions.

Objective:

- To design a high-pass FIR filter using a Rectangular window.
- To design a low-pass FIR filter using a Bartlett window.
- To design a band-stop FIR filter using a Hamming window.

Theory:

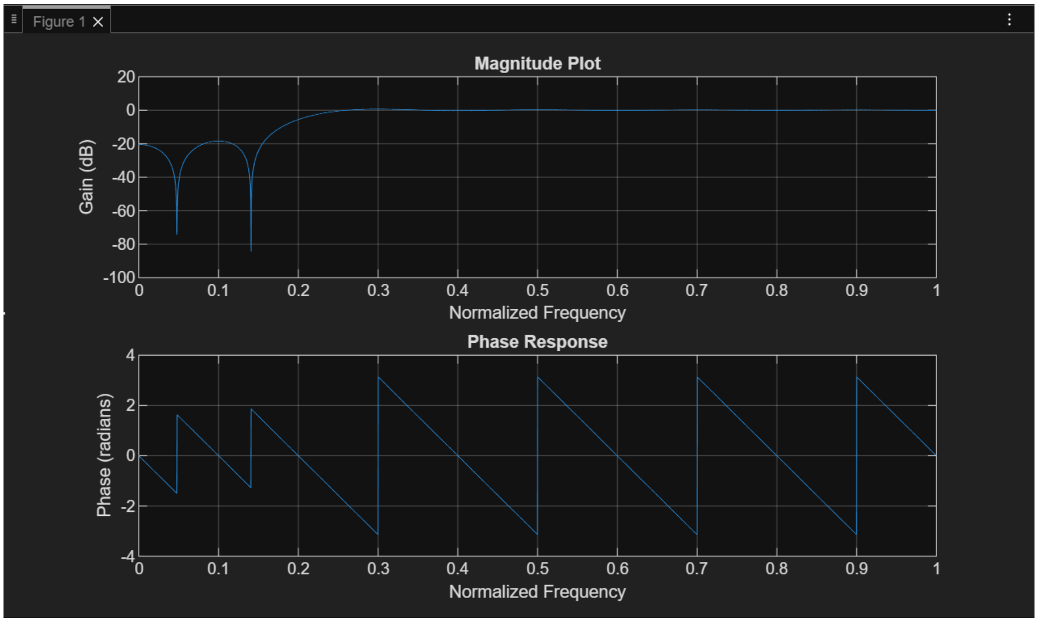
- **FIR filters** have finite impulse responses and guaranteed stability.
- **Window method** truncates the ideal impulse response to obtain practical FIR filters.
- Different windows affect the transition band and ripple characteristics.

MATLAB Code:

Program 1: FIR High-Pass Filter Using Rectangular Window

```
clc;
clear all;
close all;
n = 20;          % Filter order
fp = 100;        % Passband frequency (Hz)
fs = 1000;       % Sampling frequency (Hz)
fn = fp / (fs/2);
window = rectwin(n+1);
b = fir1(n, fn, 'high', window);
w = 0:0.001:pi;
[h, om] = freqz(b, 1, w);
mag = 20*log10(abs(h));
ph  = angle(h);
subplot(2,1,1)
plot(om/pi, mag)
grid on
xlabel('Normalized Frequency')
ylabel('Gain (dB)')
title('Magnitude Plot')
subplot(2,1,2)
plot(om/pi, ph)
grid on
xlabel('Normalized Frequency')
ylabel('Phase (radians)')
title('Phase Response')
```

Output:



Program 2: FIR Low-Pass Filter Using Bartlett Window

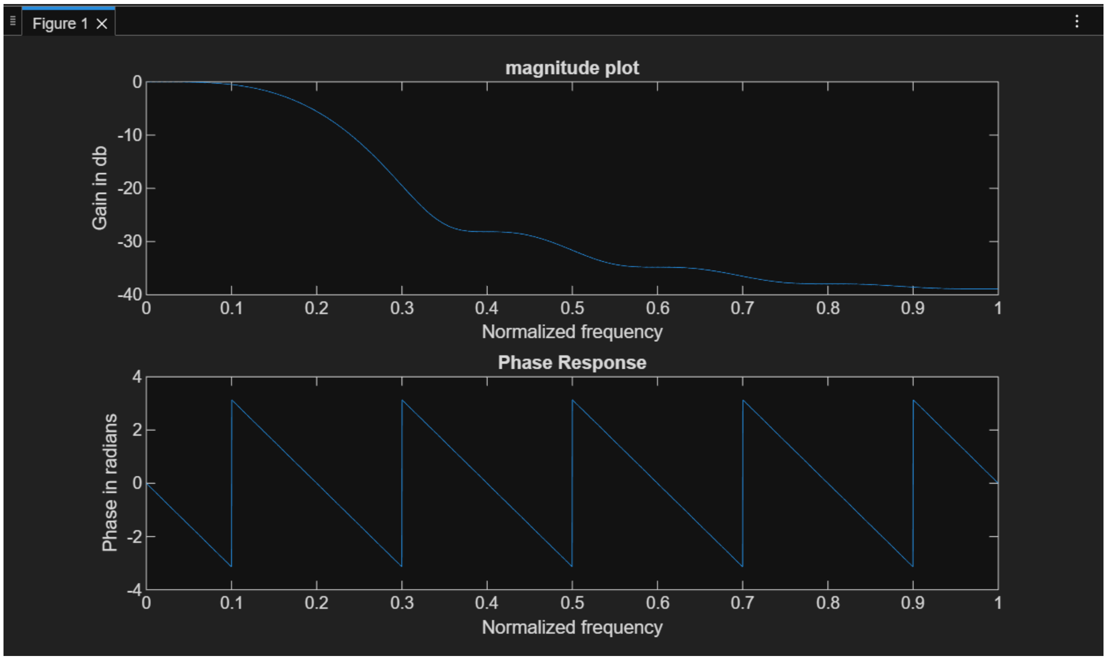
```
% Response of low-pass FIR filter using Bartlett(Triangular) window

clc; clear all; close all;

n=20;
fp=100;
fq=300;
fs=1000;
fn=2*fp/fs;
window=bartlett(n+1);
b=fir1(n,fn,window);
w=0:0.001:pi;
[h,om]=freqz(b,1,w);
a=20*log10(abs(h));

b=angle(h);
subplot(2,1,1);plot(w/pi,a);
xlabel('Normalized frequency')
ylabel('Gain in db')
title('magnitude plot')
subplot(2,1,2);plot(w/pi,b);
xlabel('Normalized frequency')
ylabel('Phase in radians')
title('Phase Response')
```

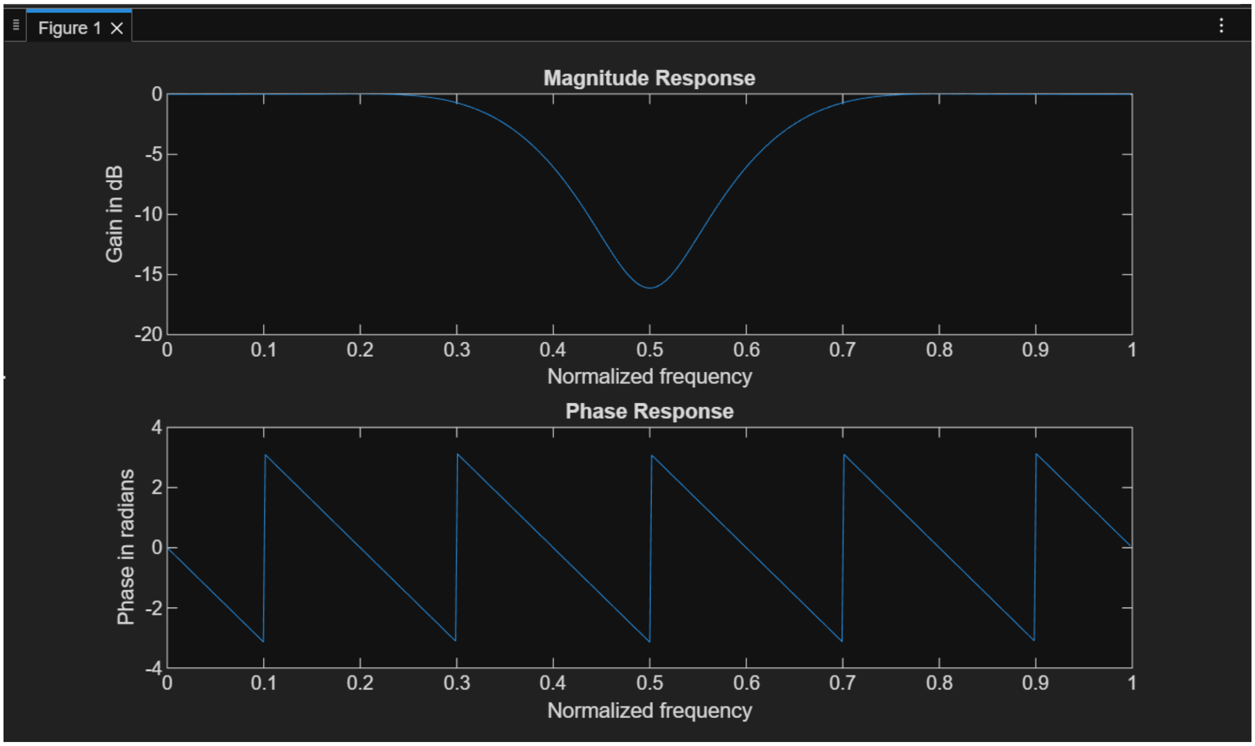
Output:



Program 3: FIR Band-Stop Filter Using Hamming Window

```
% Response of band stop FIR filter using Hamming window
clc;
clear all;
close all;
n = 20;
fp = 200;
fq = 300;
fs = 1000;
wp = 2*fp/fs;
ws = 2*fq/fs;
wn = [wp ws];
window = hamming(n+1);
b = fir1(n, wn, 'stop', window);
[h, w] = freqz(b, 1, 512);
mag = 20*log10(abs(h));
phase = angle(h);
subplot(2,1,1);
plot(w/pi, mag);
xlabel('Normalized frequency');
ylabel('Gain in dB');
title('Magnitude Response');
subplot(2,1,2);
plot(w/pi, phase);
xlabel('Normalized frequency');
ylabel('Phase in radians');
title('Phase Response');
```

Output:



Result:

- FIR filters were successfully designed using different window techniques.
- Magnitude and phase responses varied according to the window used.

Conclusion:

This experiment demonstrated FIR filter design using Rectangular, Bartlett, and Hamming windows. The results showed how window selection affects filter performance in DSP systems.