21.03.2022
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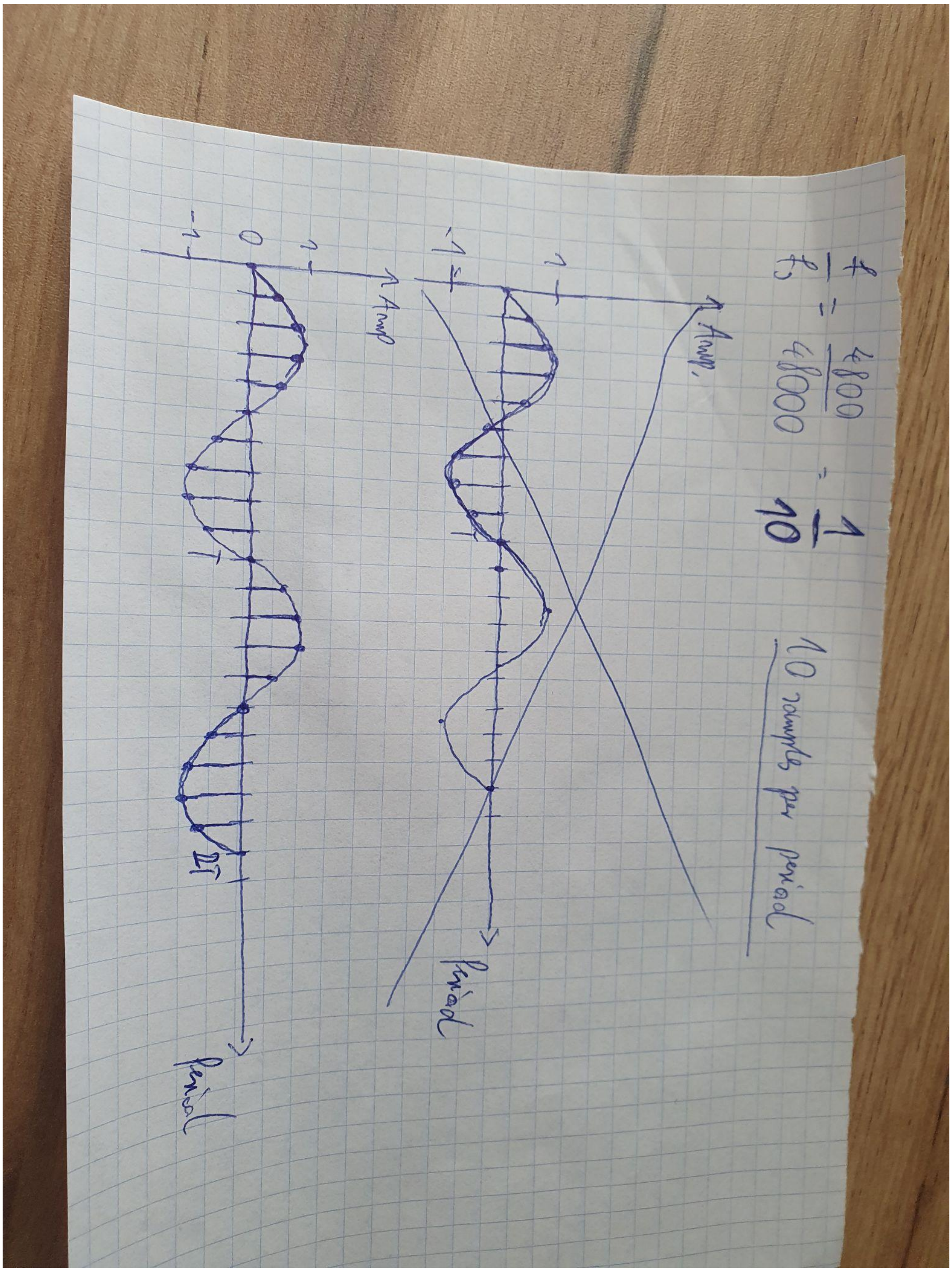
EDISP LAB 1 - DT signals, sampling, frequency

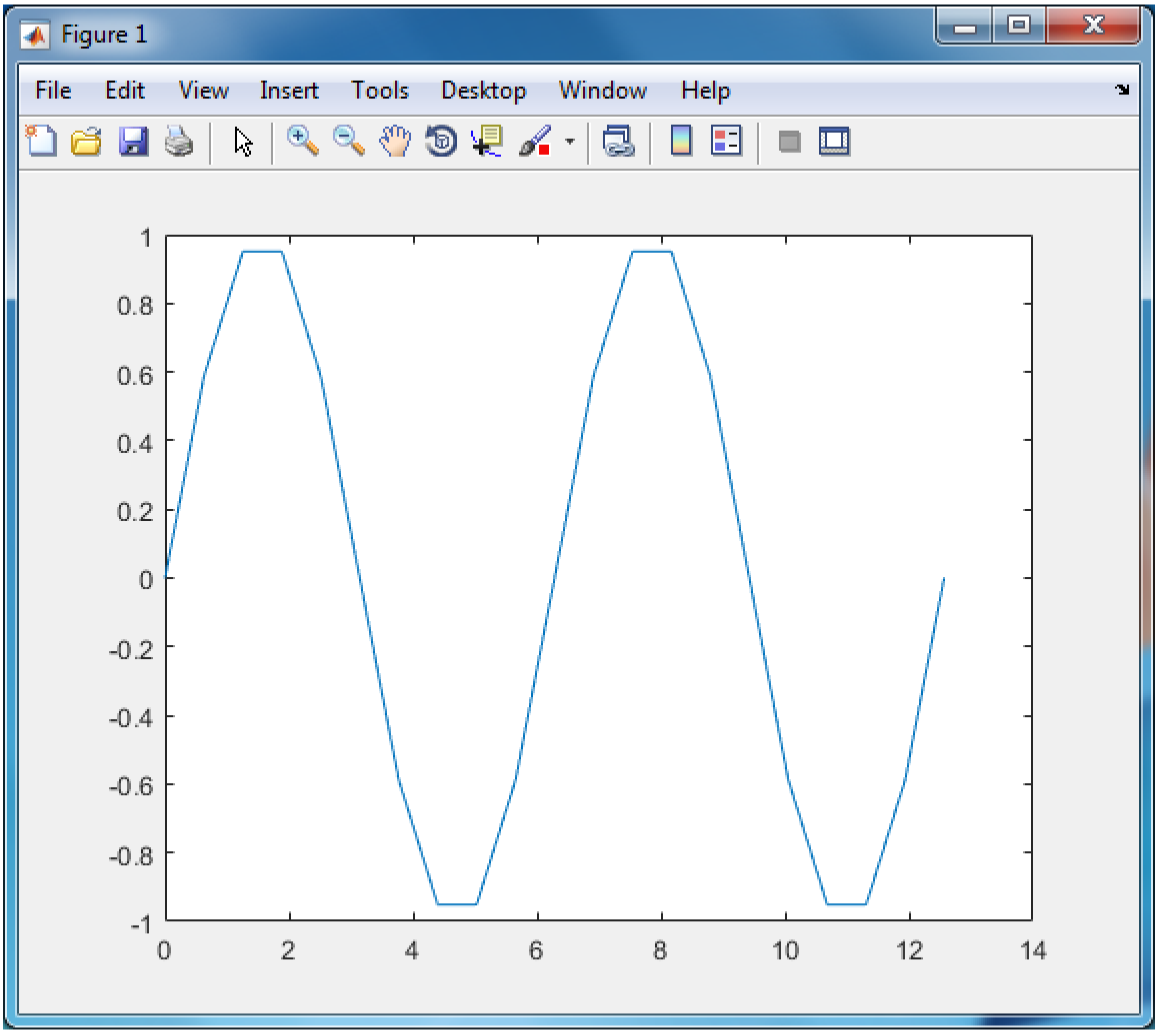
Task 1

(note: unless stated otherwise, in plots x axis is time, y axis is amplitude)

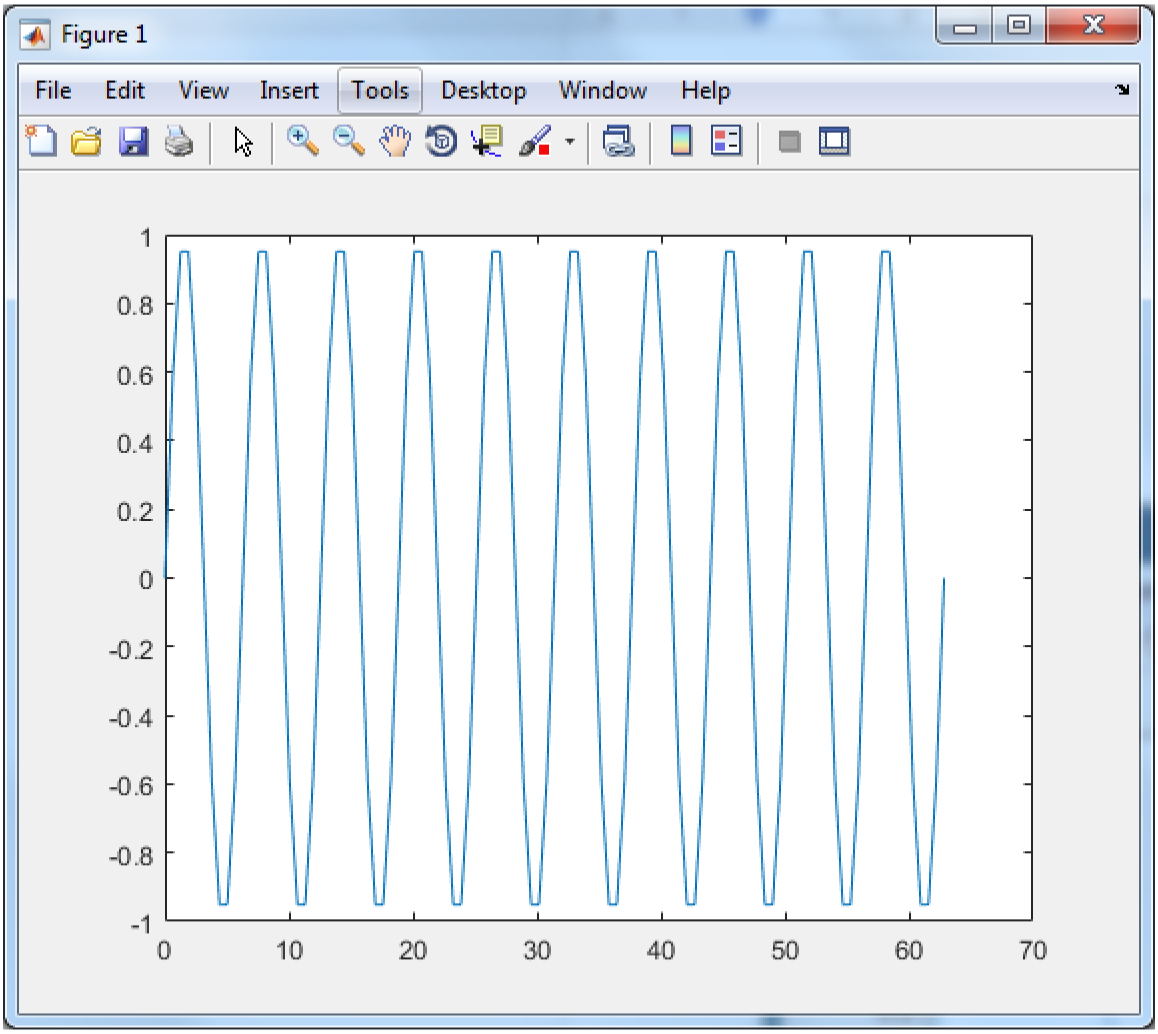


Task 2

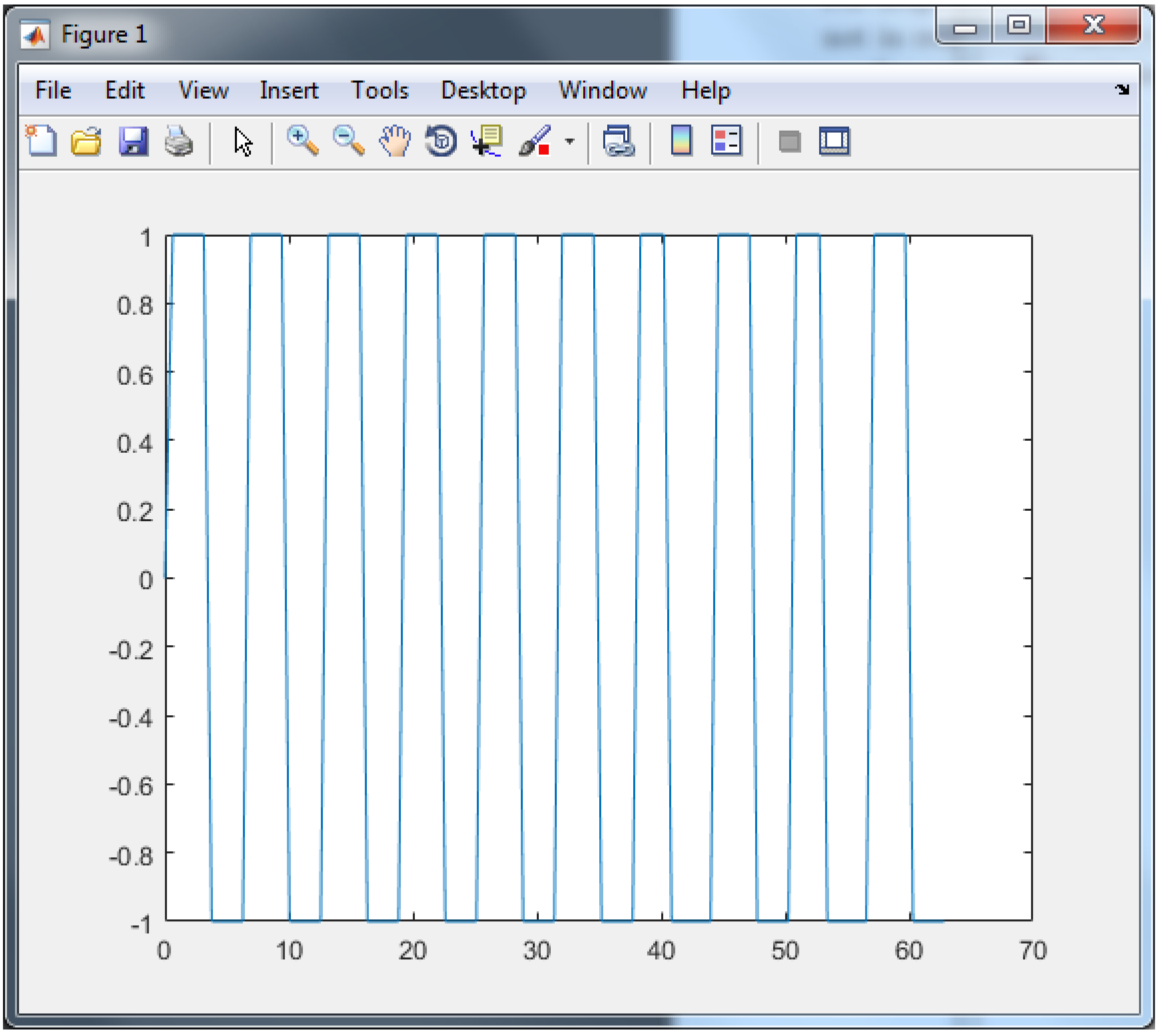
20 samples (2 periods):



100 samples (10 periods):



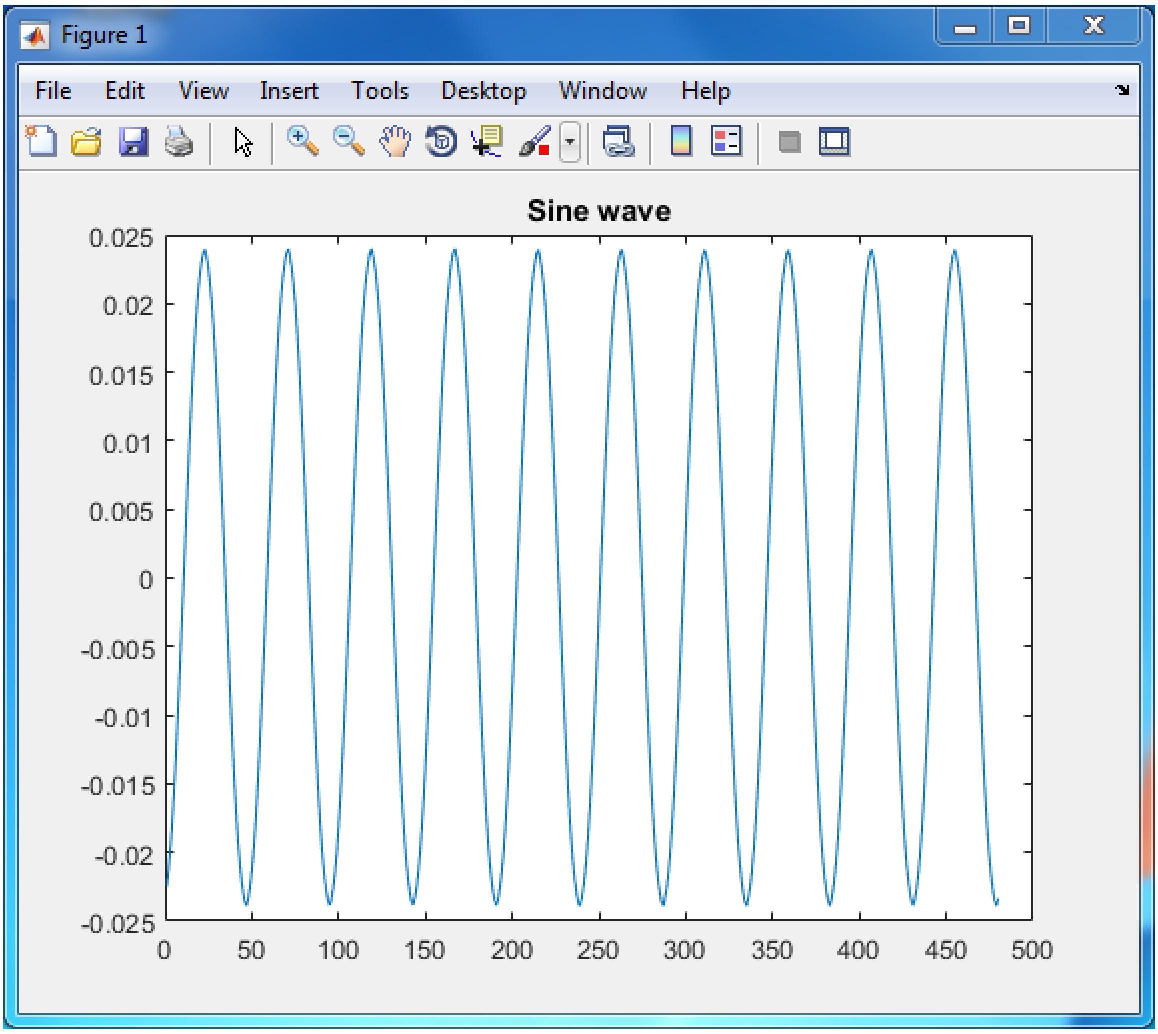
Task 3

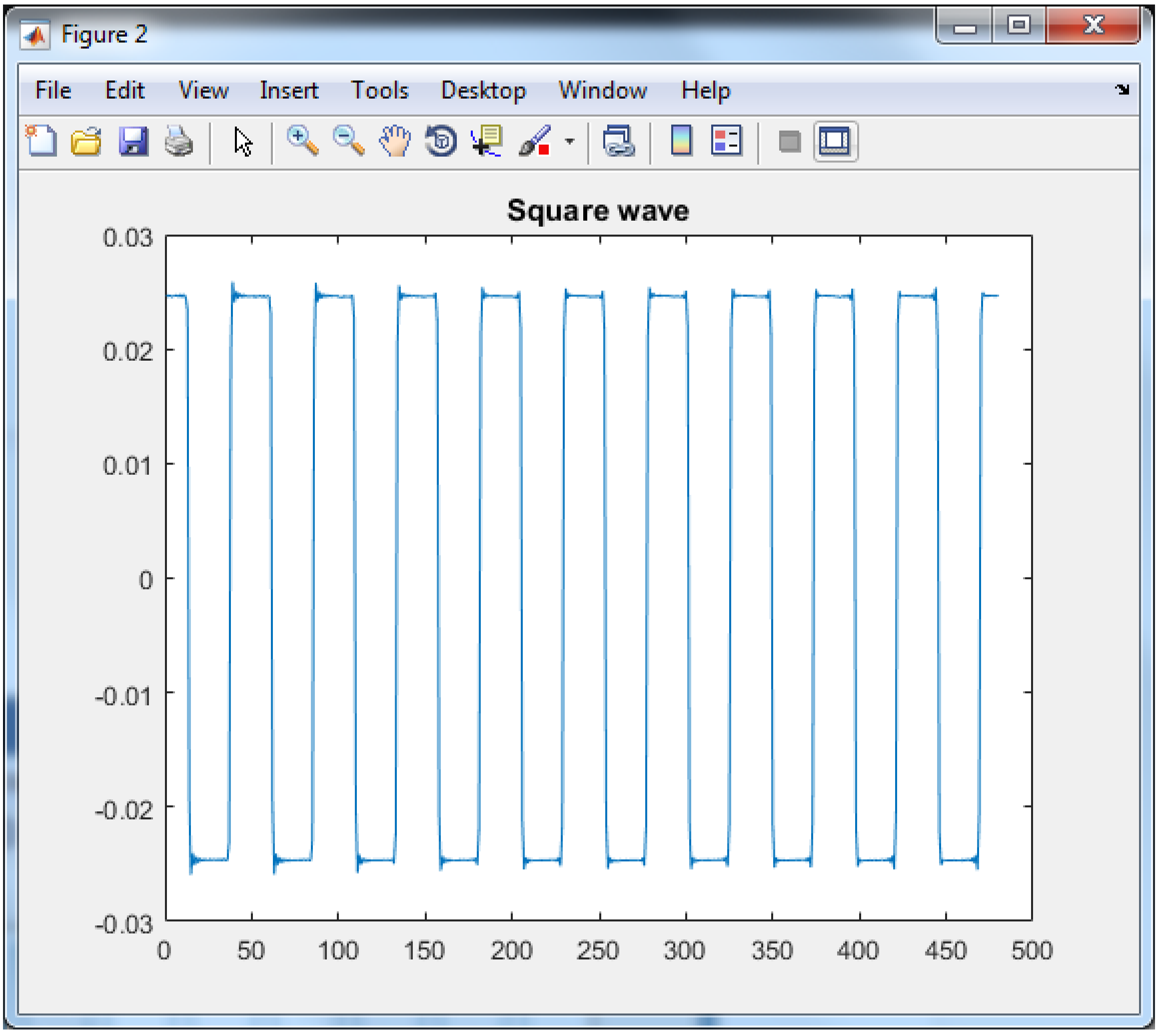


Because we sample the sine wave only 10 times per period, the sine wave looks rather similar to the obtained square wave. We would see differences if we were to plot sine wave with better sampling rate. The “jagged edges” in the sine wave would disappear.

Task 4

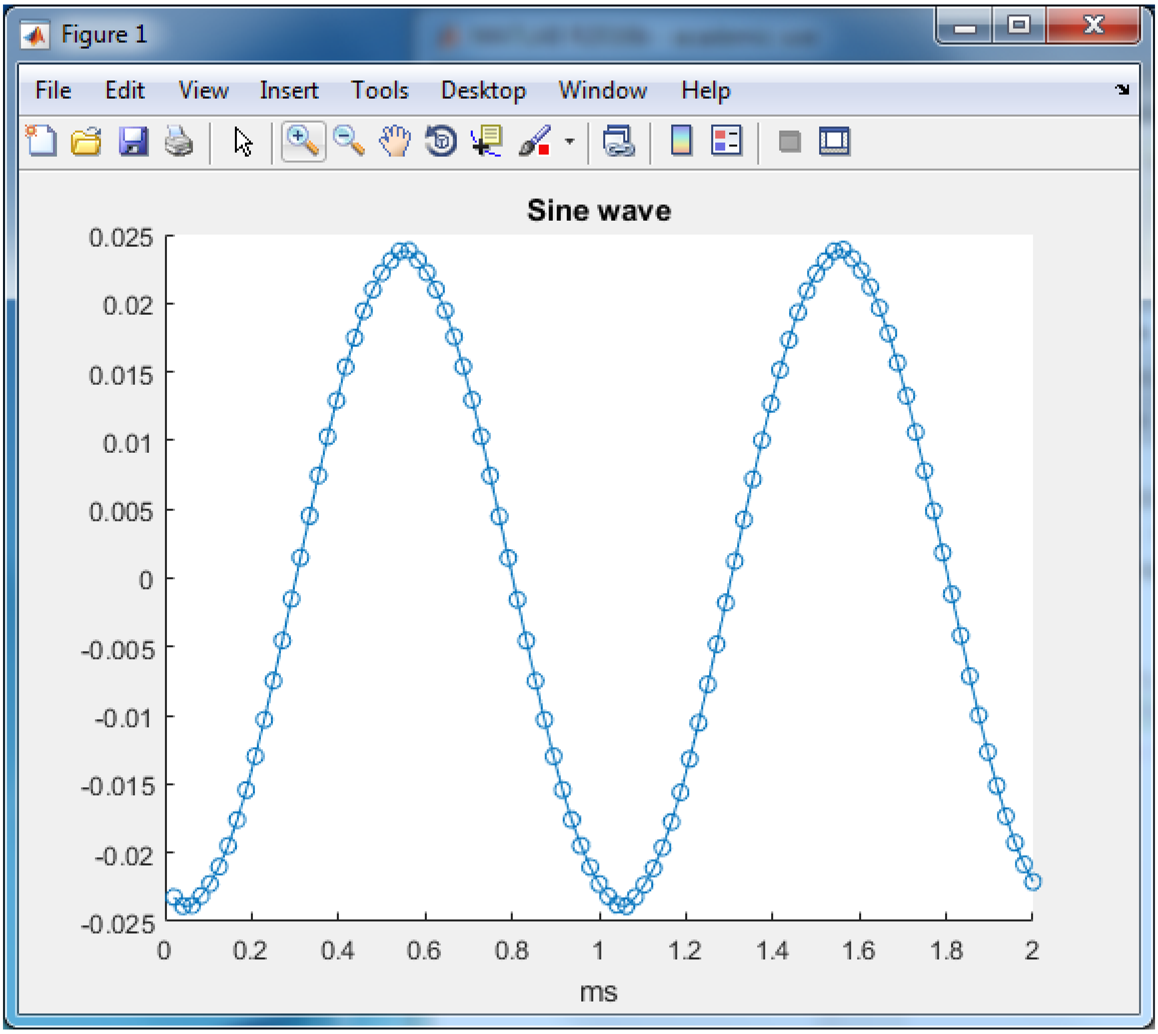
Sampling rate is 48kHz, 10 periods were collected. Wave freq. on oscilloscope is about 1kHz, amplitude is about 5V





Biggest difference can be seen in the square wave. Analog device is unable to create a perfect square wave compared to digital square wave. Especially the constant parts in the analog wave are not perfectly constant (notice imperfections near signal drops).
Sine wave quality is almost the same, with a small problem - sampling frequency is too low for the sine wave in previous tasks. If we were to increase digital wave sampling frequency, then there wouldn't be much difference between analog and digital waves.

Task 5



1 wave lasts for 1/1000 s = 1 ms, because f = 1kHz

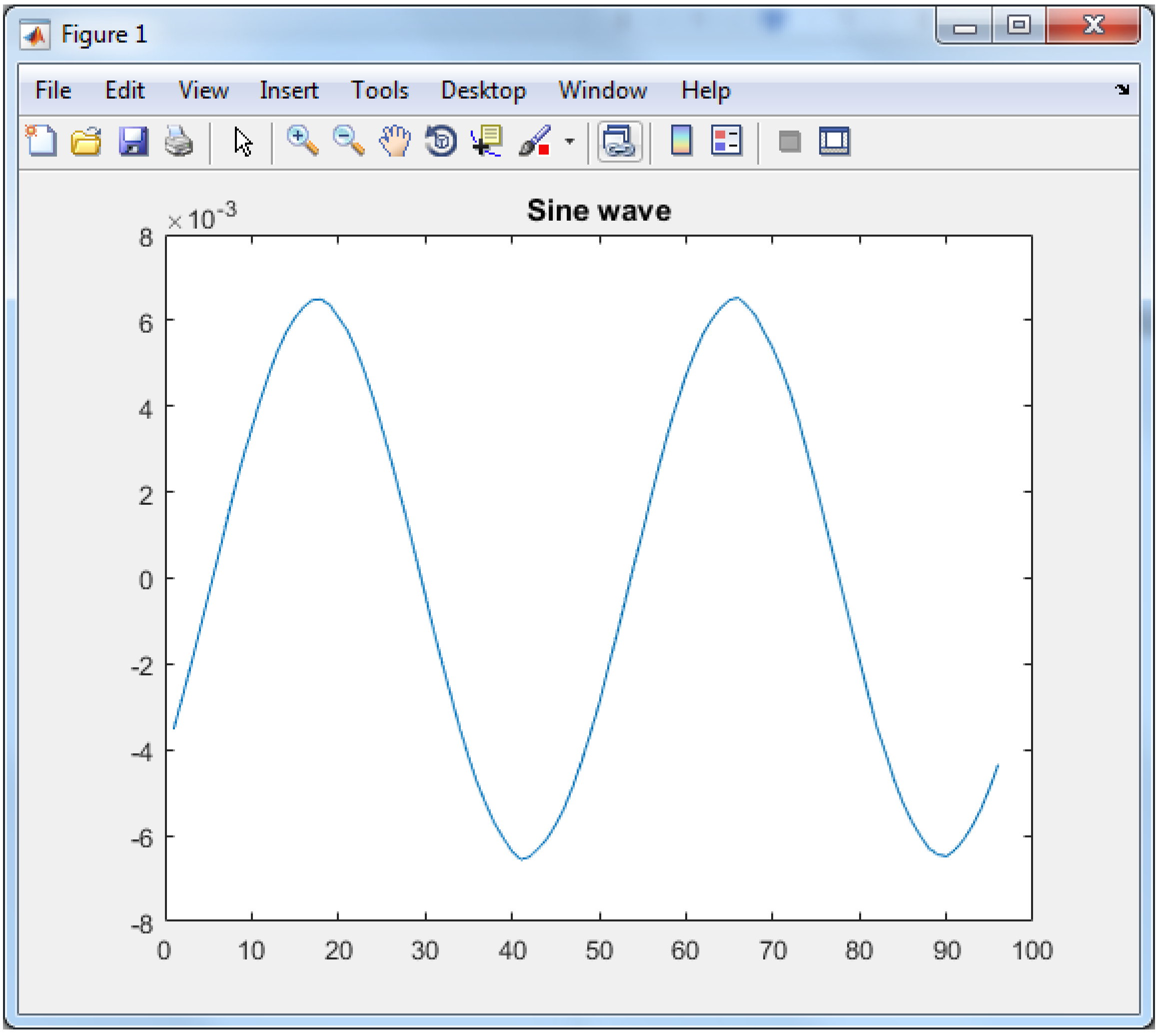
MATLAB code:

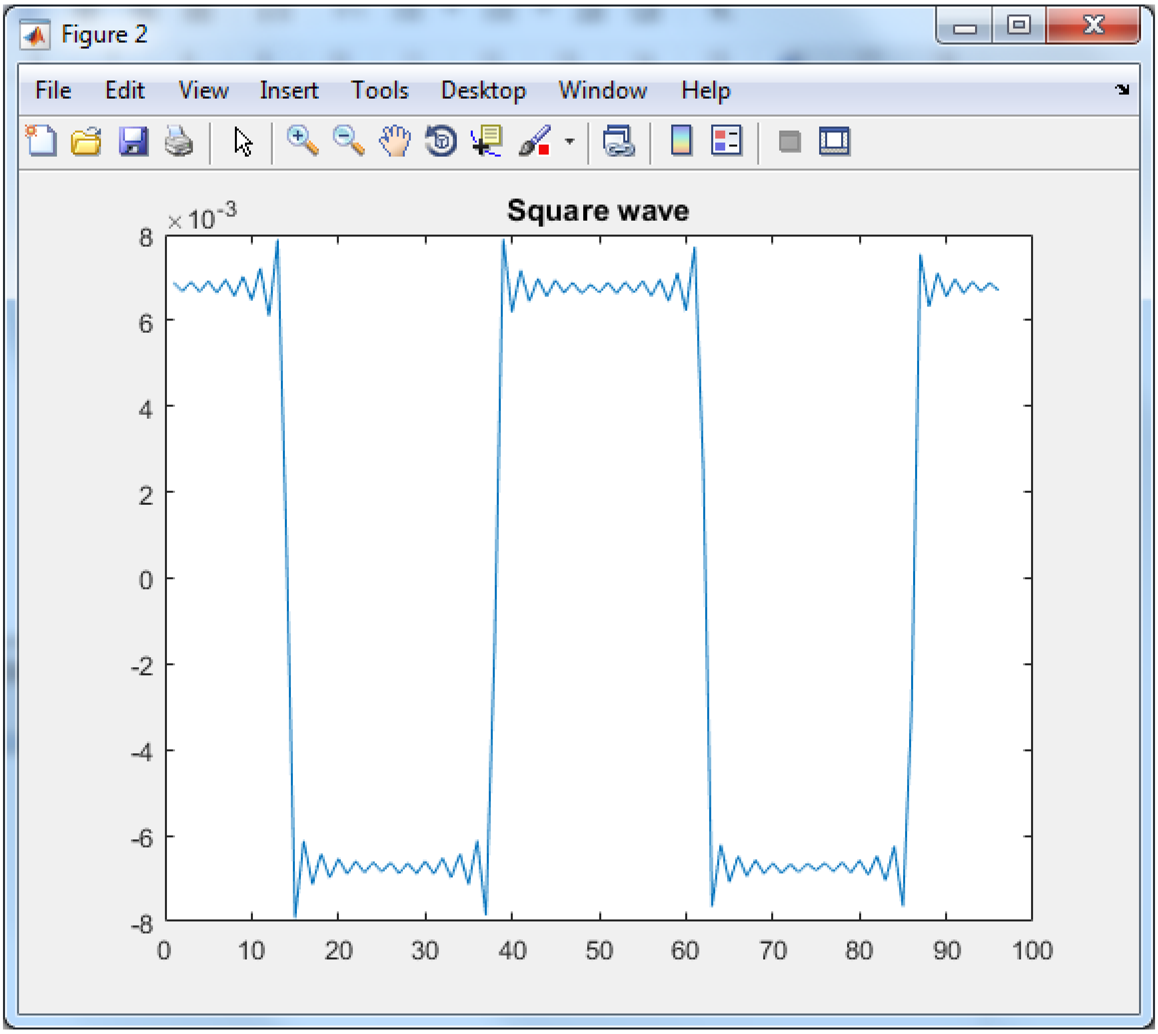
```
N = 2 * 48000/1000; % 2 periods
[x1, ~, Fs] = LCPS_getdata(N,1,1/48000);
x = 1/48:1/48:N/48; % In ms
figure;
hold on;
xlabel('ms');
plot(x,x1, '-o');
title('Sine wave');
hold off;
```

Task 6

Max voltage was about 250 V, smallest voltage was about 1.5 V

For 1.5V:





For this voltage, we see big noise effects on the square wave. Sine wave looks rather ok.

For 250 V:

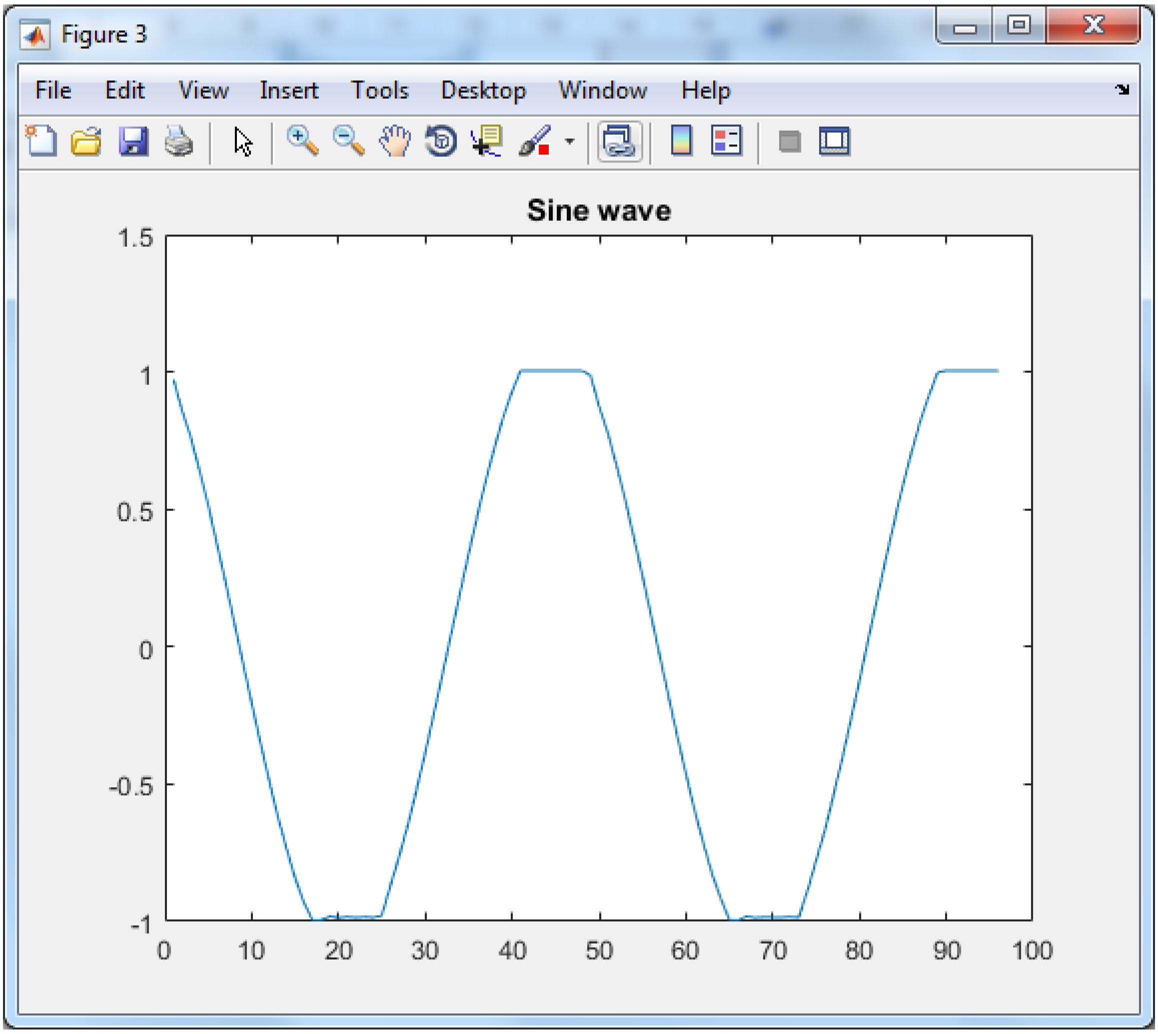
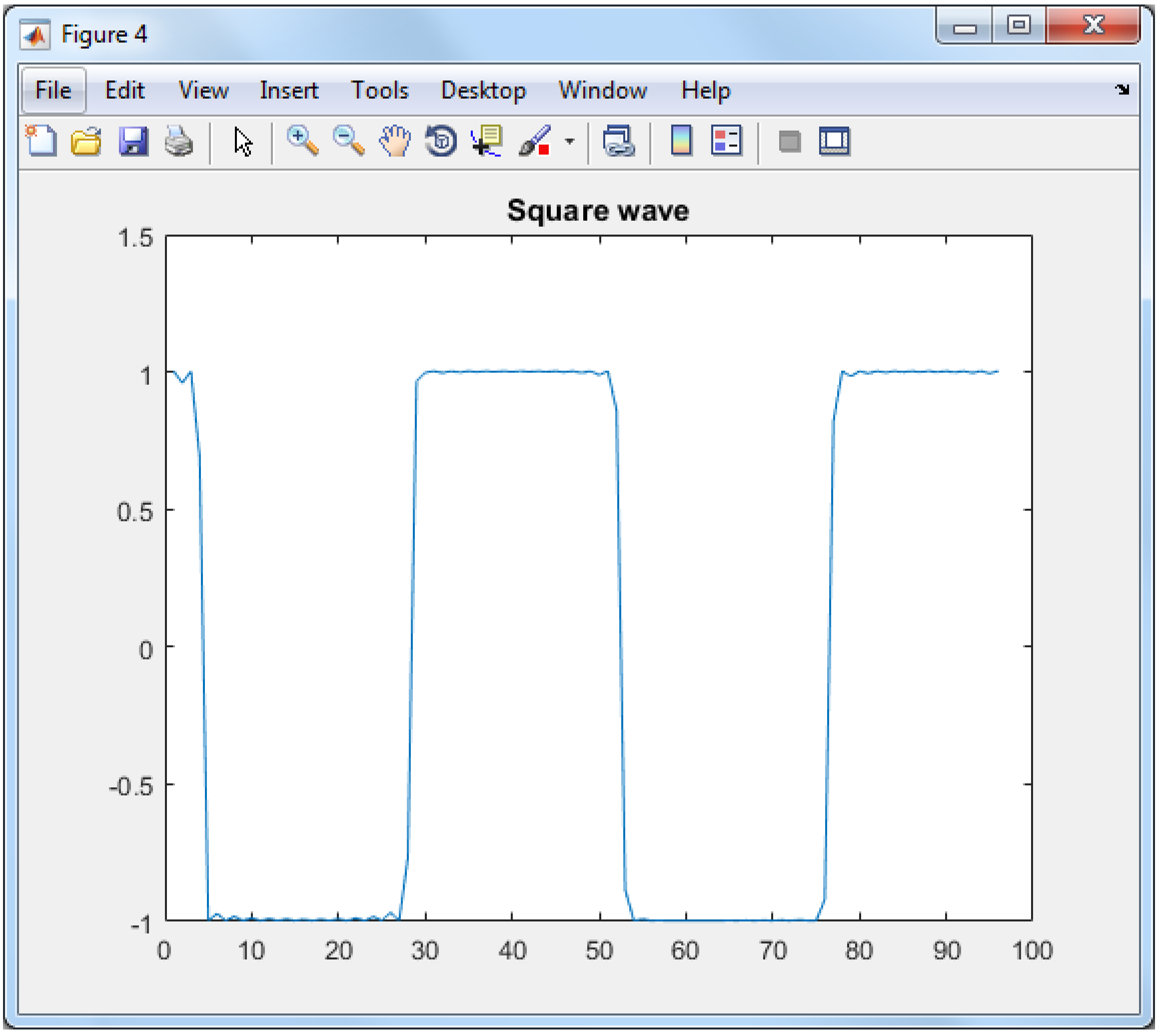


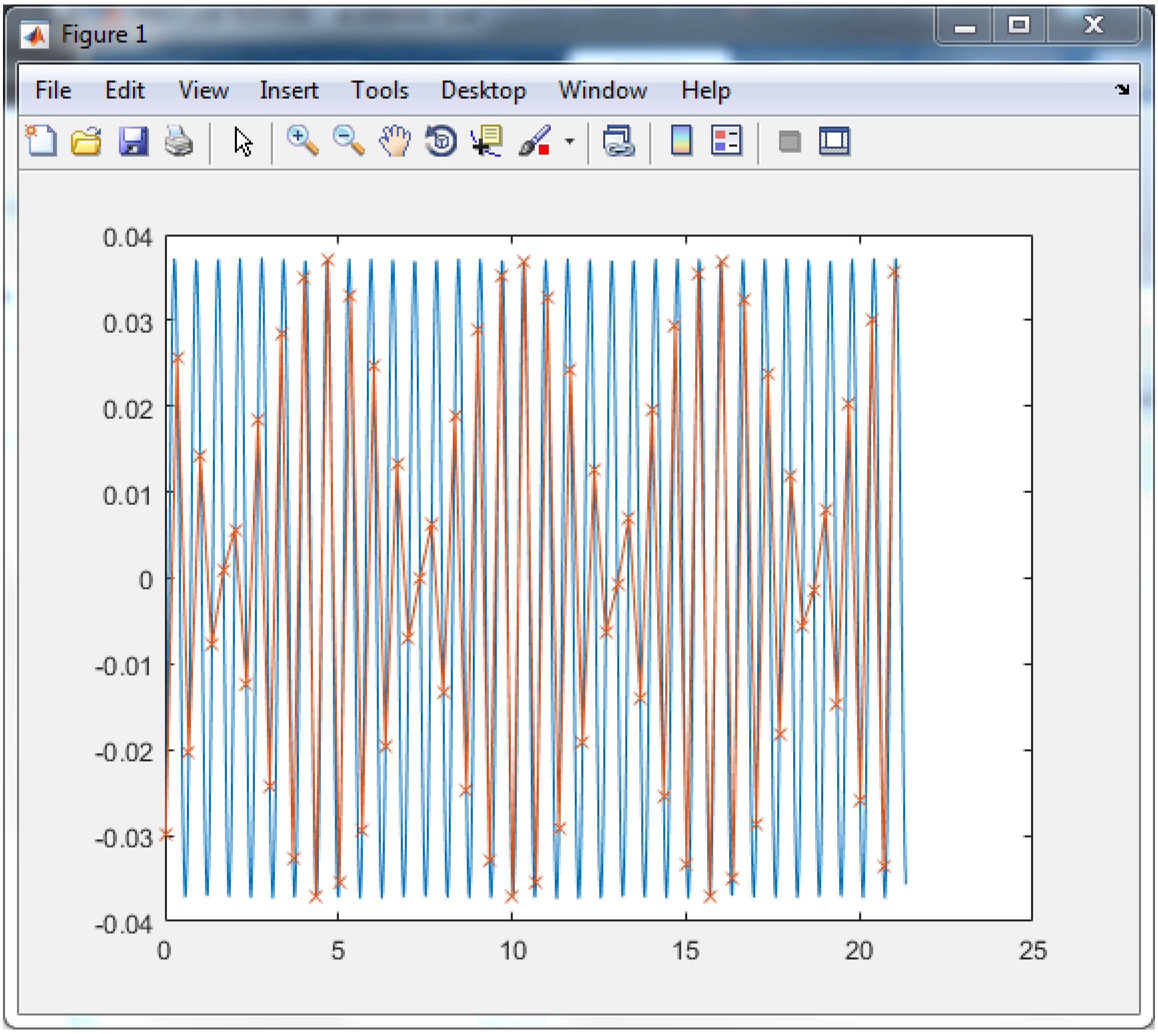
Figure 3
File Edit View Insert Tools Desktop Window Help
Sine wave
1.5
1
0.5
0
-0.5
-1
0 10 20 30 40 50 60 70 80 90 100



Here on the other hand we see clipping in the sine wave. Square wave looks ok, with a very small amount of noise.

Note: task4 matlab code was used for this task

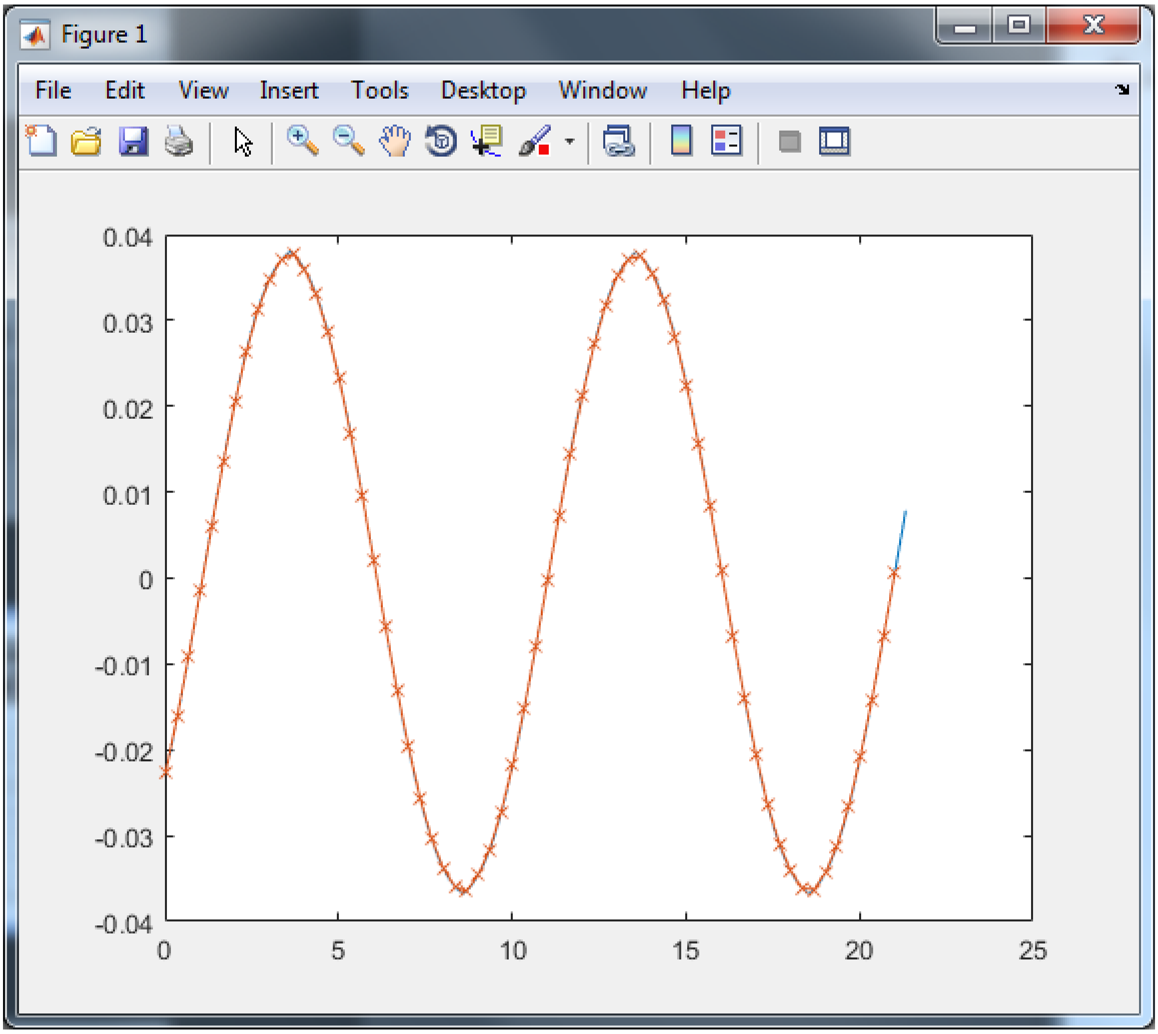
Task 9



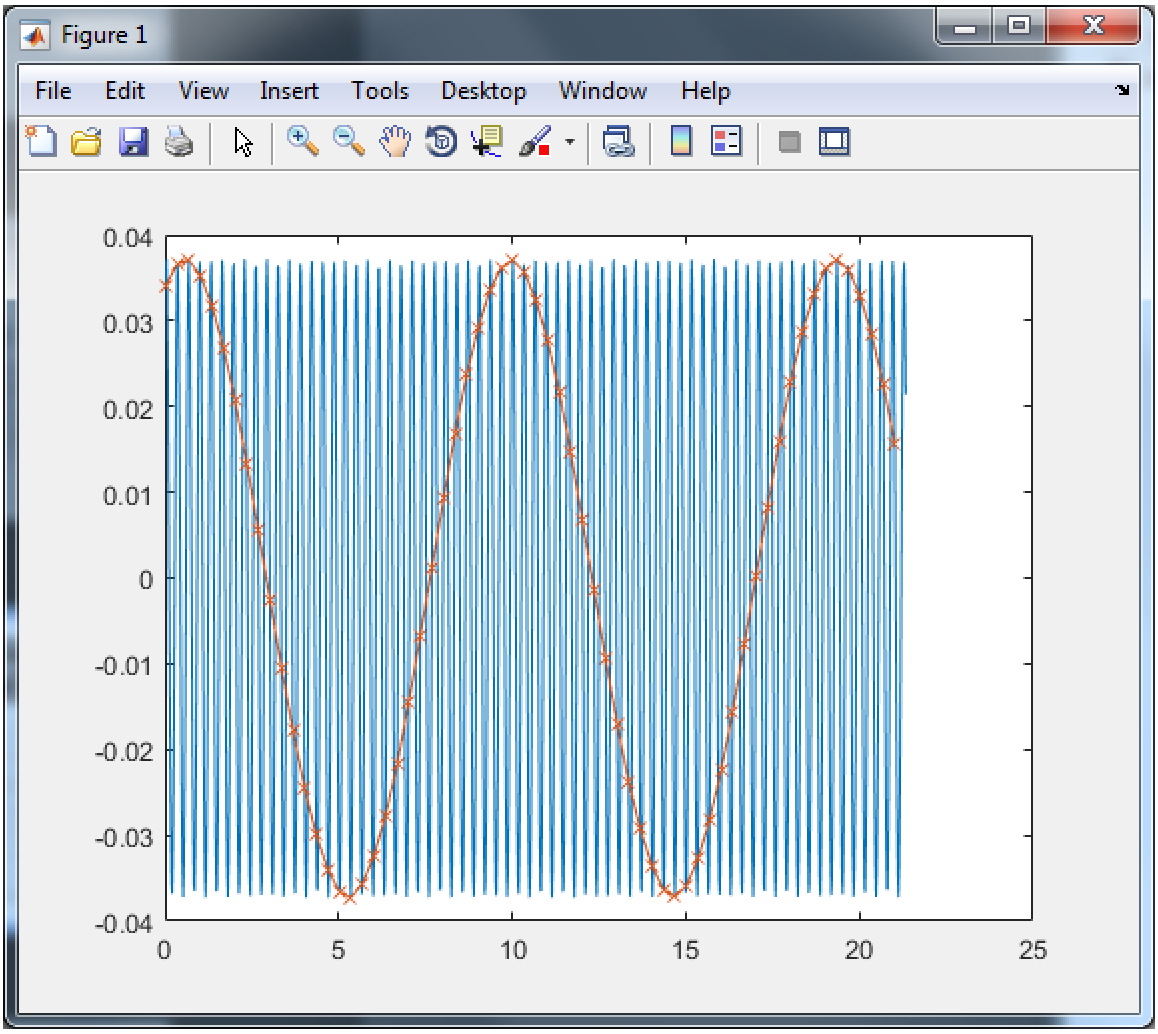
Undersampling results in a different wave. Since some samples are omitted, different waveforms are created.

Task 10

100 Hz:



3.1 kHz:



For 3.1 kHz aliasing occurs. Aliasing occurs when a signal is undersampled. In this case, a different signal is sampled than the correct signal
For 100 Hz this doesn't occur due to low frequency.

Task 8

Nyquist freq. is 2*sampling frequency, which is 24 kHz.

Below 24kHz signals overlap, but as we reach nyquist frequency, the signals are sampled farther from each other, which causes them not to overlap.