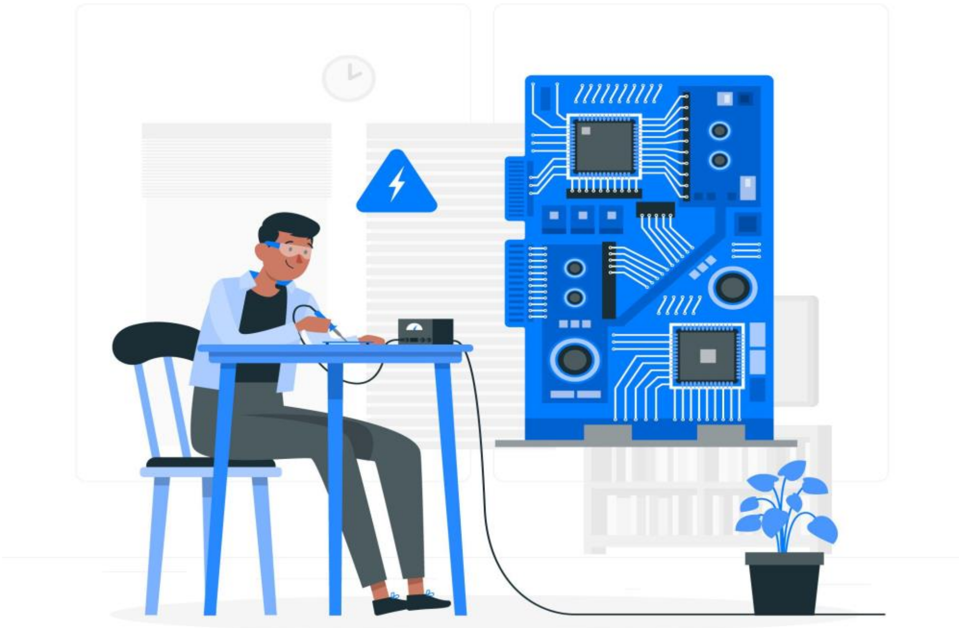


Lab 1: Sampling theorem and its example

Akshar Panchani ID- 202101522

IT314 Software Engineering

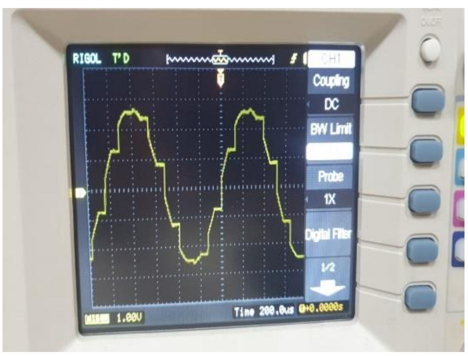
7/31/23

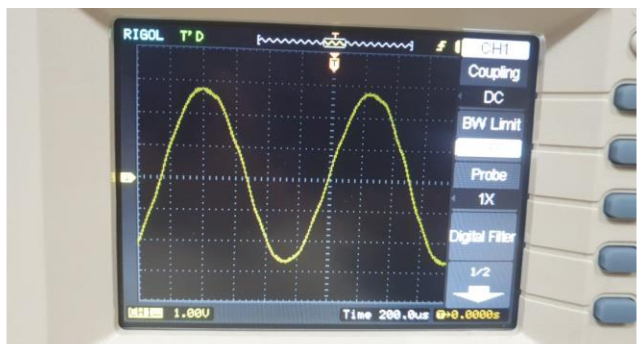
Lab 1: Sampling theorem and its example

EXERCISE 1:

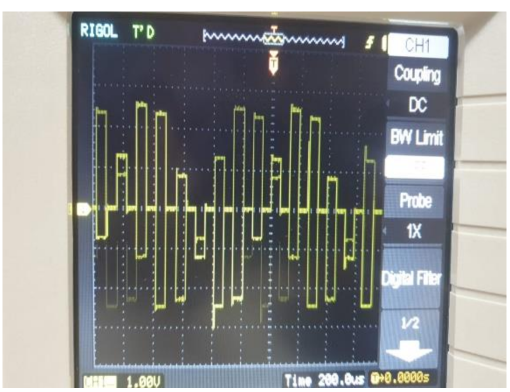
Natural Sampling with 1Khz

Sample Hold





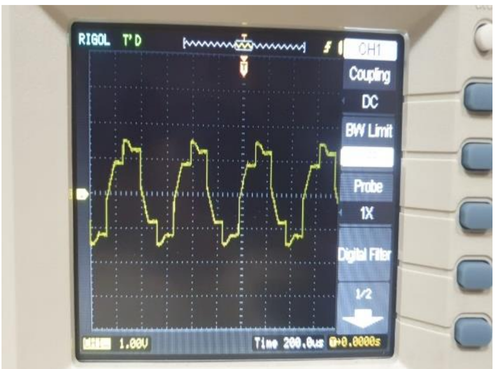
Flat top

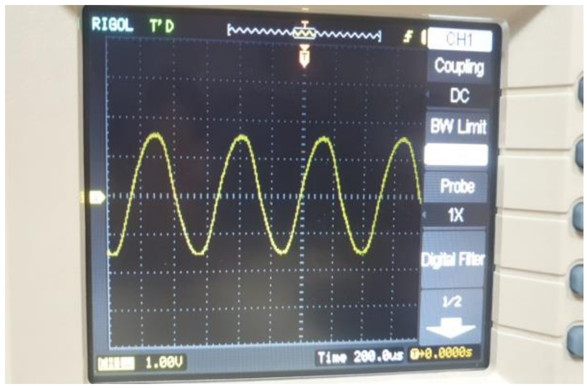


Frequency 2khz:

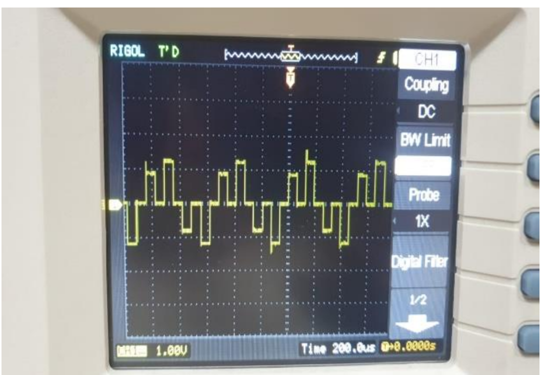
Natural Sampling

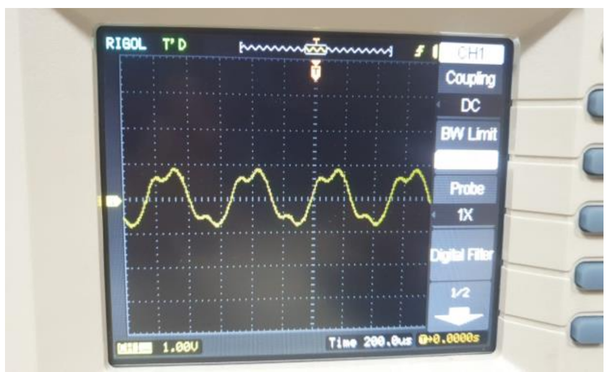
Sample hold





Flat top

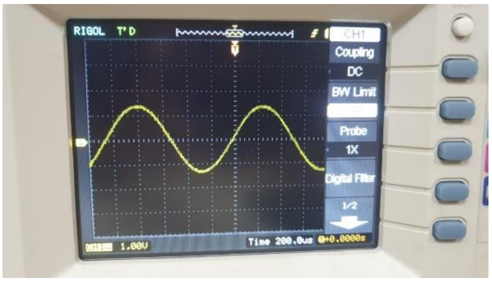


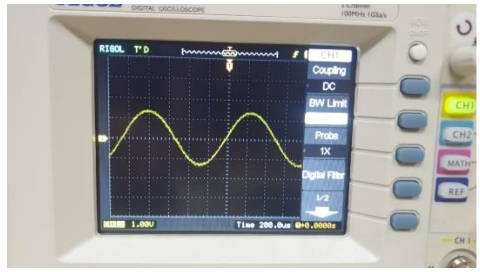


EXERCISE 2:

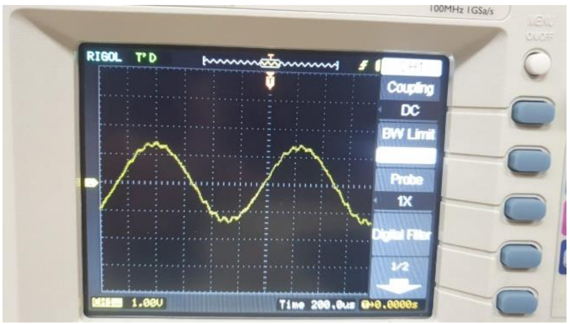
Natural 1khz

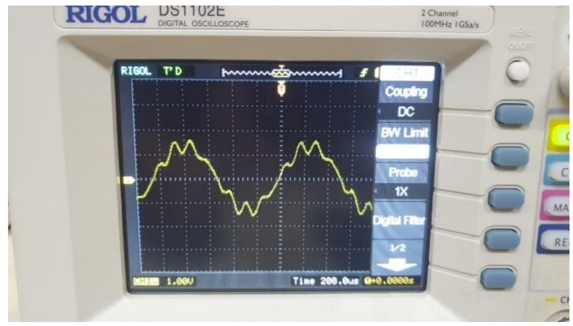
64 Khz and 32 Khz



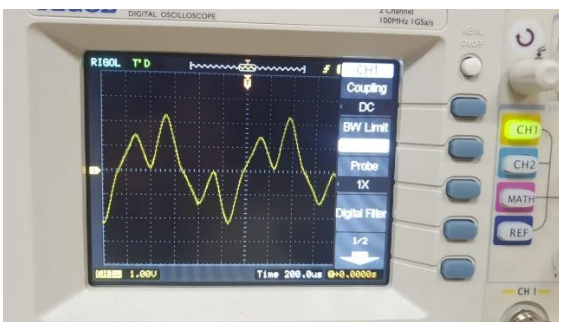


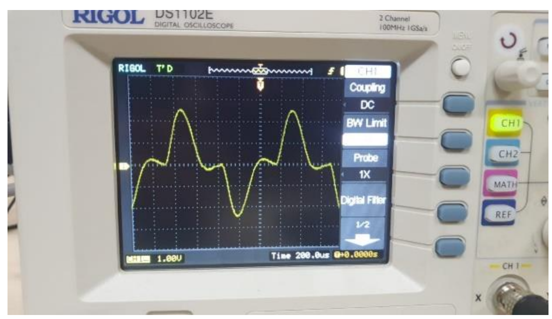
16Khz and 8Khz





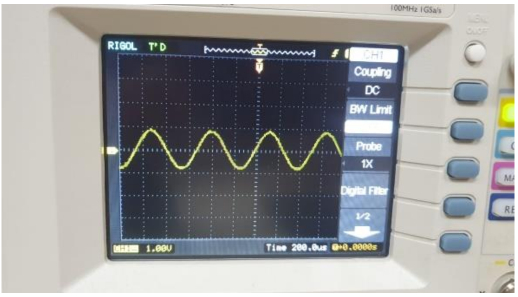
4Khz and 2Khz

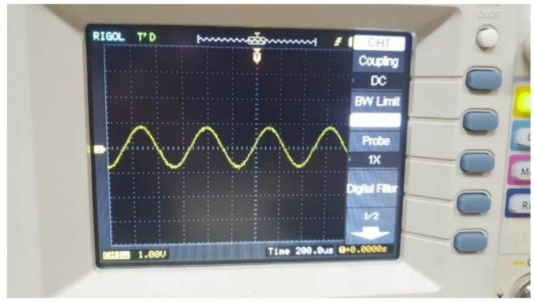




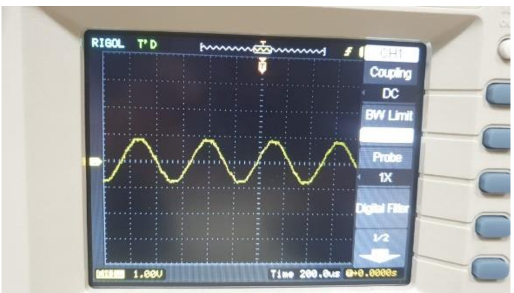
Natural 2khz

64 Khz and 32 Khz

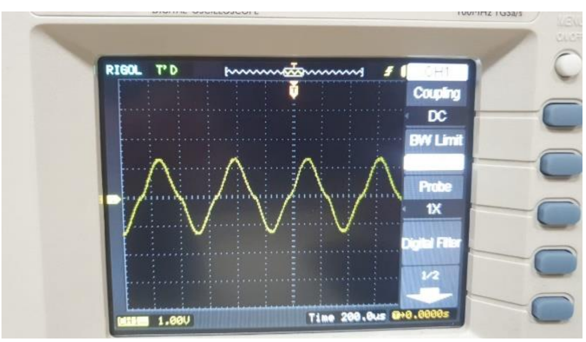


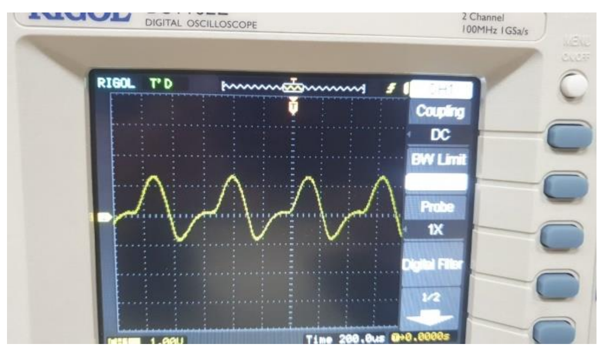


16Khz and 8Khz



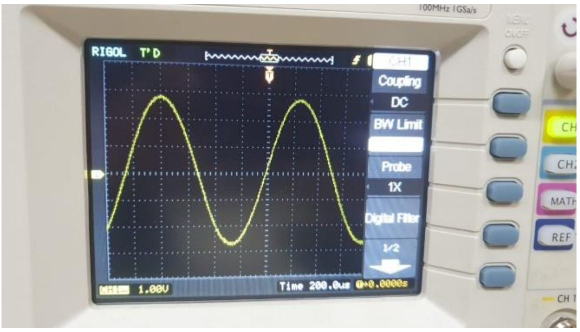
4Khz and 2Khz

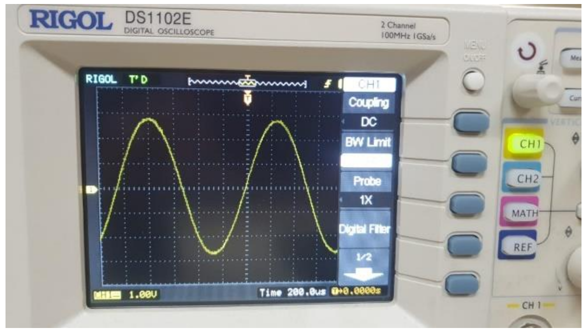




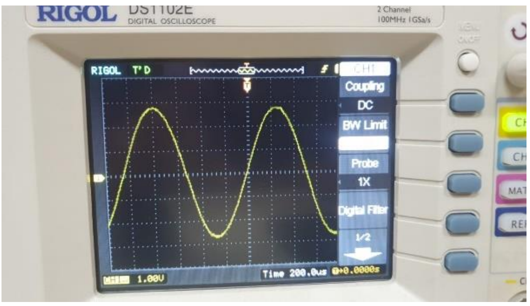
Sample and hold 1khz

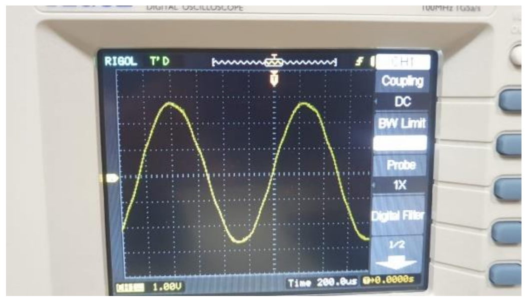
64 Khz and 32 Khz



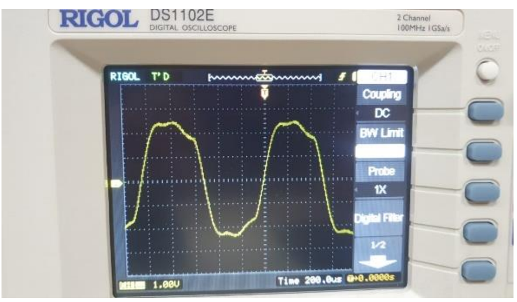


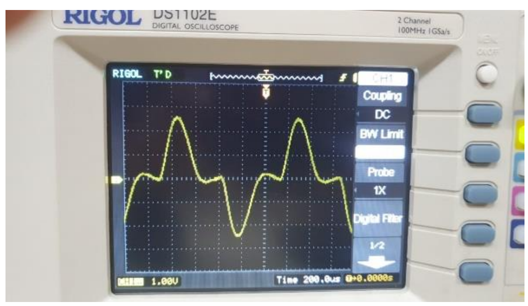
16Khz and 8Khz





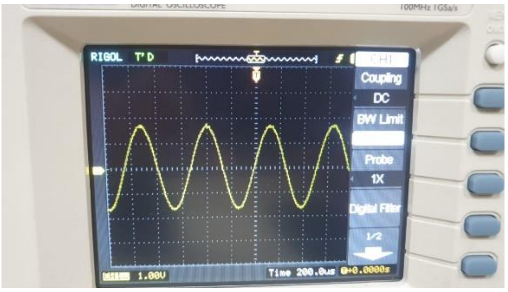
4Khz and 2Khz

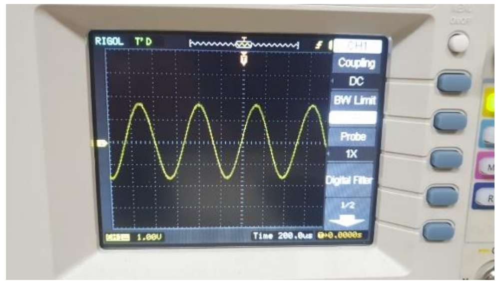




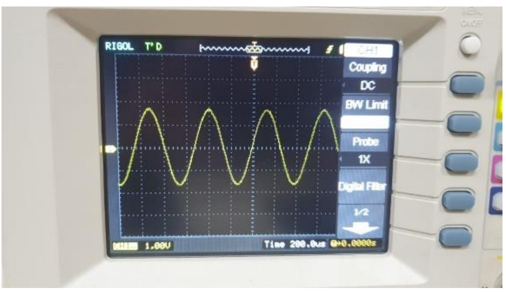
Sample and hold 2khz

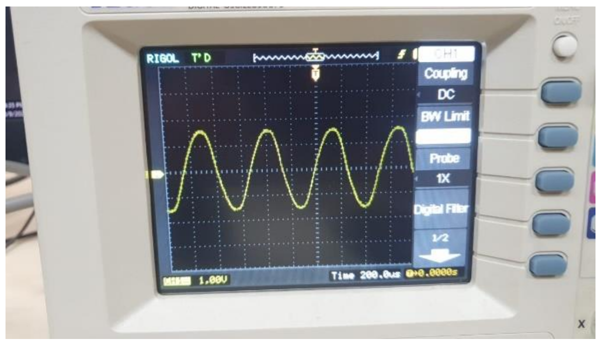
64 Khz and 32 Khz



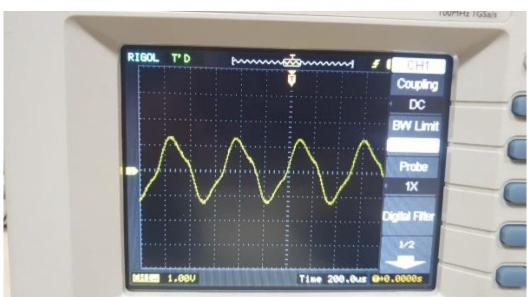


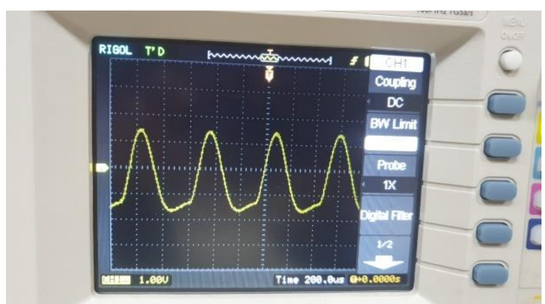
16Khz and 8Khz





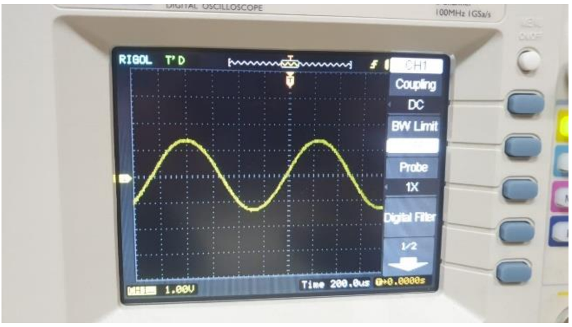
4Khz and 2Khz

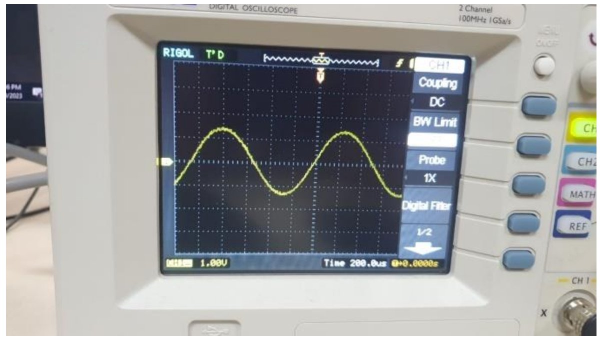




Flat top1khz

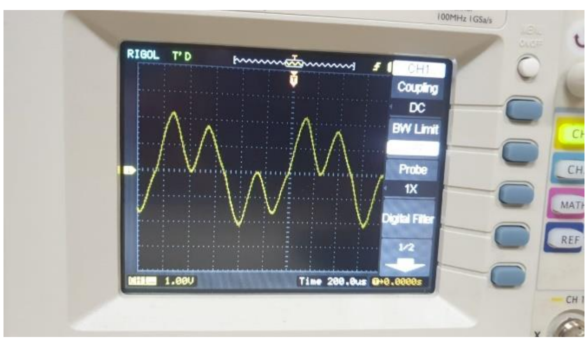
64 Khz and 32 Khz

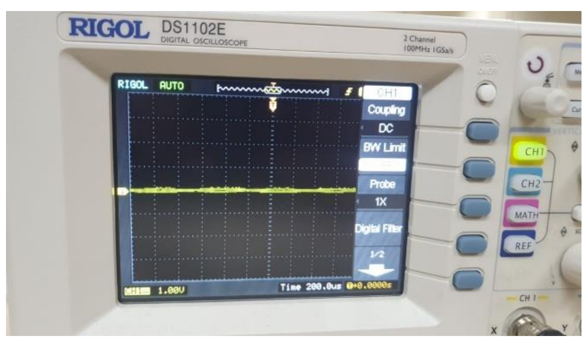




16Khz and 8Khz

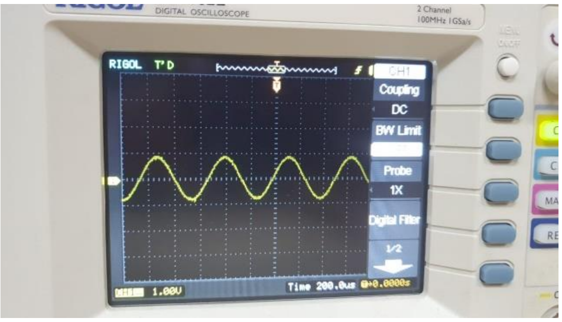
4Khz and 2Khz

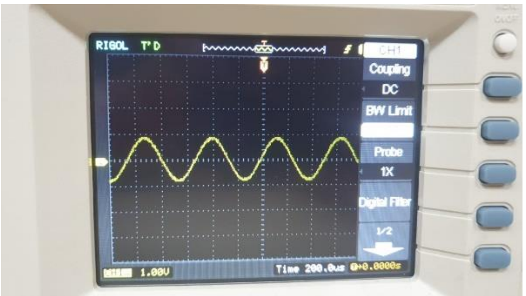




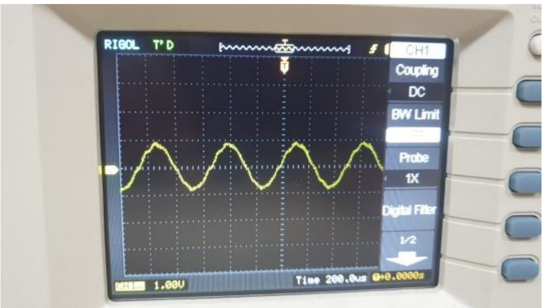
Flat top 2khz

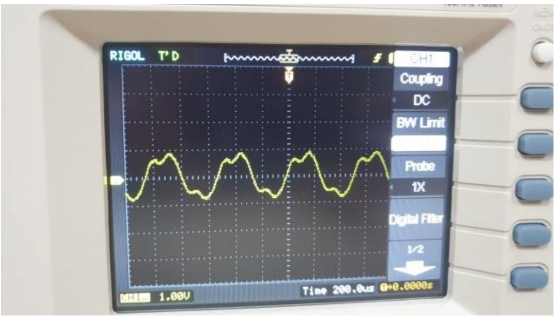
64 Khz and 32 Khz



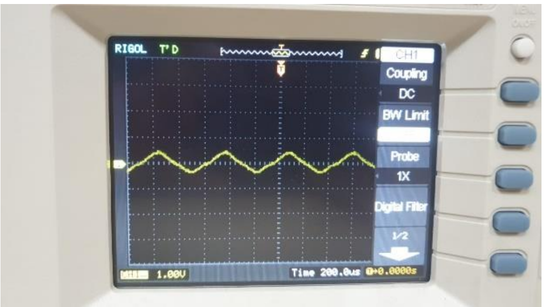


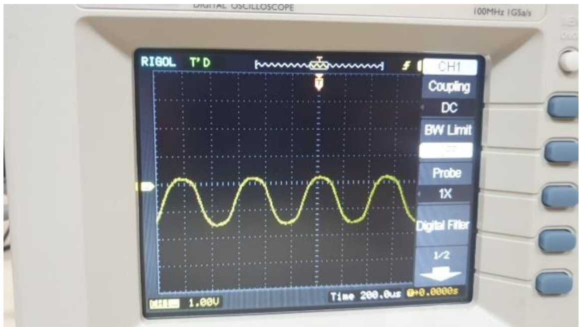
16Khz and 8Khz





4Khz and 2Khz

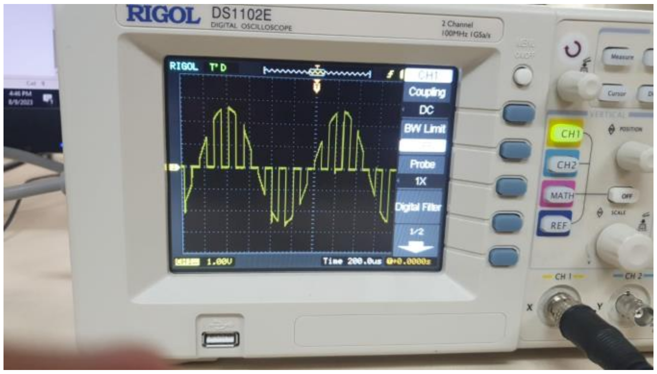


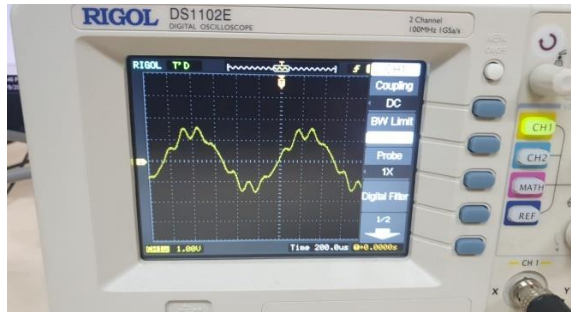


EXERCISE 3:

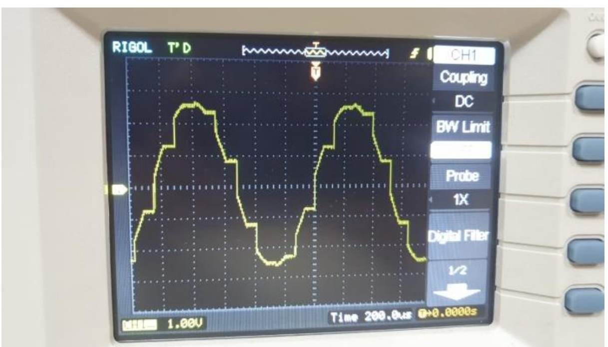
4^{th} Order 1Khz

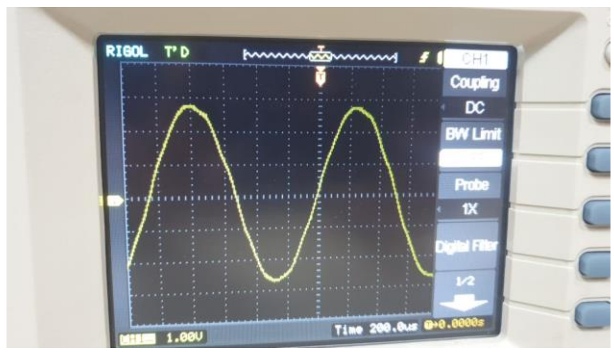
Natural





Sample hold

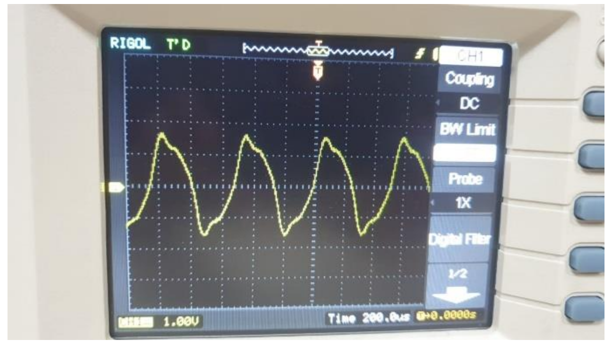




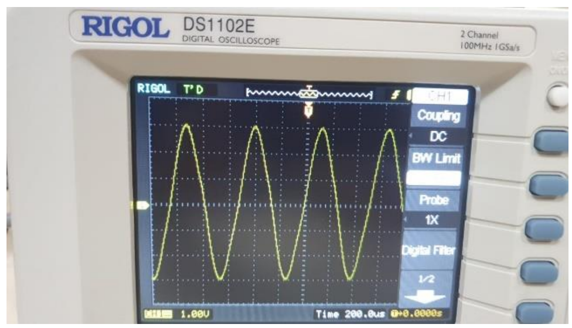
Flat top

4th Order 2Khz

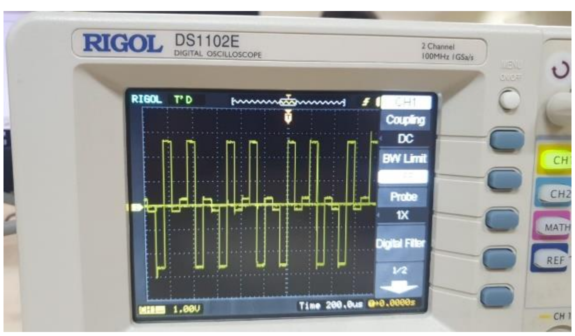
Natural

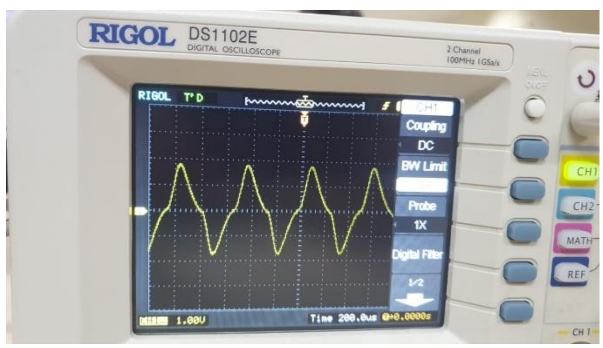


Sample hold



Flat top





Matlab code is as follow:

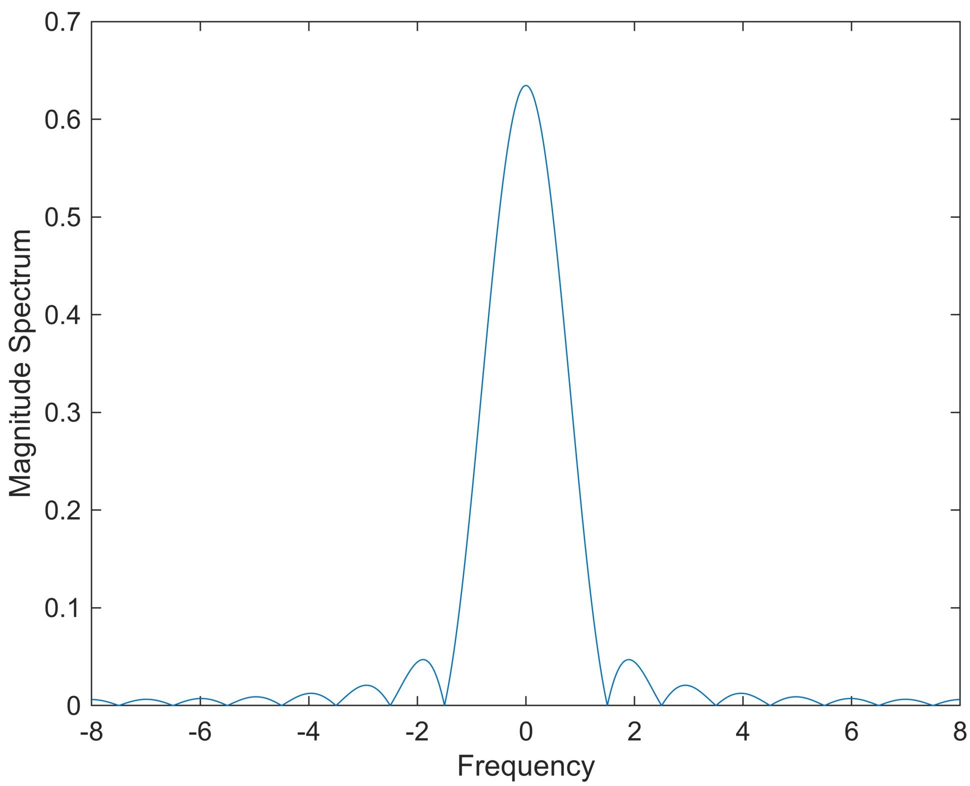
Code Fragment 2.5.1

Numerical computation of Fourier transform using FFT

```
ts=1/16;
time_step = 0:ts:1;
signal_time = sin(pi*time_step);
fimesignal_expecct = 1/160;
N_min = ceil(1/(fimesignal_expecct*ts));
N_FFT = 2^(nextpow2(N_min)) %FFT size = the next power of 2 at least as big as Nmin
```

```
N_FFT = 4096
```

```
signalfreq_domain = ts*fft(signal_time,N_FFT);
signalfreq_domainc = fftshift(signalfreq_domain);
fs=1/(N_FFT*ts); %actual frequency resolution attained
freq = ((1:N_FFT)-1-N_FFT/2)*fs;
plot(freq,abs(signalfreq_domainc));
xlabel('Frequency');
ylabel('Magnitude Spectrum');
```

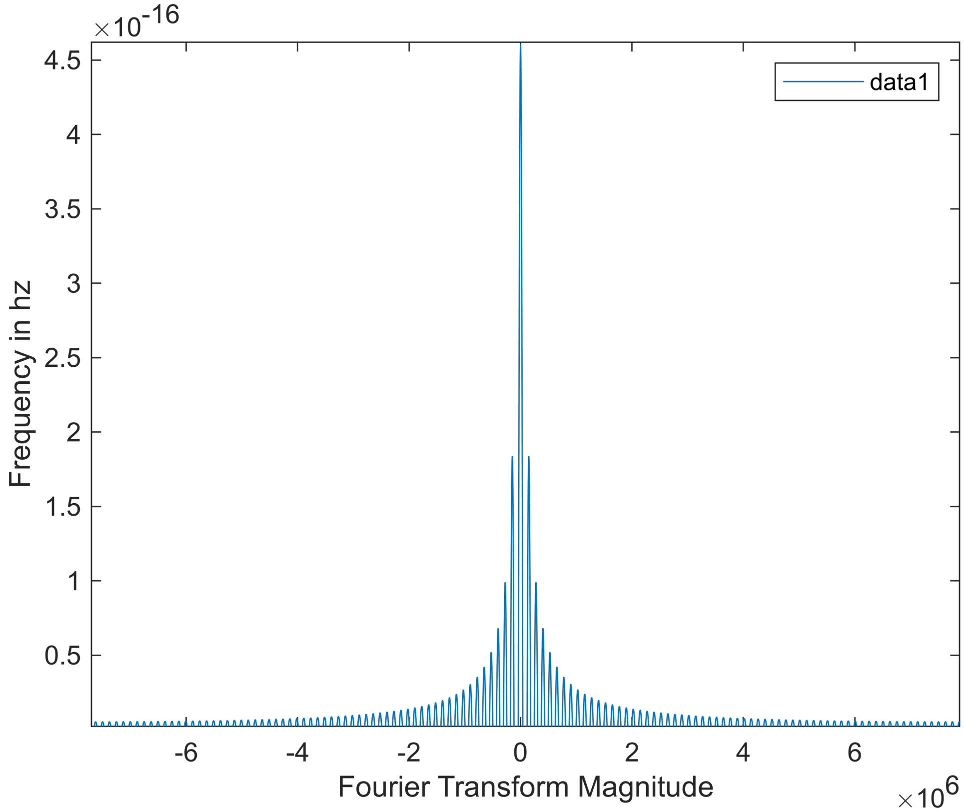


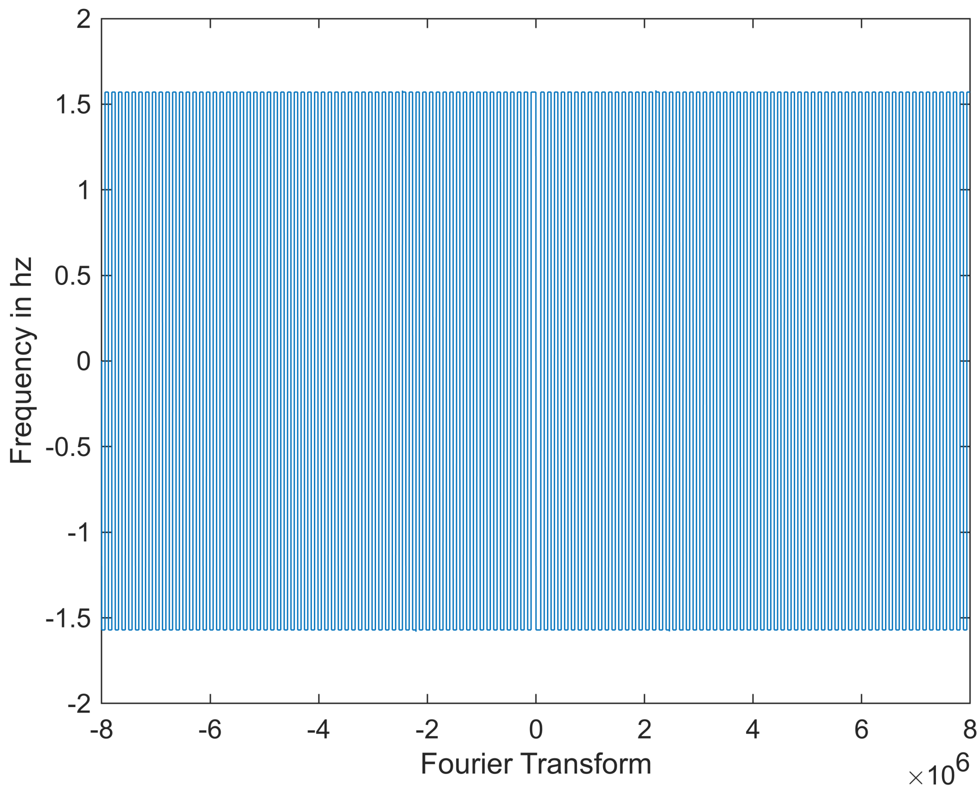
Signals and Systems Computations using Matlab

Fourier Transform of signal.

```
%Transform output
%Inputs
```

```
t=10^(-6);
dt = (1/16)*t;
time=-8*t:dt:8*t;
x = 3.*sinc(2*time-3) ;
t_start = -8*t;
df_expected = 1000;
contFT(x,t_start,dt,df_expected);
```






```
function [X,f,df] = contFT(x,tstart,dt,df_desired)

Nmin=max(ceil(1/(df_desired*dt)),length(x));
%choose FFT size to be the next power of 2
Nfft = 2^(nextpow2(Nmin));
X=dt*fftshift(fft(x,Nfft));
df=1/(Nfft*dt);
f = ((0:Nfft-1)-Nfft/2)*df; %same as f=-1/(2*dt):df:1/(2*dt) - df
%phase shift associated with start time
X=X.*exp(-j*2*pi*f*tstart);
figure(1);
plot(f,X);
xlabel('Fourier Transform Magnitude');
ylabel('Frequency in hz');
figure(2);
plot(f,angle(X));
xlabel('Fourier Transform');
ylabel('Frequency in hz');
end
```