Ahsanullah University of Science & Technology

Department of Electrical and Electronic Engineering

<u>Project Report</u>

Course No : EEE 3218

Course Title : Digital Signal Processing Lab

Submission Date : 23-02-2023

Submitted by

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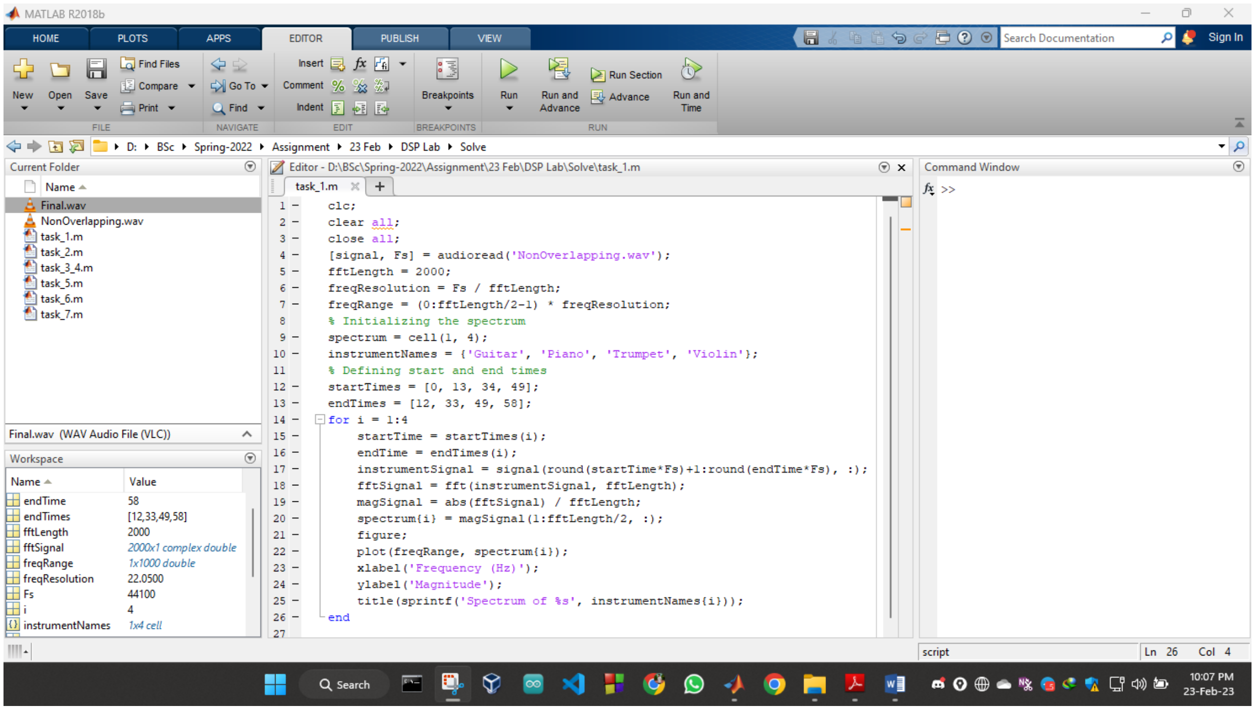
Section : C2

Year : 3rd

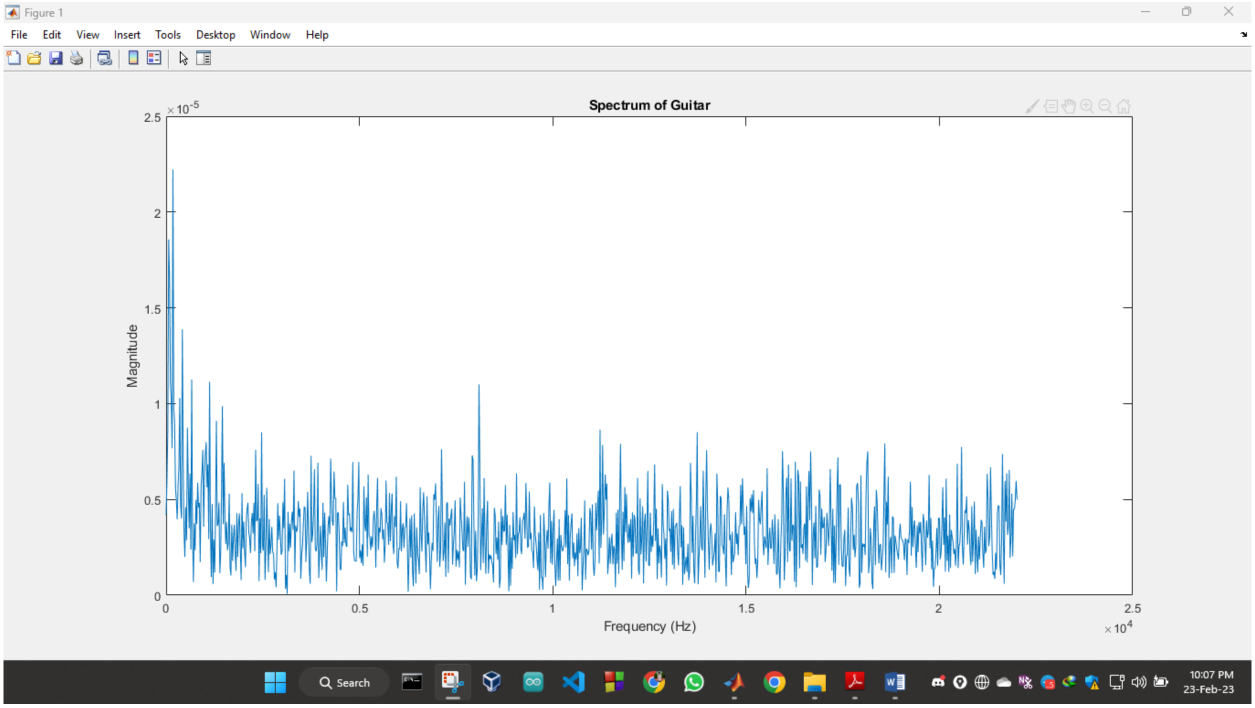
Semester : 2nd

Task 1:

Code:

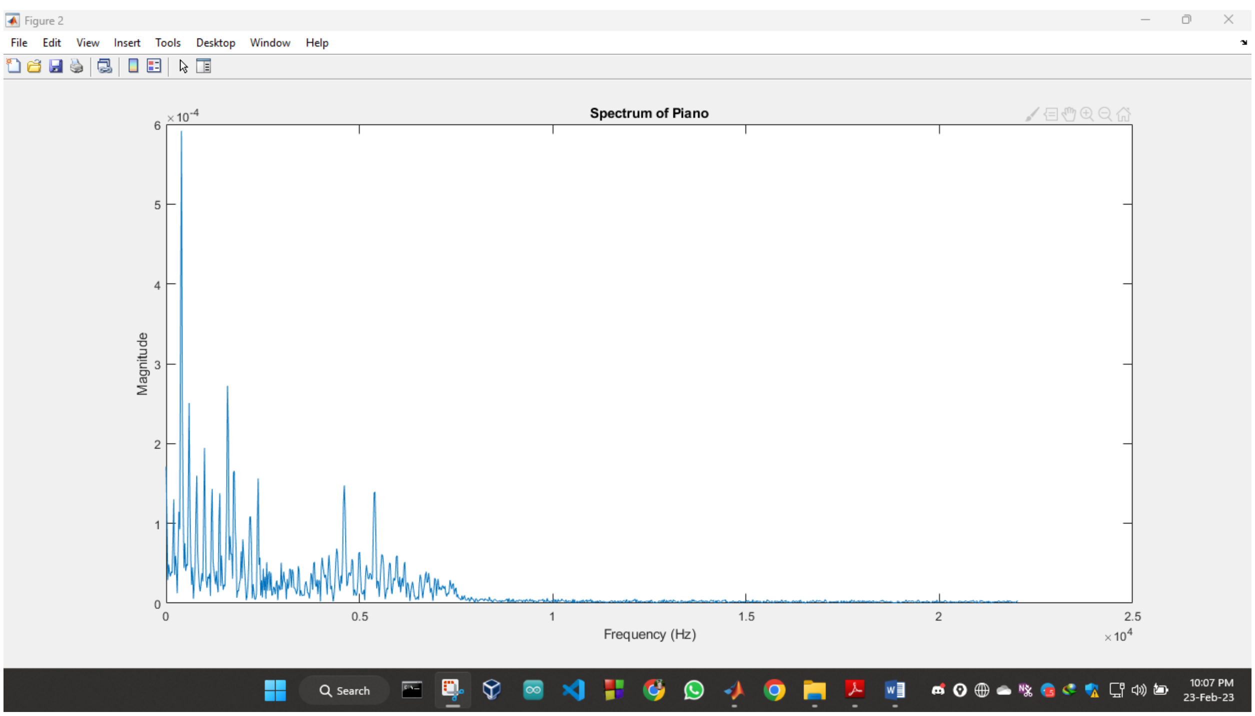

MATLAB R2018b
Editor - D:\BSc\Spring-2022\Assignment\23 Feb\DSP Lab\Solve\task_1.m
clc;
clear all;
close all;
[signal, Fs] = audioread('NonOverlapping.wav');
fftLength = 2000;
freqResolution = Fs / fftLength;
freqRange = (0:fftLength/2-1) * freqResolution;
% Initializing the spectrum
spectrum = cell(1, 4);
instrumentNames = {'Guitar', 'Piano', 'Trumpet', 'Violin'};
% Defining start and end times
startTimes = [0, 13, 34, 49];
endTimes = [12, 33, 49, 58];
for i = 1:4
startTime = startTimes(i);
endTime = endTimes(i);
instrumentSignal = signal(round(startTime*Fs)+1:round(endTime*Fs), :);
fftSignal = fft(instrumentSignal, fftLength);
magSignal = abs(fftSignal) / fftLength;
spectrum{i} = magSignal(1:fftLength/2, :);
figure;
plot(freqRange, spectrum{i});
xlabel('Frequency (Hz)');
ylabel('Magnitude');
title(sprintf('Spectrum of %s', instrumentNames{i}));
end

Guitar:



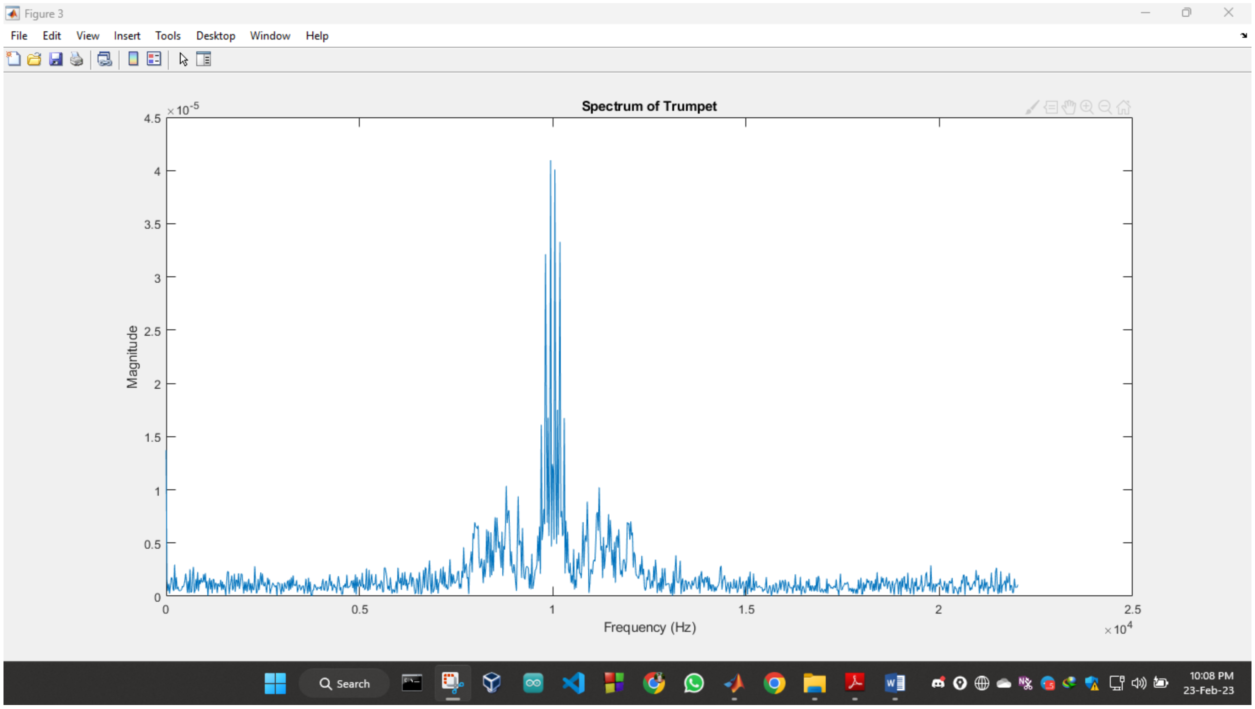
It has a frequency range between 0 Hz to 22010 Hz.

Piano:



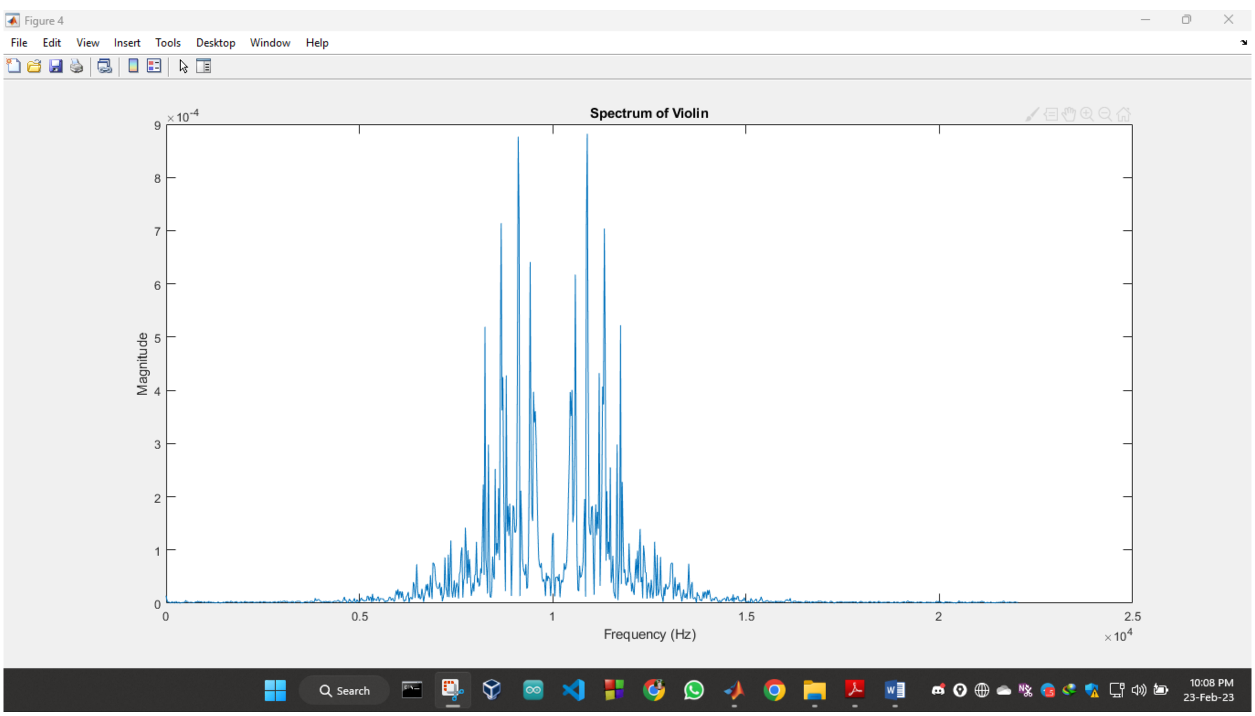
It has a frequency range between 0 Hz to 7629 Hz.

Trumpet:



It has a frequency range between 0 Hz to 22030 Hz.

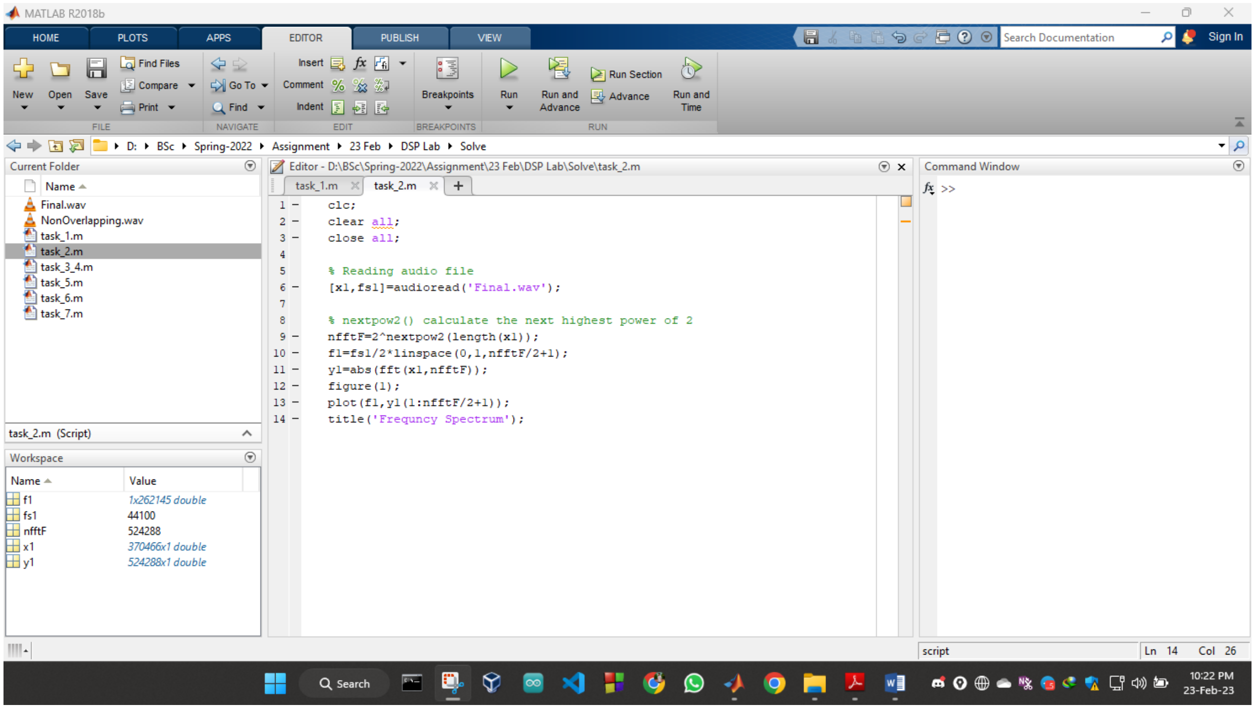
Violin:



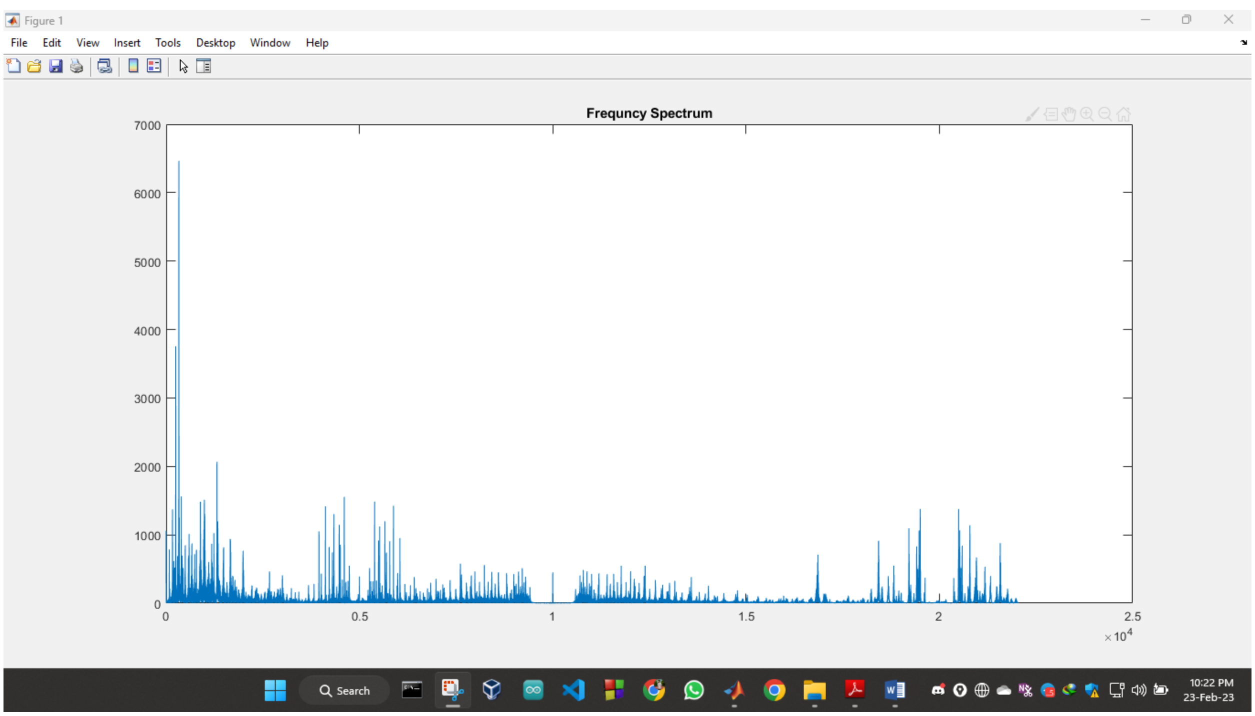
It has a frequency range between 5005 Hz to 16140 Hz.

Task 2:

Code:



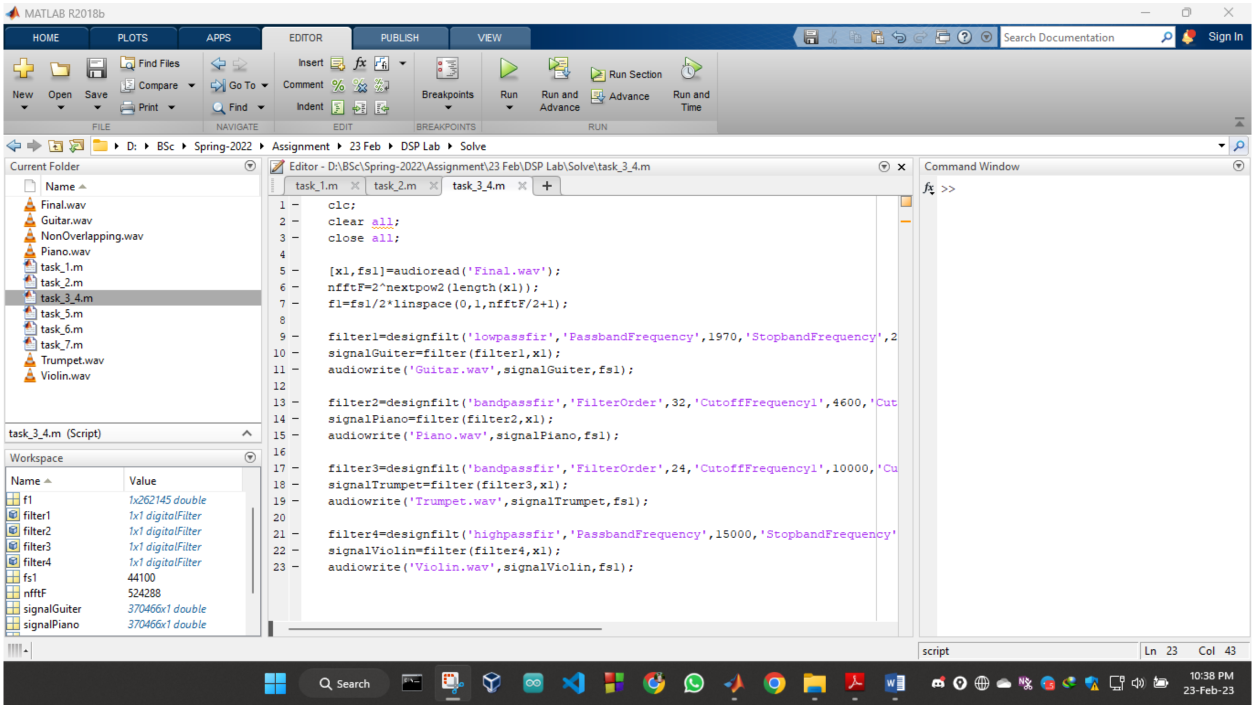
Spectrum:



The frequency range is between 0 Hz to 22050 Hz.

Task 3 & 4:

Code:



Guitar: Guitar uses low pass filter with pass band frequency of 1970 Hz, stopband frequency of 2290 Hz, pass band ripple 1, stopband attenuation of 94.

Piano: Piano uses band pass filter with order 32, cutoff frequency 4600Hz and 6100 Hz.

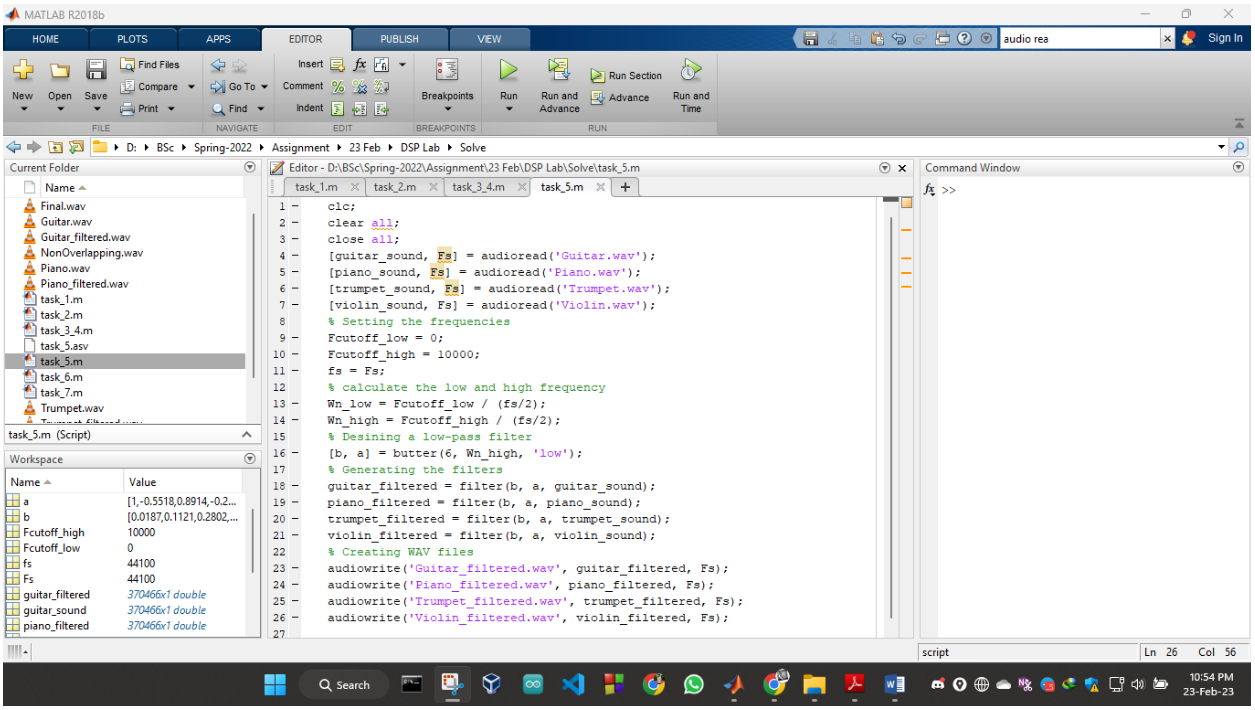
Trumpet: Trumpet uses band pass filter with filter order 24, cutoff frequency 10000Hz and 11000 Hz.

Violin: Violin uses high pass filter with pass band frequency of 15000 Hz, stopband frequency of 14900 Hz, pass band ripple 1, stopband attenuation of 77.

Extracted files are Guitar.wav, Piano.wav, Trumpet.wav and Violin.wav.

Task 5:

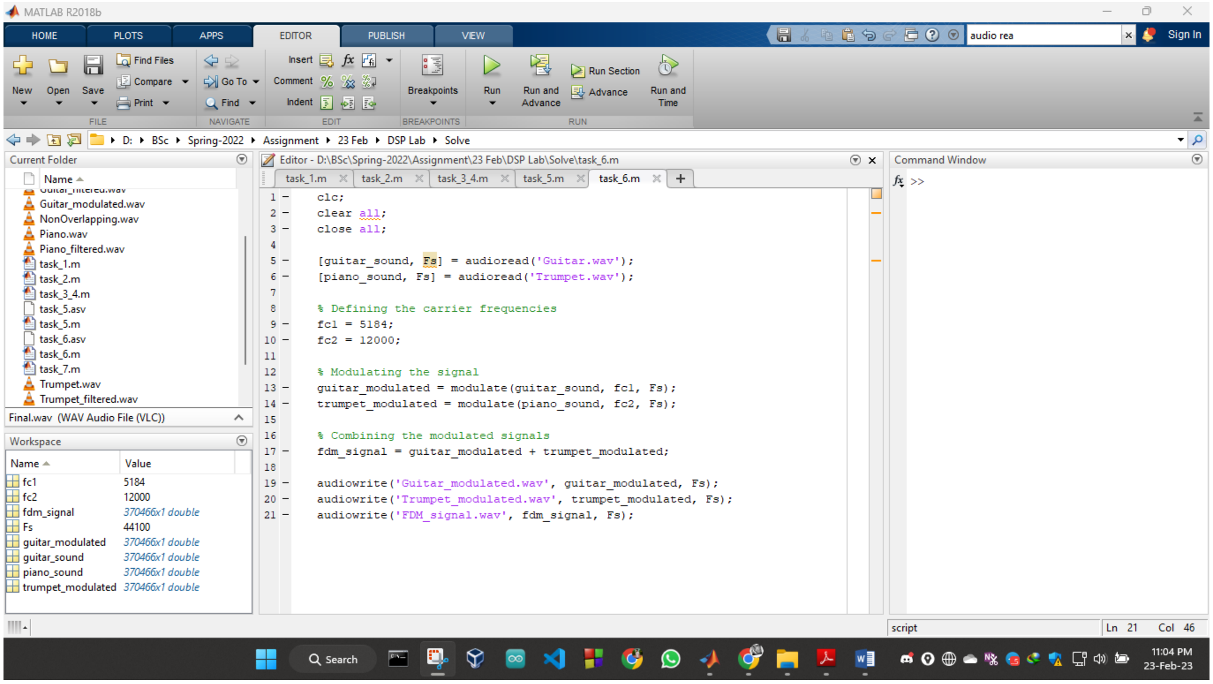
I can pass the individual wav files separately through a channel of bandwidth 0 to 10 kHz by setting the lower frequency to 0 Hz and higher frequency to 10000 Hz and using the low pass filter with butter function with filter order 6.



<u>Task 6:</u>

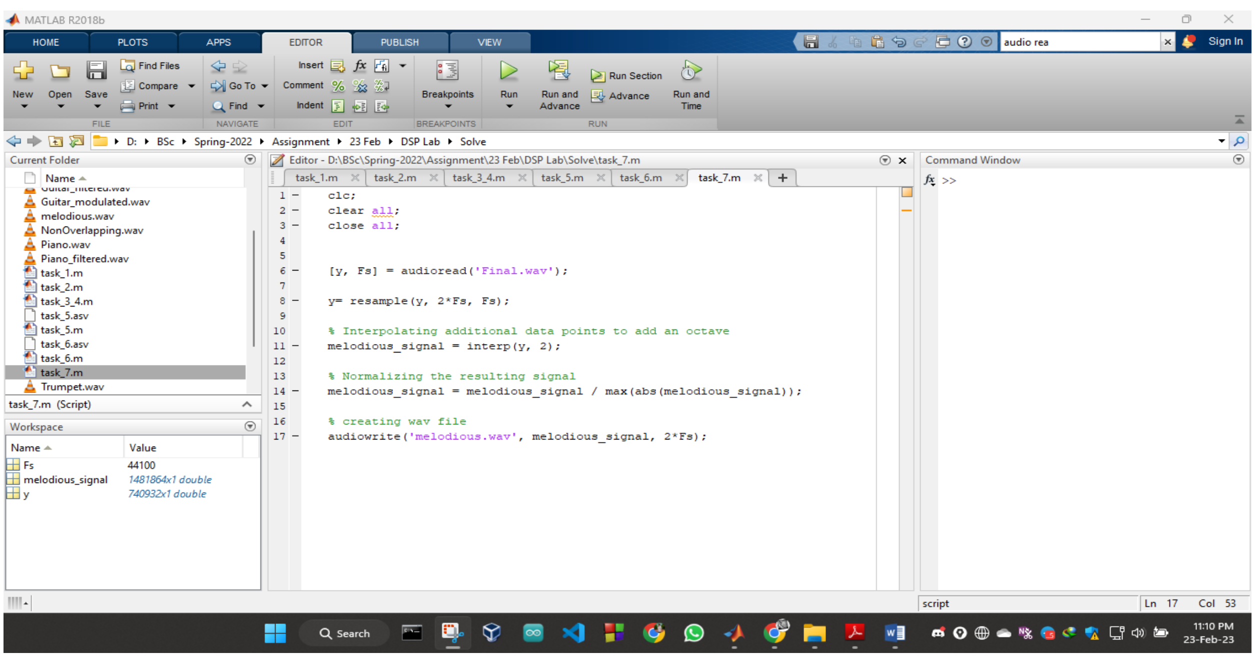
Sending guitar and trumpet signals through a 2-channel FDM link using carrier frequency of 5184 Hz and 12000 Hz.

Code:


MATLAB R2018b
Editor - D:\BSc\Spring-2022\Assignment\23 Feb\DSP Lab\Solve\task_6.m
clc;
clear all;
close all;
[guitar_sound, Fs] = audioread('Guitar.wav');
[piano_sound, Fs] = audioread('Trumpet.wav');
% Defining the carrier frequencies
fc1 = 5184;
fc2 = 12000;
% Modulating the signal
guitar_modulated = modulate(guitar_sound, fc1, Fs);
trumpet_modulated = modulate(piano_sound, fc2, Fs);
% Combining the modulated signals
fdm_signal = guitar_modulated + trumpet_modulated;
audiowrite('Guitar_modulated.wav', guitar_modulated, Fs);
audiowrite('Trumpet_modulated.wav', trumpet_modulated, Fs);
audiowrite('FDM_signal.wav', fdm_signal, Fs);

Task 7:

Code:


MATLAB R2018b
Editor - D:\BSc\Spring-2022\Assignment\23 Feb\DSP Lab\Solve\task_7.m
clc;
clear all;
close all;
[y, Fs] = audioread('Final.wav');
y= resample(y, 2*Fs, Fs);
% Interpolating additional data points to add an octave
melodious_signal = interp(y, 2);
% Normalizing the resulting signal
melodious_signal = melodious_signal / max(abs(melodious_signal));
% creating wav file
audiowrite('melodious.wav', melodious_signal, 2*Fs);