Assignment and Report

Course: Digital Signal Processing I (EEE 3217)

- Submitted to

Prof. Dr. A.K.M. Baki

Professor & Head,

Dept. of Electrical & Electronic Engineering

Ahsanullah University of Science & Technology

Submitted by
Rudro Raihan

ID: 190105048

Section: A

3rd Year 2nd Semester

Task 1

The objective of this assignment is to design a notch filter with the following specification using pole-zero placement method

Where, D2D3 = Last two digits of my student ID means 48

i. Find out the value of frequency in terms of Hz and radian.

Ans: Notch Frequency = (60+48) Hz
= 108 Hz

Notch frequency in Radian=(108×2π)rad

=678.584 rad

ii. Find out the value of 3 dB bandwidth.

Ans: 3 dB bandwidth of Notch = $\frac{\pm(60+\frac{48}{10})}{2}$ Hz

= 32.4 Hz

iii. The value of “r” :

Given, Notch Frequency=(60+D2D3) Hz

Sampling Frequency =(60+D2D3) × 5 Hz

Sampling Frequency = (60+48) × 5 Hz

=540 Hz

We know the relationship between r & bw is,

$$r \approx 1-\left(\frac{bw}{sampling\ frequency}\right)\times\pi$$

$$\therefore r \approx 1-\left(\frac{32.4}{540}\right)\times\pi \approx 0.811504$$

iv. Find out the value of feed forward and feedback coefficients

$$\theta = \pm \frac{360}{540} \times 108 \text{ degree}$$

$$= \pm 72 \text{ degree}$$

Zeros,(in polar form)

Z1= $e\ j\theta = e\ j(72)$

Z2= $e\ -j\theta = e\ -j(72)$

Zeros,(in rectangular form)

z1 =0.309+j0.951

z2 =0.309-j0.951

Poles(in polar form)

p1=$re j\theta$=0.8115$ej(72)$

p2=$re-j\theta$=0.8115$e-j(72)$

Poles(in rectangular form)

p1 =0.2507+j0.7717

p2 =0.2507-j0.7717

Transfer function, H(z) = $\frac{(z-z1)(z-z2)}{(z-p1)(z-p2)}$

Transfer function, $H(z) = \frac{(z-z1)(z-z2)}{(z-p1)(z-p2)}$

$$= \frac{(z-(0.309+j0.951))(z-(0.309-j0.951))}{(z-(0.2507+j0.7717))(z-(0.2507-j0.7717))}$$

$$= \left(\frac{1z^2-0.618z+0.999882}{1z^2-0.5014z+0.658385}\right) \times \frac{z^{-2}}{z^{-2}}$$

$$= \left(\frac{1-0.618z^{-1}+0.999882z^{-2}}{1-0.5014z^{-1}+0.658385z^{-2}}\right)$$

∴Feed-forward coefficients,

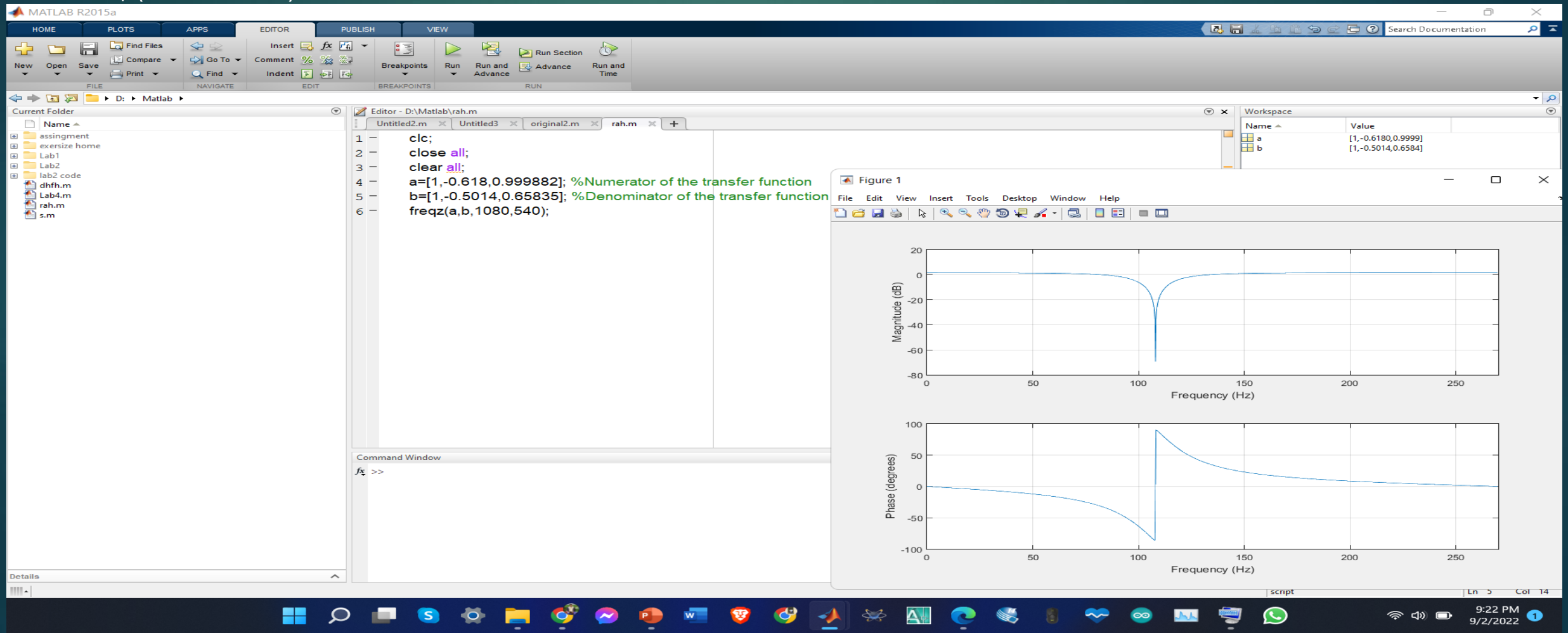
a0=1; a1= -0.618 ; a2= 0.999882

∴Feed-backward coefficients,

b1=0.5014; b2= - 0.658385

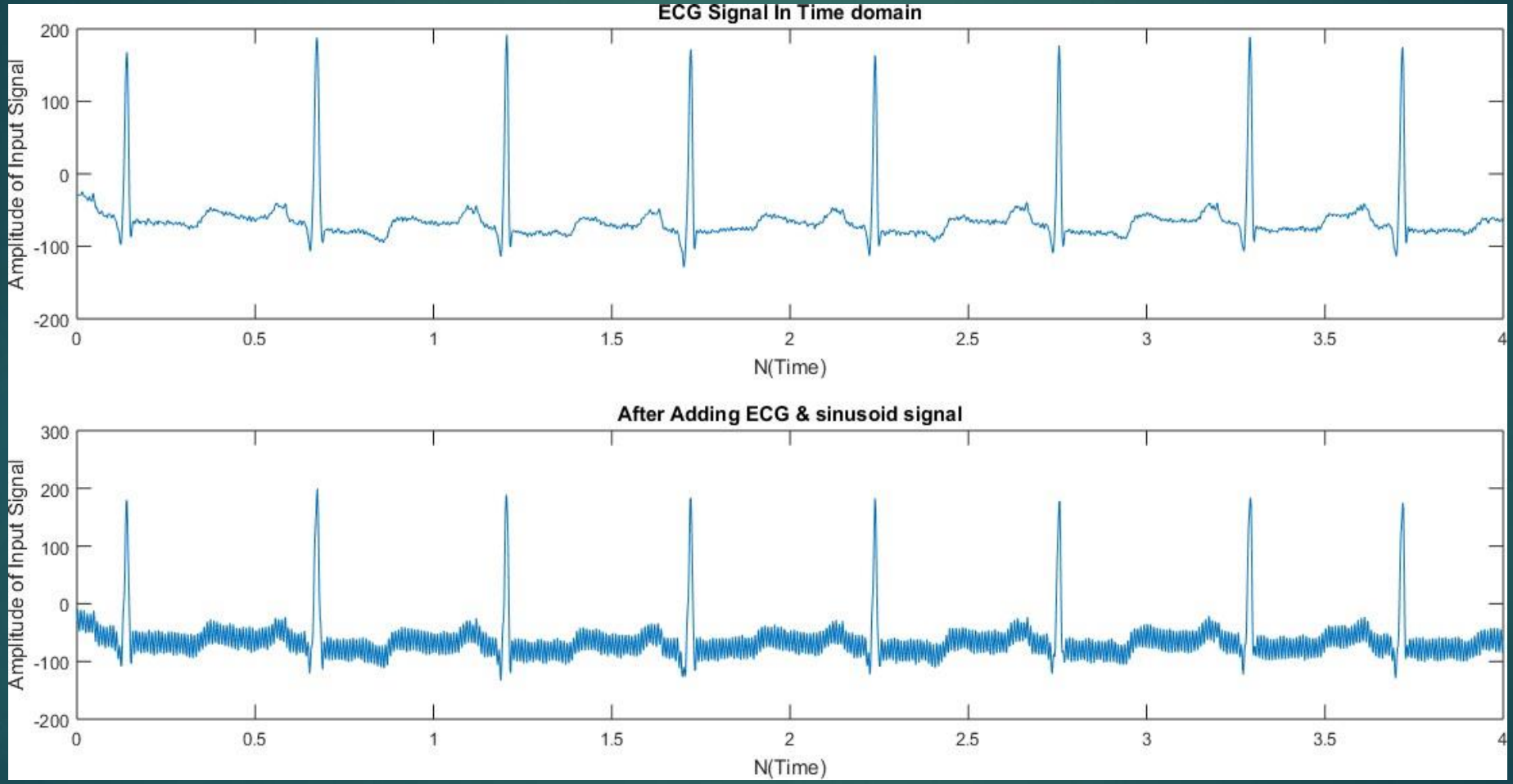
MATLAB CODE:

```
clc;
close all;  clear all;
a=[1,-0.618,0.999882]; %Numerator of the transfer function
b=[1,-0.5014,0.65835]; %Denominator of the transfer function
freqz(a,b,1080,540);
```

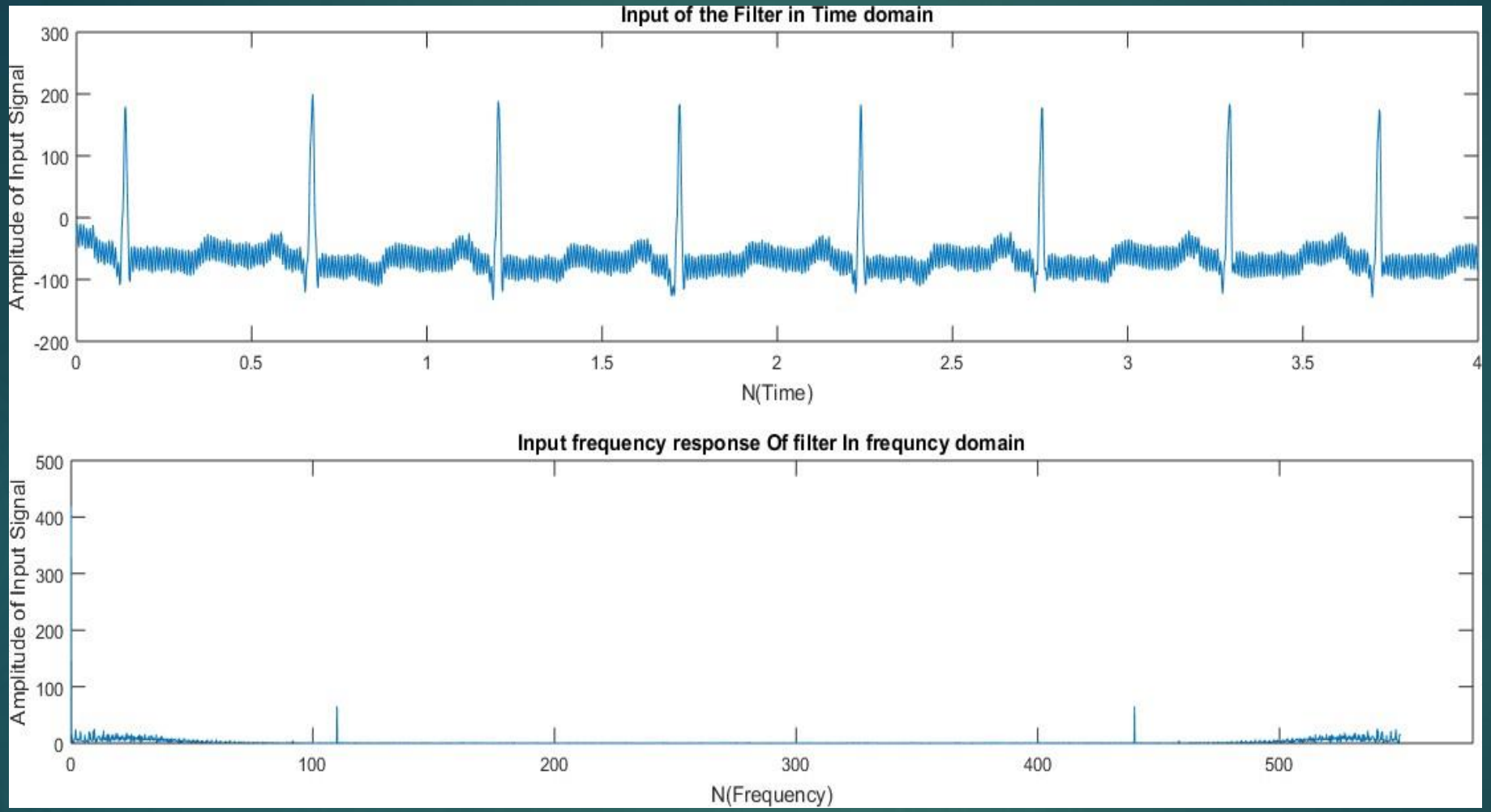


Task 2

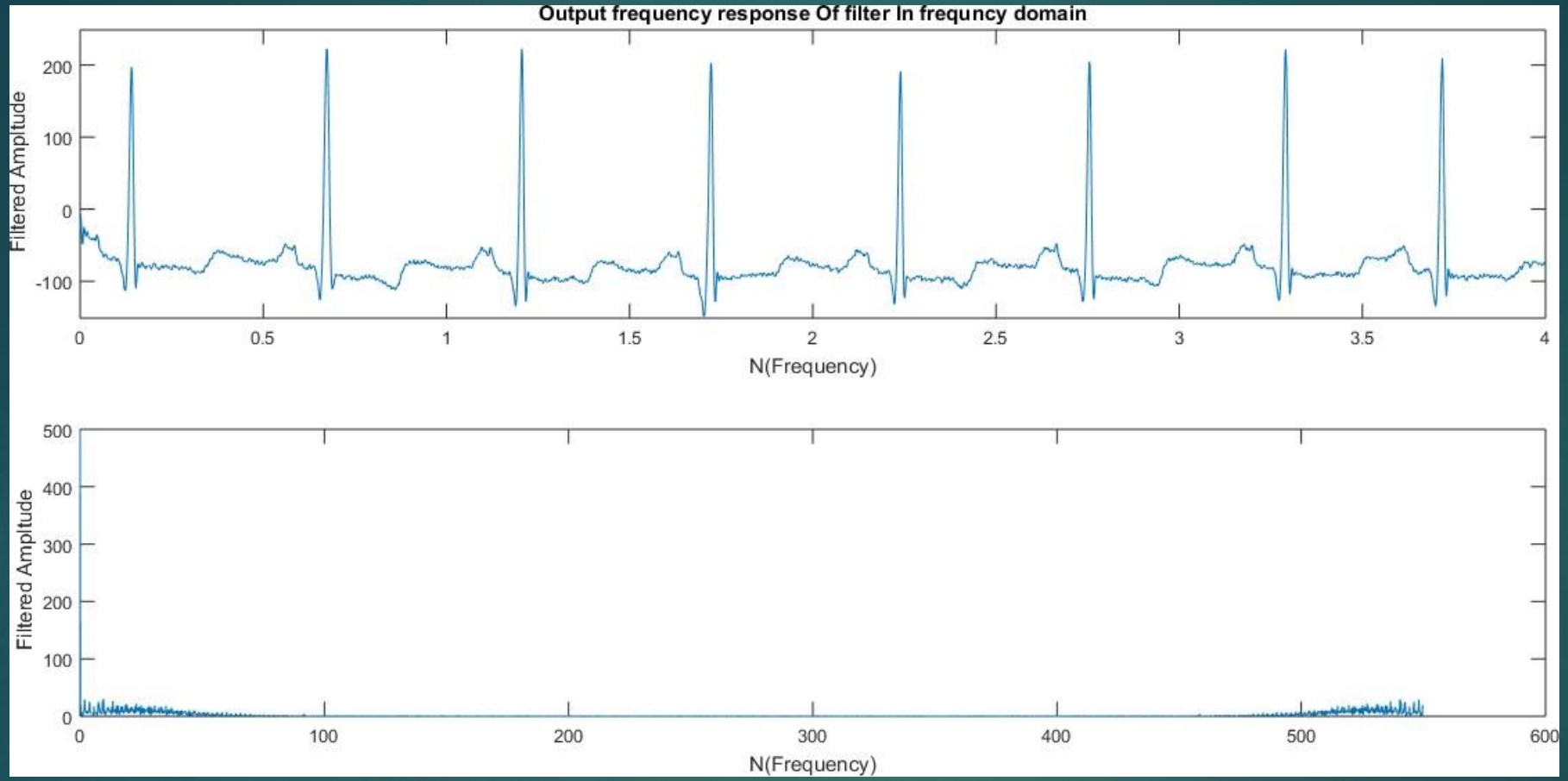
a) The ECG signal & added sine signal to ECG signal:



c) Input signal of filter's in Time domain & frequency response:



d) Output signal of filter's in Time domain & frequency response:



CODE

```
clc;
clear all; % clear all varaiables
close all; % close all figures
load('111m.mat')
y1=val(1,:);
fs=1000;
ts=1/fs
f0=108;
% Fs=1000;
% ts=1/Fs;
N1=length(y1);
t=((0:N1-1)*ts)/fs;
% fs=540;
% f0=108;
w1=2*pi*f0*t;
x1=30*sin(w1);
x2=x1+y1;
k=fft(x2);
```

```
a=[1,-0.618,0.999882];% INITIALISING VECTOR A WITH COEFFICIENTS OF THE
NUMERATOR;
b=[1,-0.5032,0.66315]; %INITIALISING VECTOR B WITH COEFFICIENTS OF THE
DENOMINATOR;
y=filter(a,b,x2); %TIME DOMAIN OF OUTPUT FILTER
w = fft(y);
subplot(2,2,1)
plot(t,x2);
title('Input Of filter');
subplot(2,2,2)
plot(t,k);
title('Input frequency response Of filter ');
subplot(2,2,3)
plot(t,y);
title('Output Of filter');
subplot(2,2,4)
plot(t,w);
title('frequency response Of filter o/p');
```

THANK YOU

AHSANULLAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

Assignment REPORT

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Course Title: Digital Signal Processing I

SUBMITTED TO

Prof. Dr. A.K.M. Baki

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SUBMITTED BY

Name: MD Rudro Raihan

ID: 190105048

Year: 3rd Semester: 2nd

Section: A Department: EEE

Task 1

CODE:

```
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close all;
clear all;
a=[1,-0.618,0.999882]; %Numerator of the transfer function
b=[1,-0.5014,0.65835]; %Denominator of the transfer function
freqz(a,b,1080,540);
```
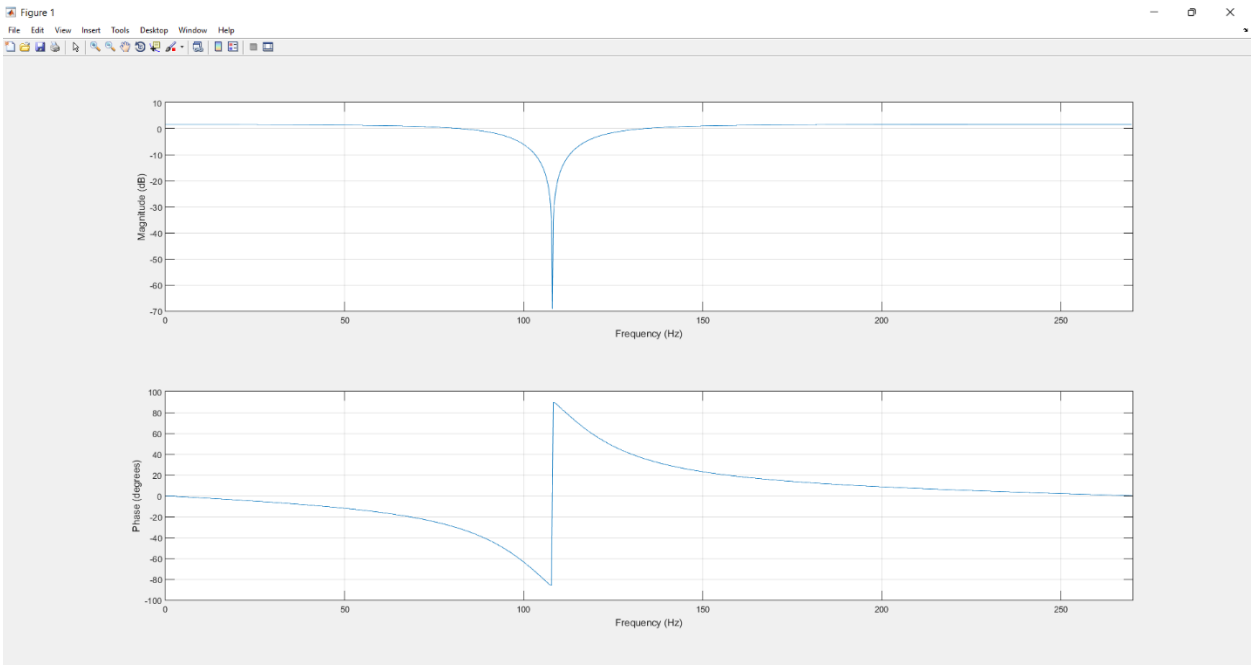

OUTPUT:



Task 2

CODE:

```
clc;

clear all; % clear all varaiables
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load('111m.mat')
y1=val(1,:);
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ts=1/fs
f0=108;
% Fs=1000;
% ts=1/Fs;
N1=length(y1);
t=((0:N1-1)*ts)/fs;
% fs=540;
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w1=2*pi*f0*t;
x1=30*sin(w1);
x2=x1+y1;
k=fft(x2);
a=[1,-0.618,0.999882];% INITIALISING VECTOR A WITH COEFFICIENTS
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plot(t,w);title('frequency response Of filter o/p');
```
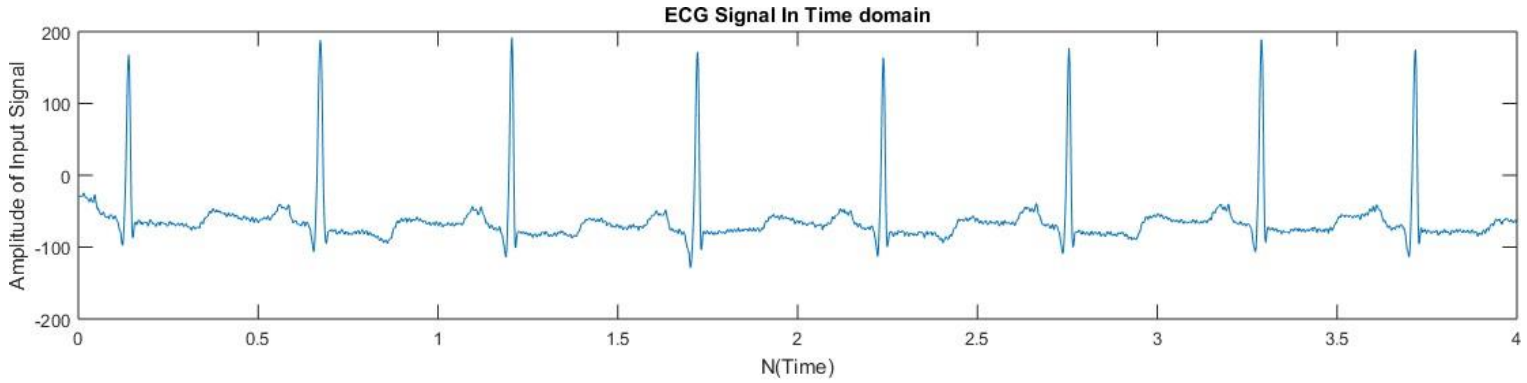
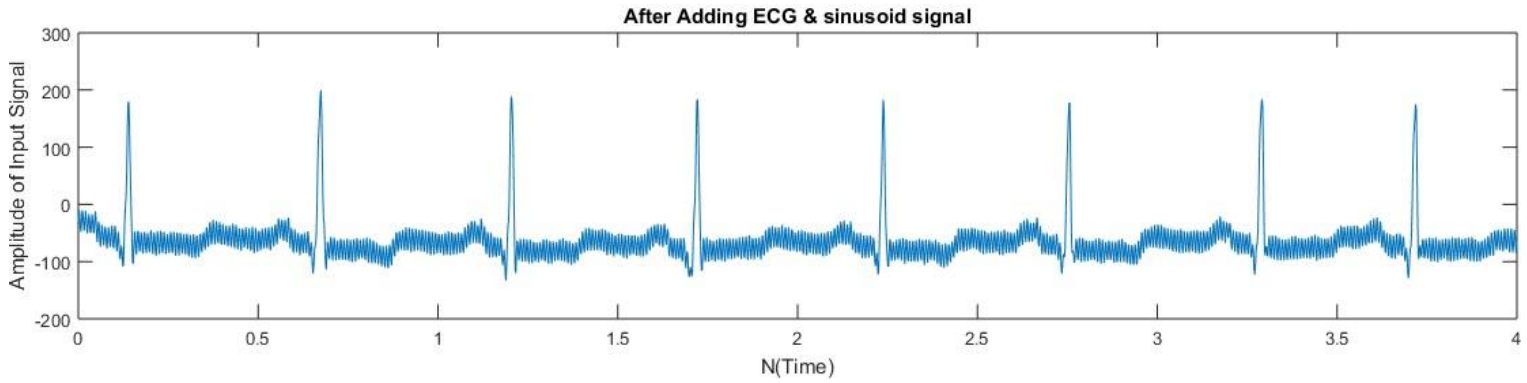
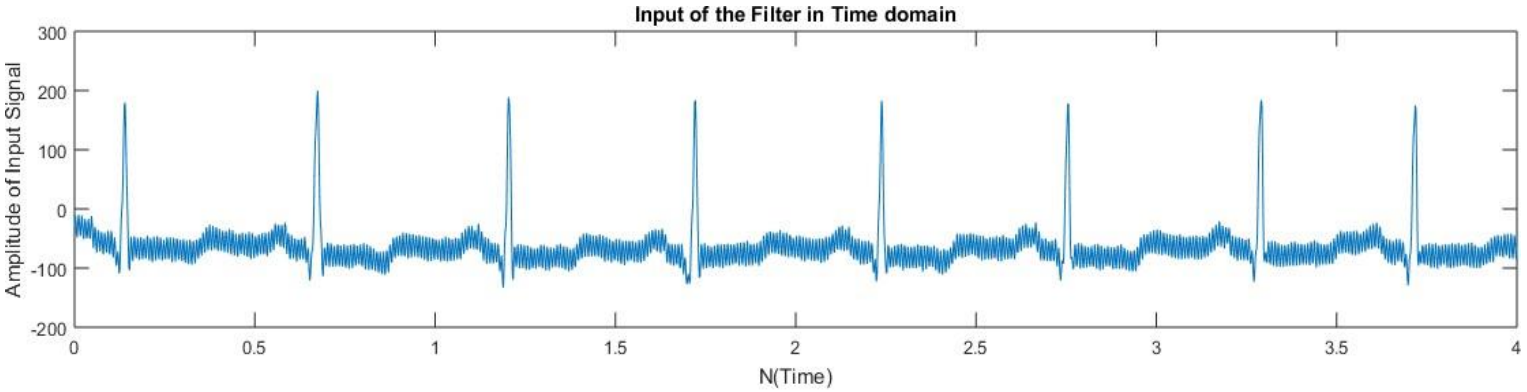

OUTPUT:

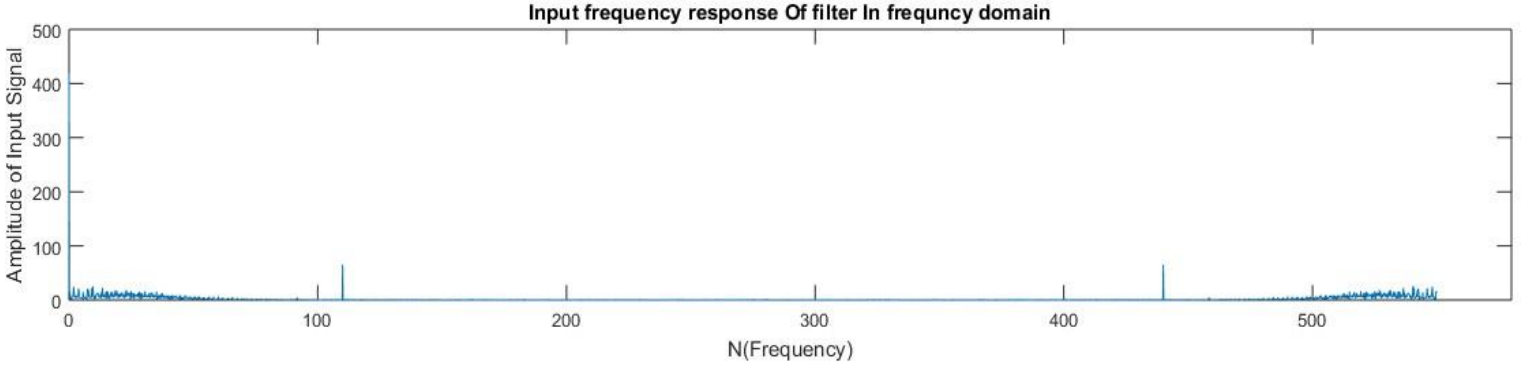
a) The ECG signal & added sine signal to ECG signal:





c) Input signal of filter's in Time domain & frequency response:





d) Output signal of filter's in Time domain & frequency response: