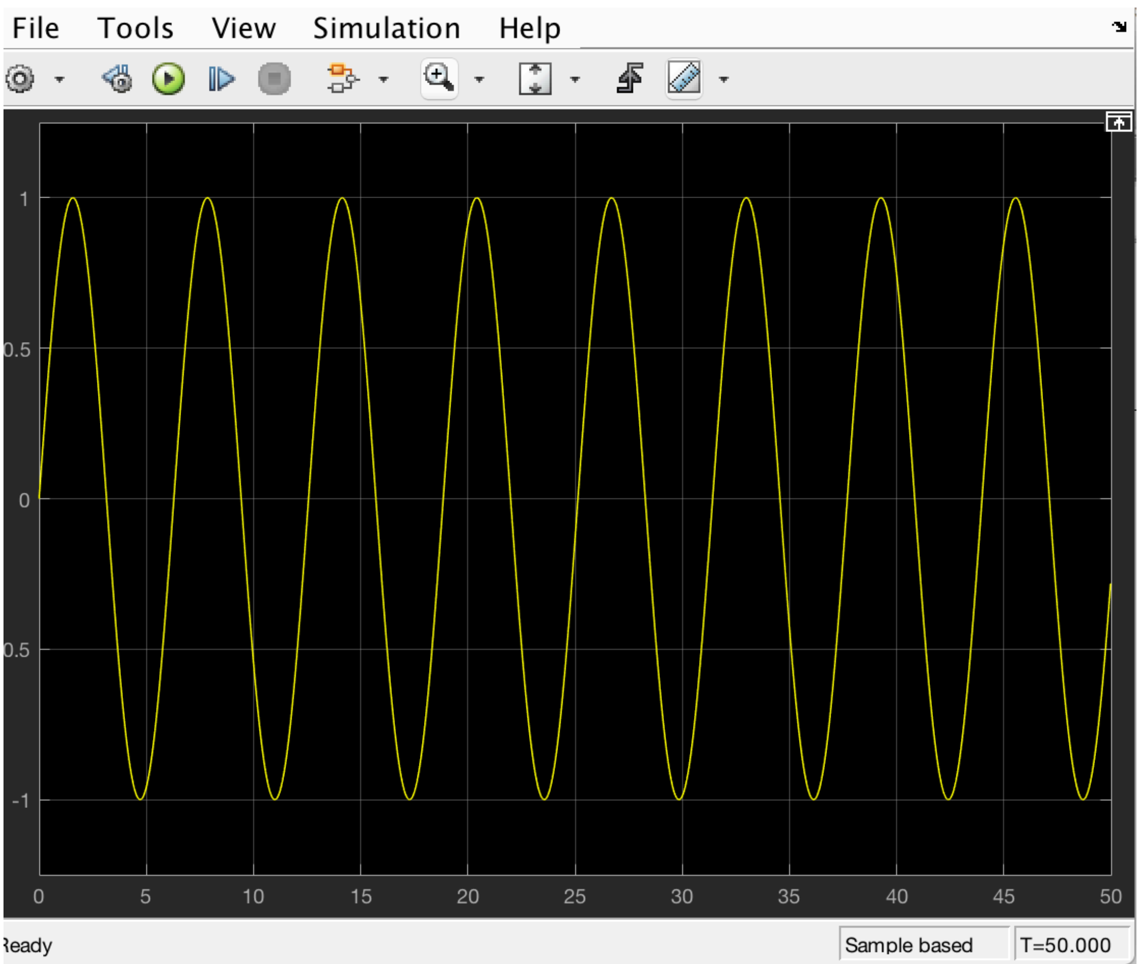
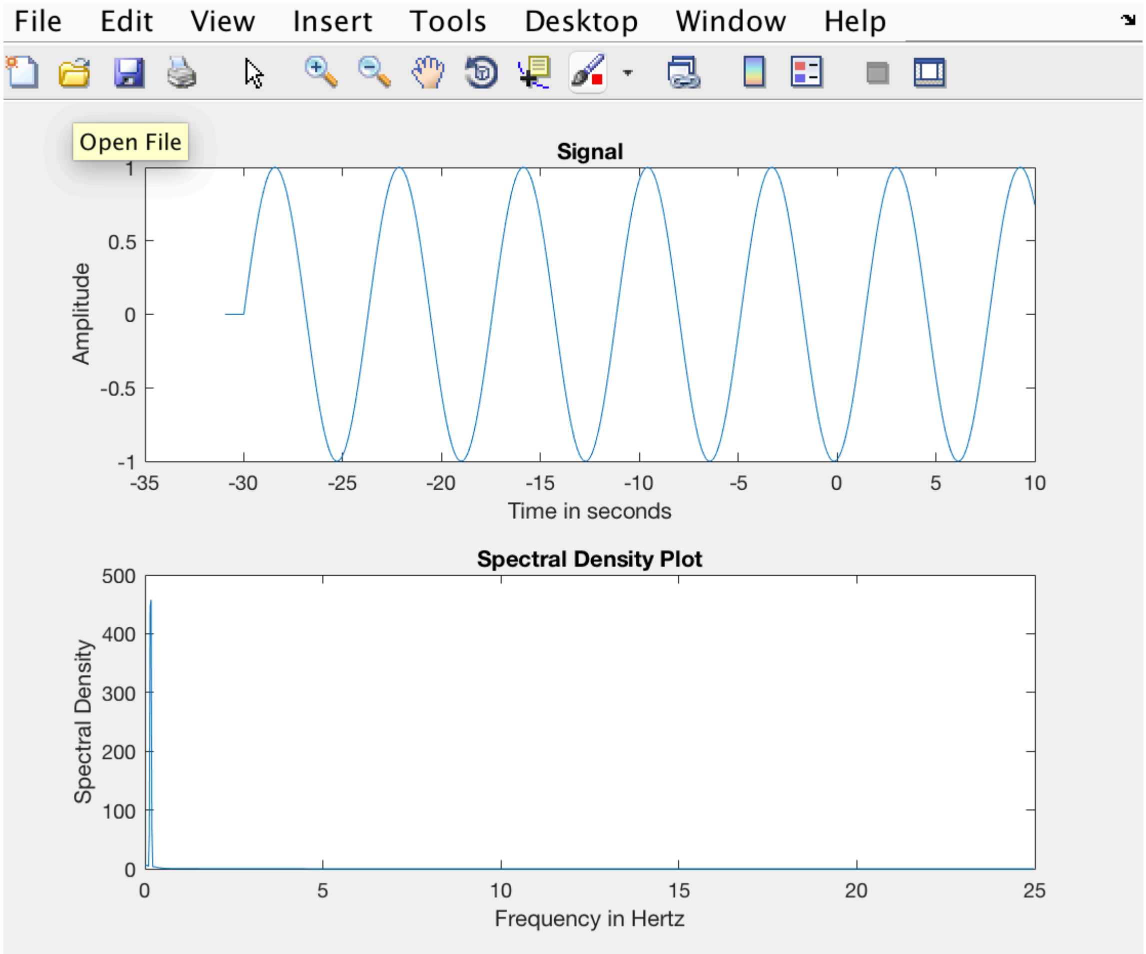
Introduction: This lab teaches about using Simulink for frequency analysis and sampling of continuous time signals.

2. Pre-Lab

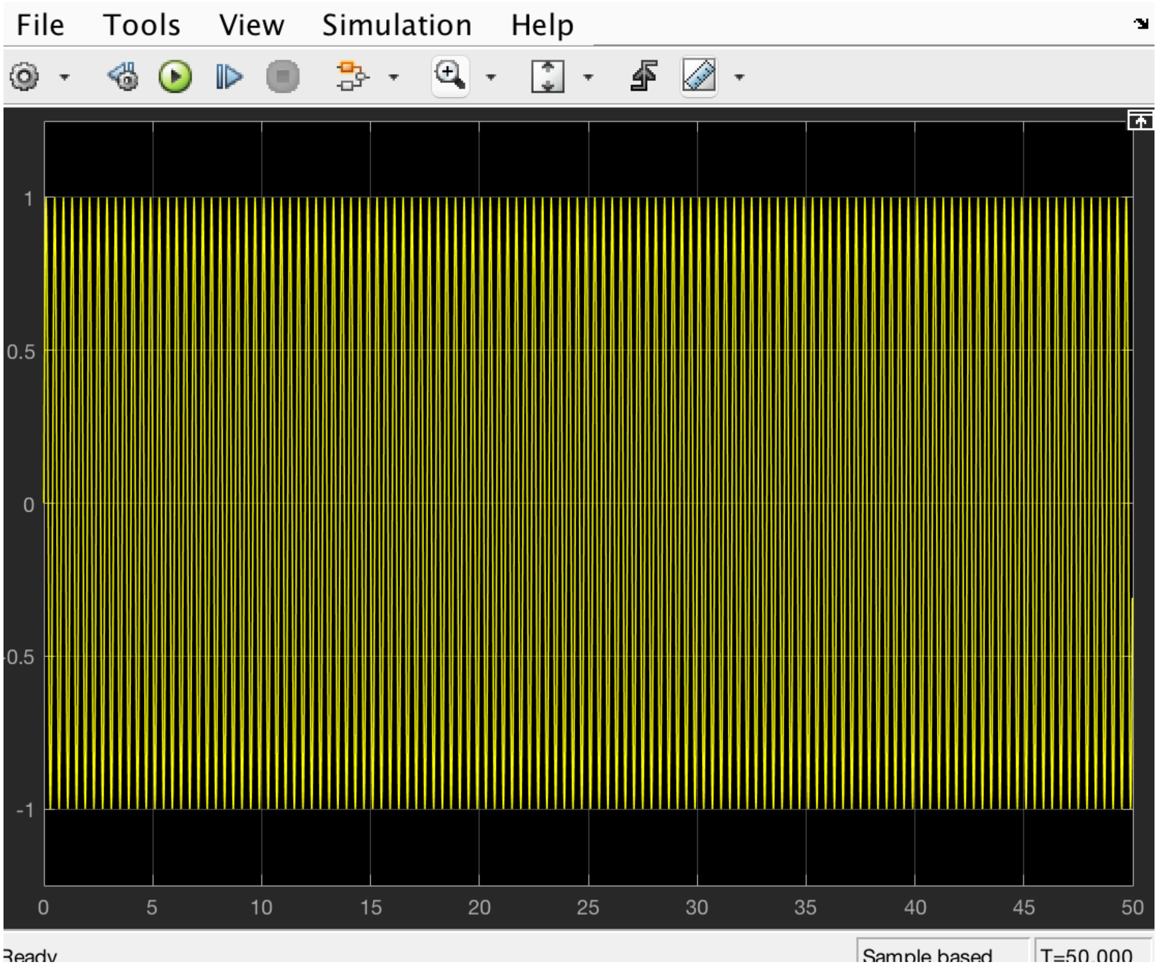
2.2

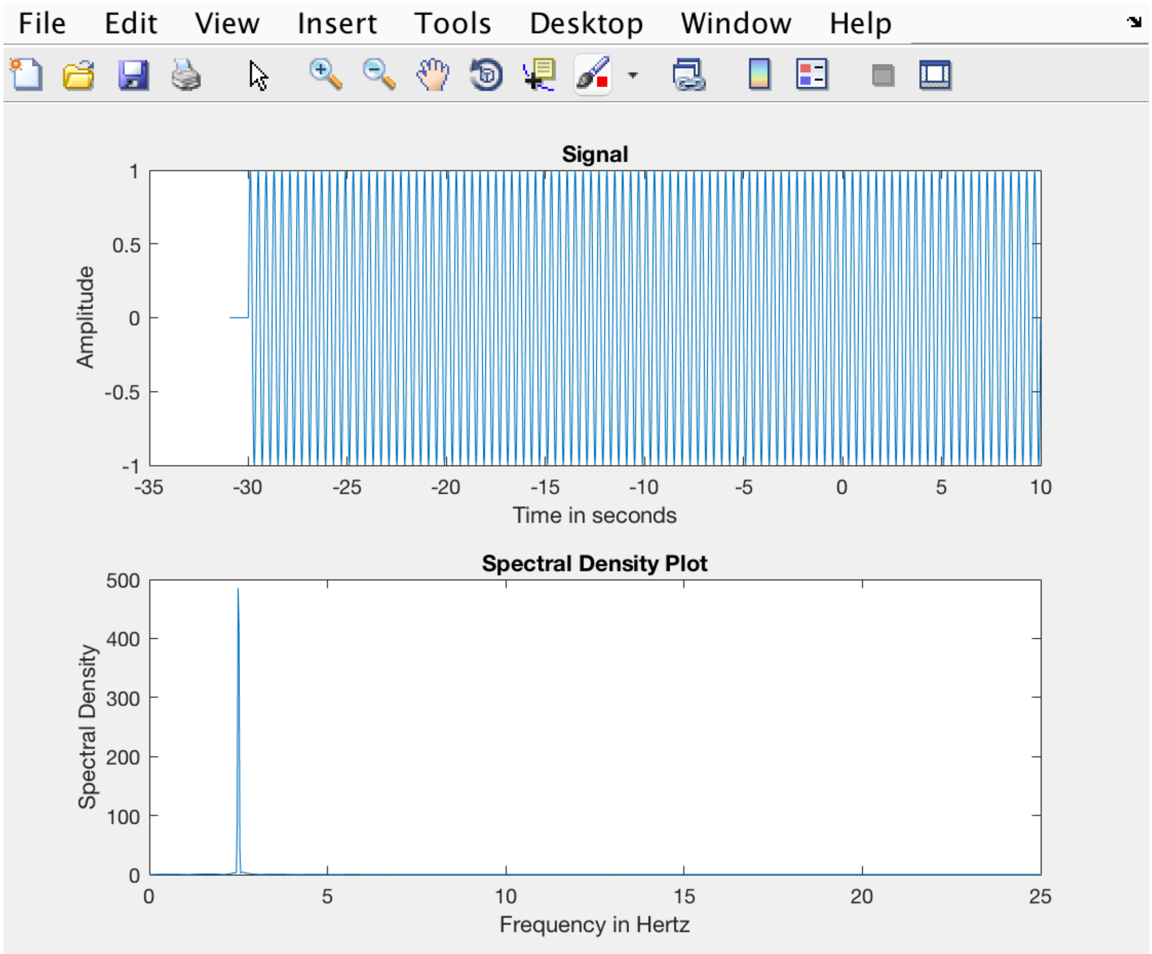




The frequency is at around 0 Hz.

Changing the frequency to 5*pi rad/s:

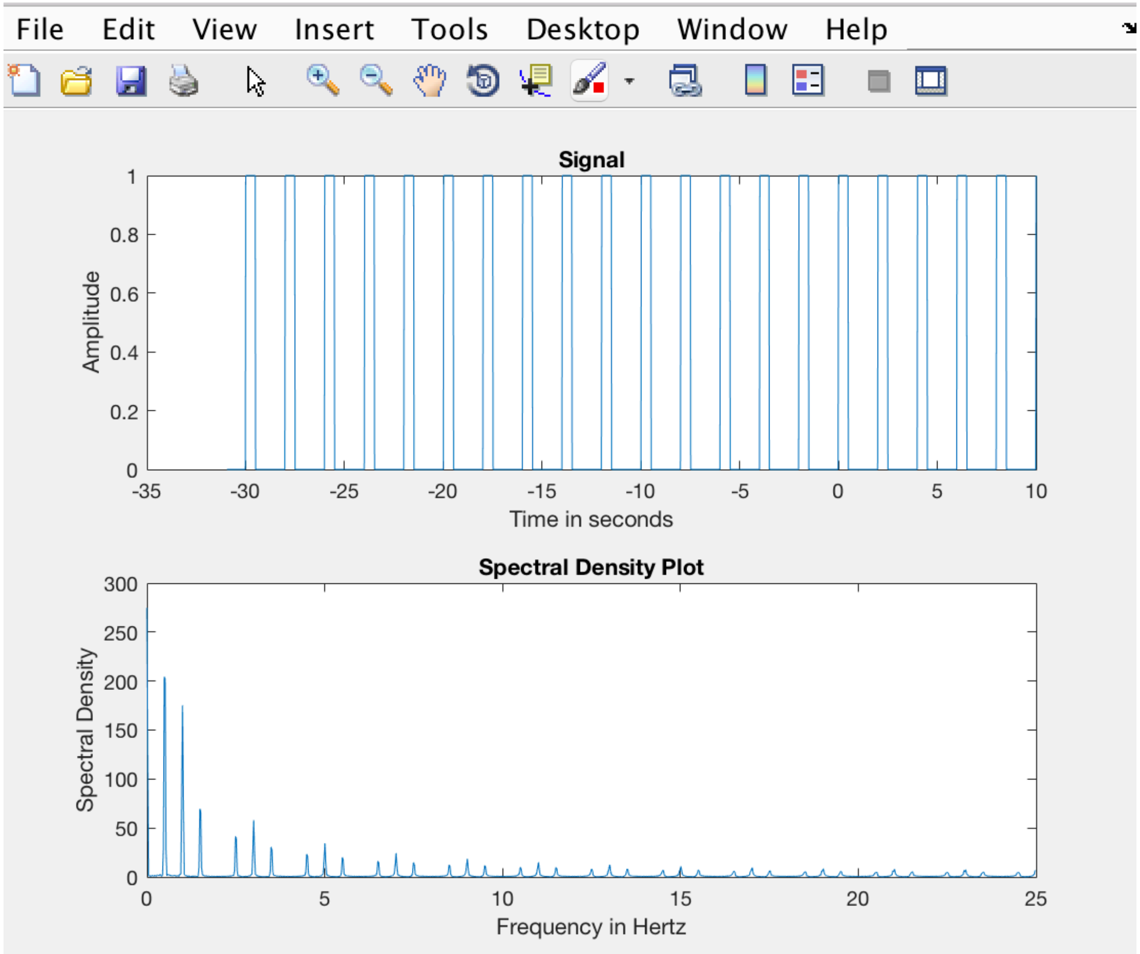




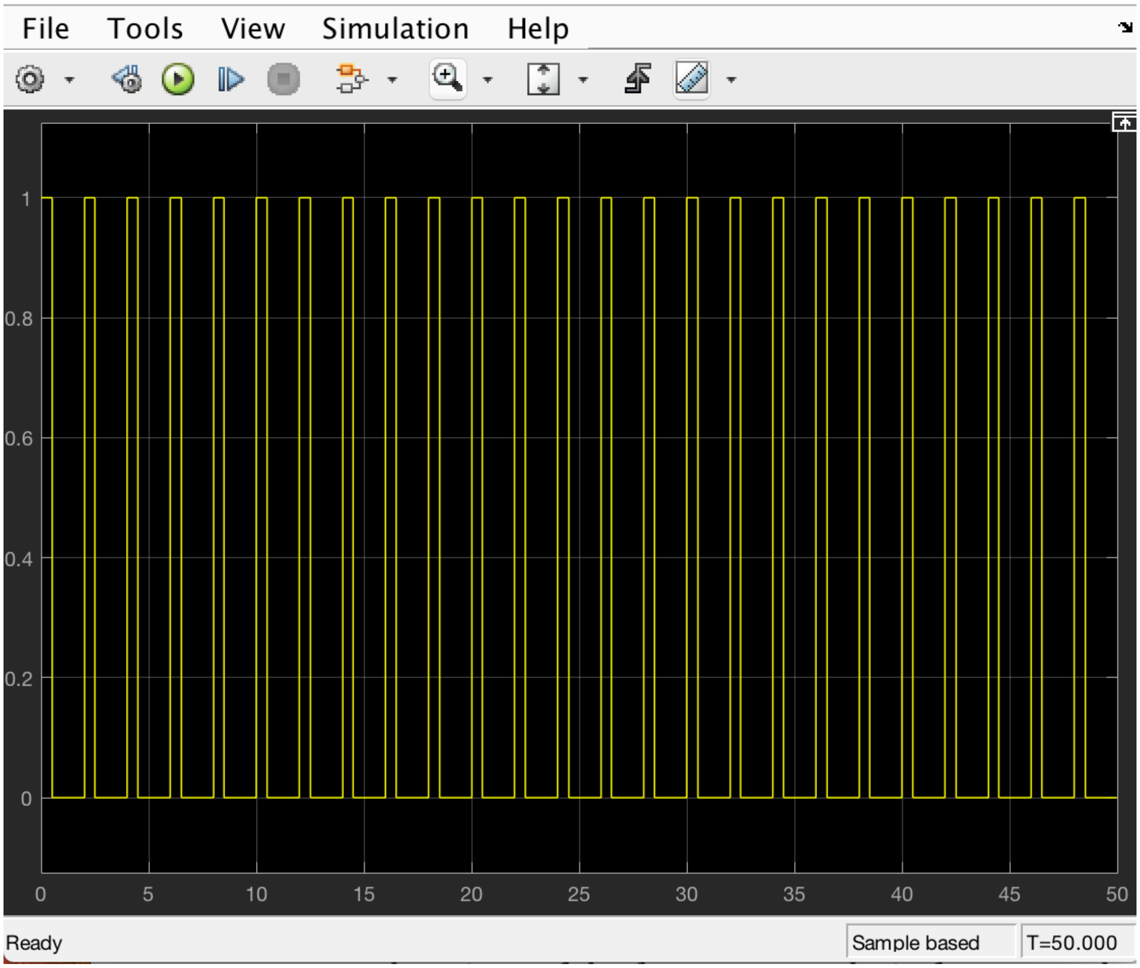
The frequency is peak at around 2.5 Hz.

3.

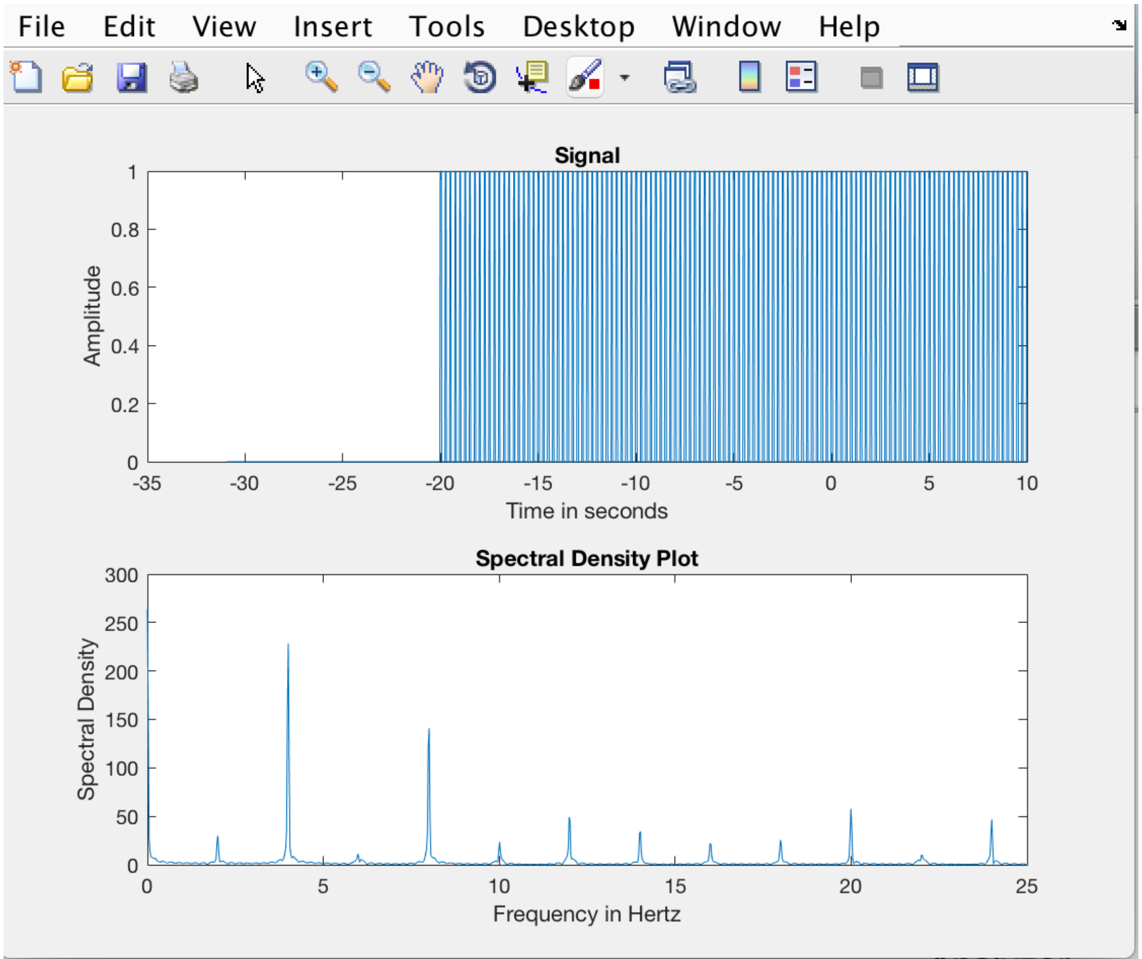
3.1 When period of square-wave = 2 sec:

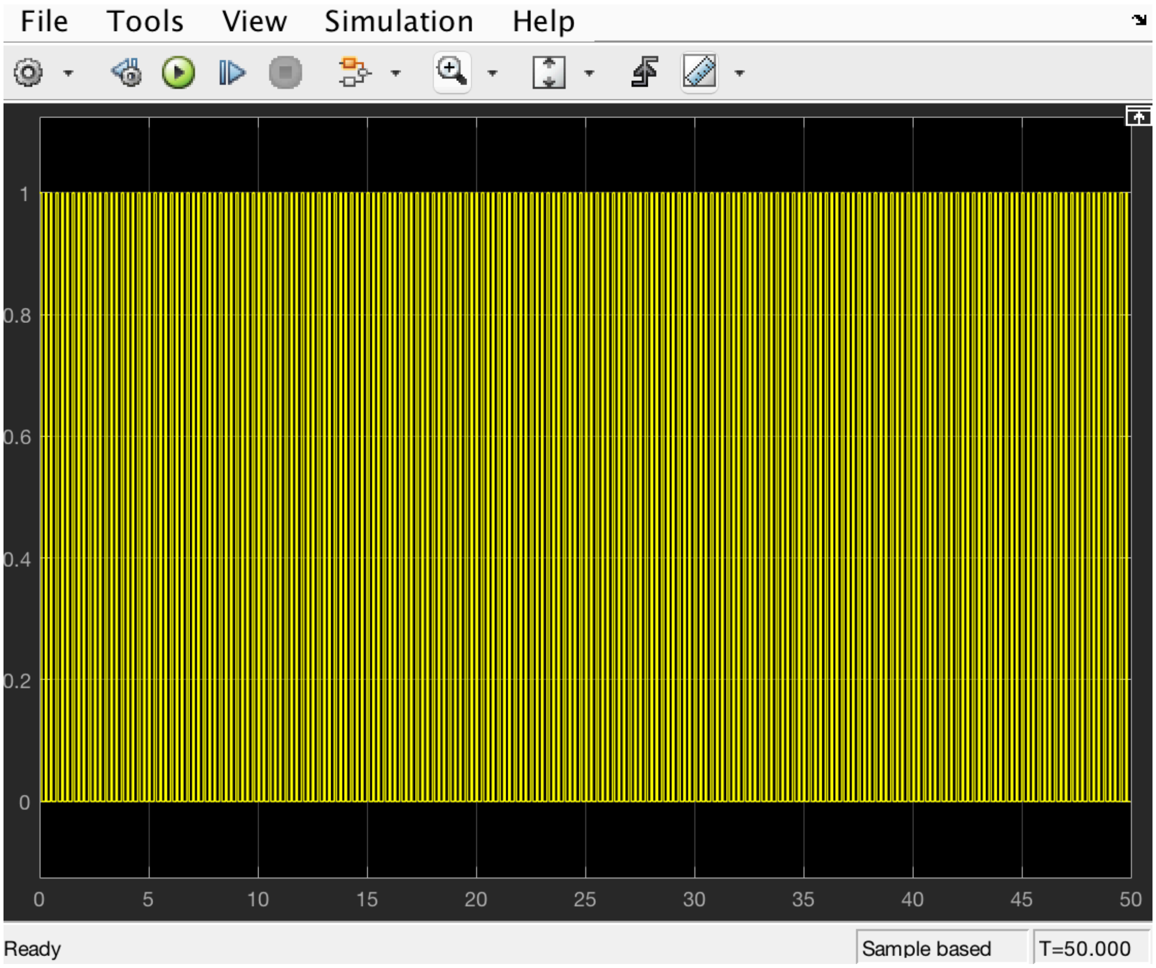


The frequency is spiked around 0.5 Hz, and looks slight different than that seen in the class.

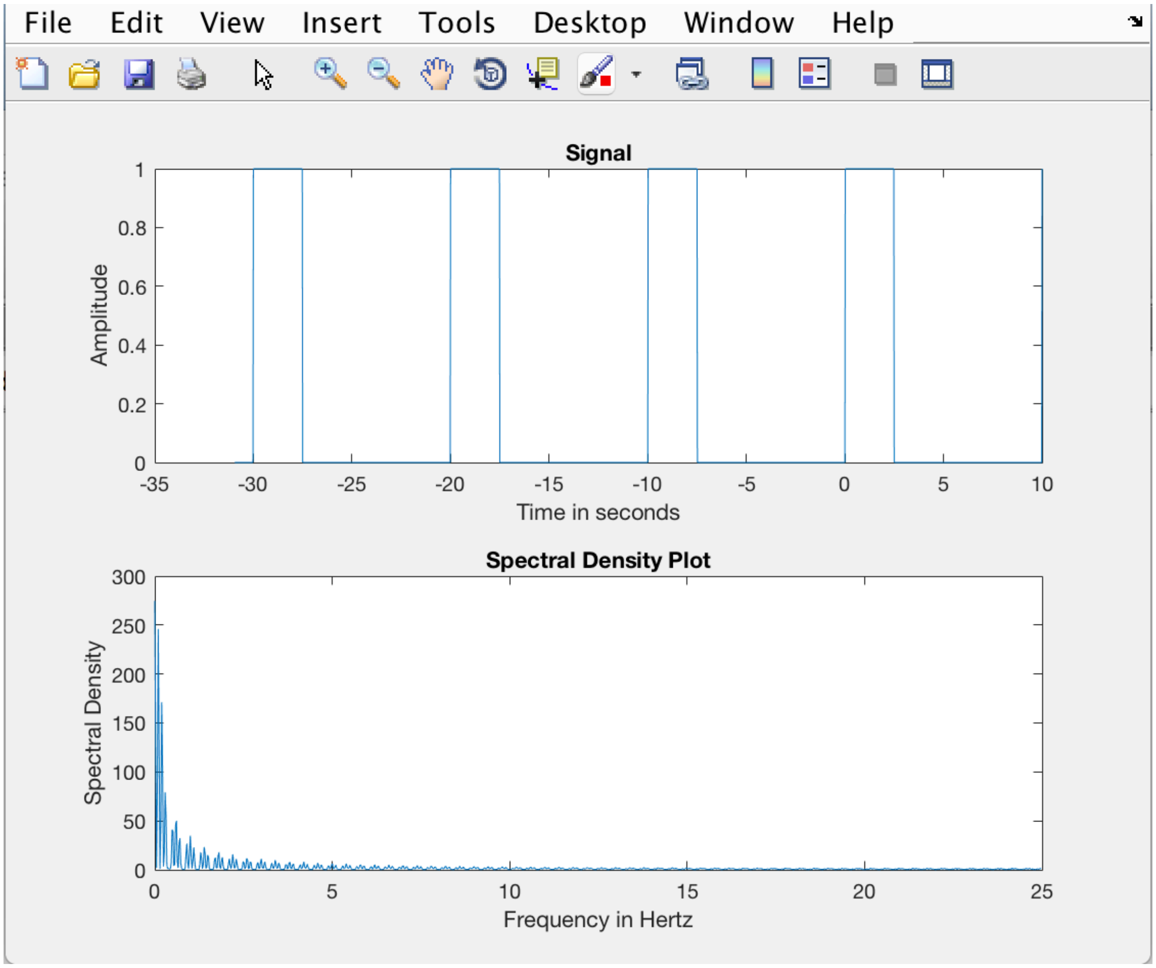


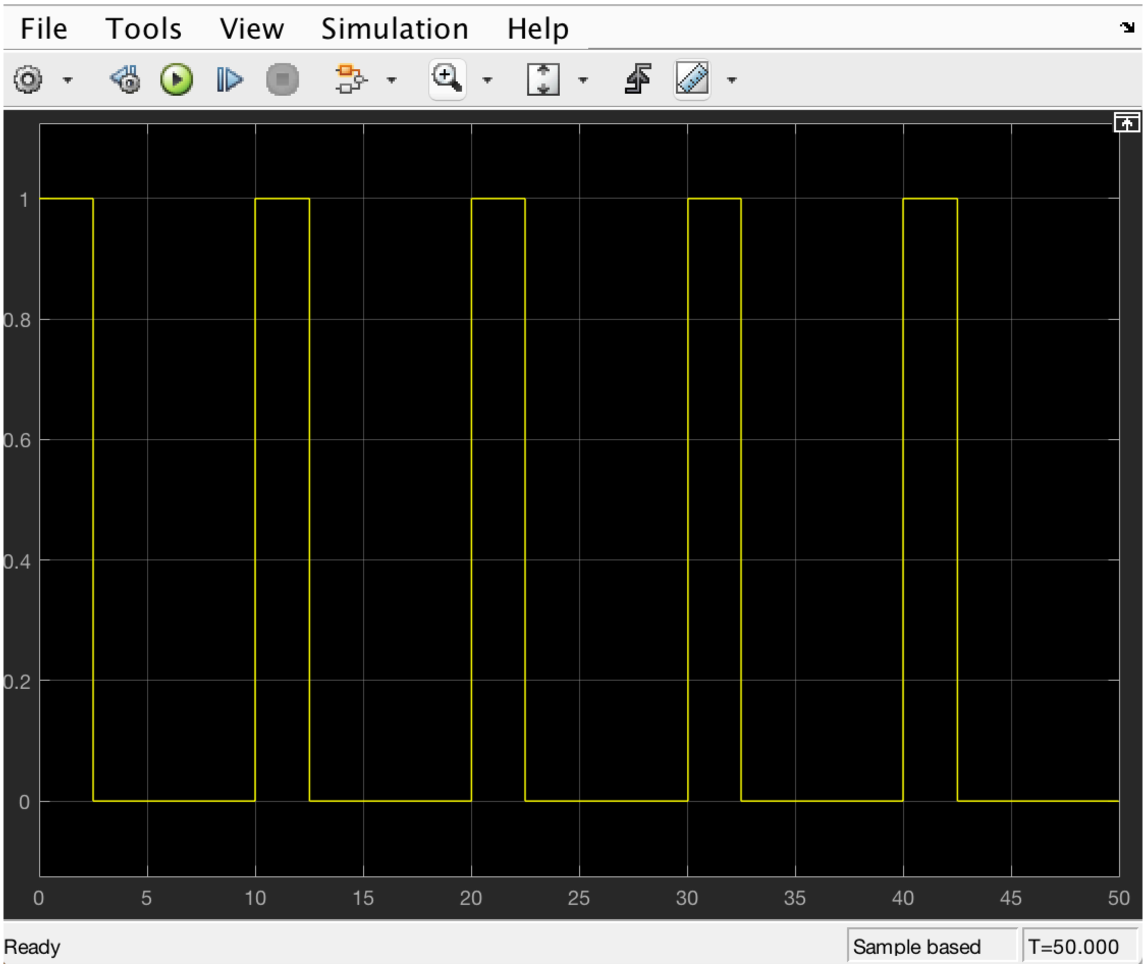
When period = 0.25 sec:


File Edit View Insert Tools Desktop Window Help
Signal
Amplitude
Time in seconds
1
0.8
0.6
0.4
0.2
0
-35 -30 -25 -20 -15 -10 -5 0 5 10
Spectral Density Plot
Spectral Density
Frequency in Hertz
300
250
200
150
100
50
0
0 5 10 15 20 25



When period = 10 sec:


File Edit View Insert Tools Desktop Window Help
Signal
Amplitude
Time in seconds
-35 -30 -25 -20 -15 -10 -5 0 5 10
0 0.2 0.4 0.6 0.8 1
Spectral Density Plot
Spectral Density
Frequency in Hertz
0 5 10 15 20 25
0 50 100 150 200 250 300

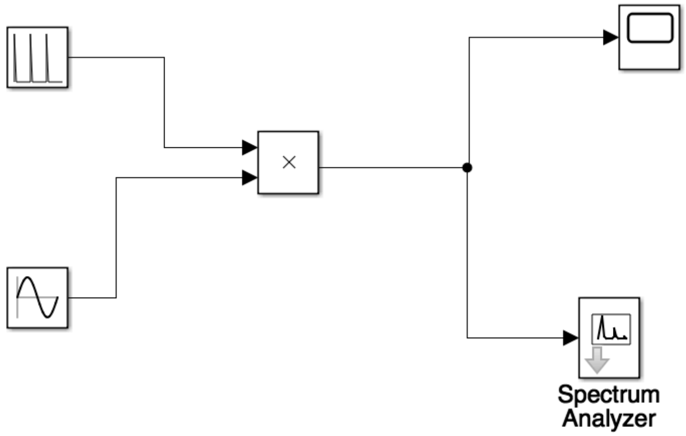


Yes, the results did correspond to the Time-Scaling Property.

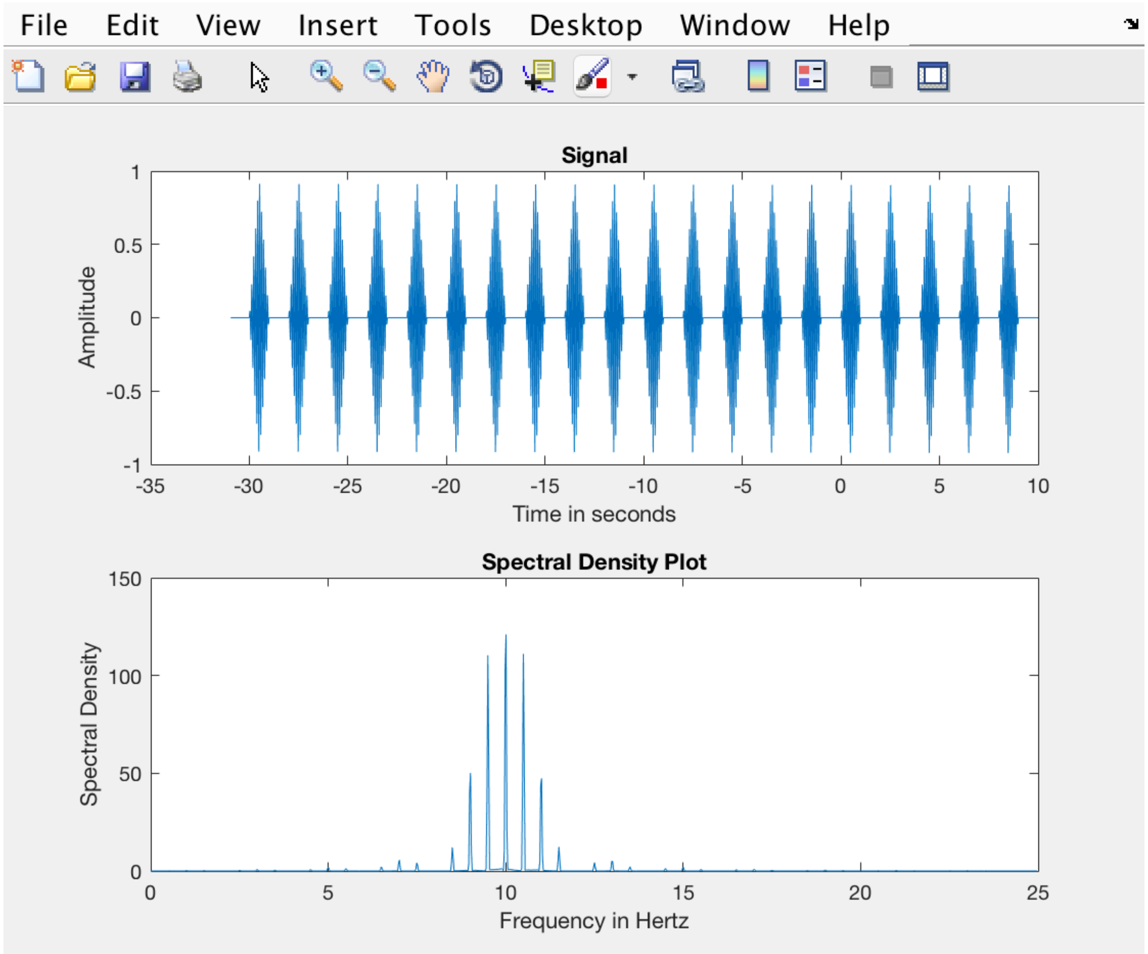
Fundamental period and the frequency are inverse of each other.

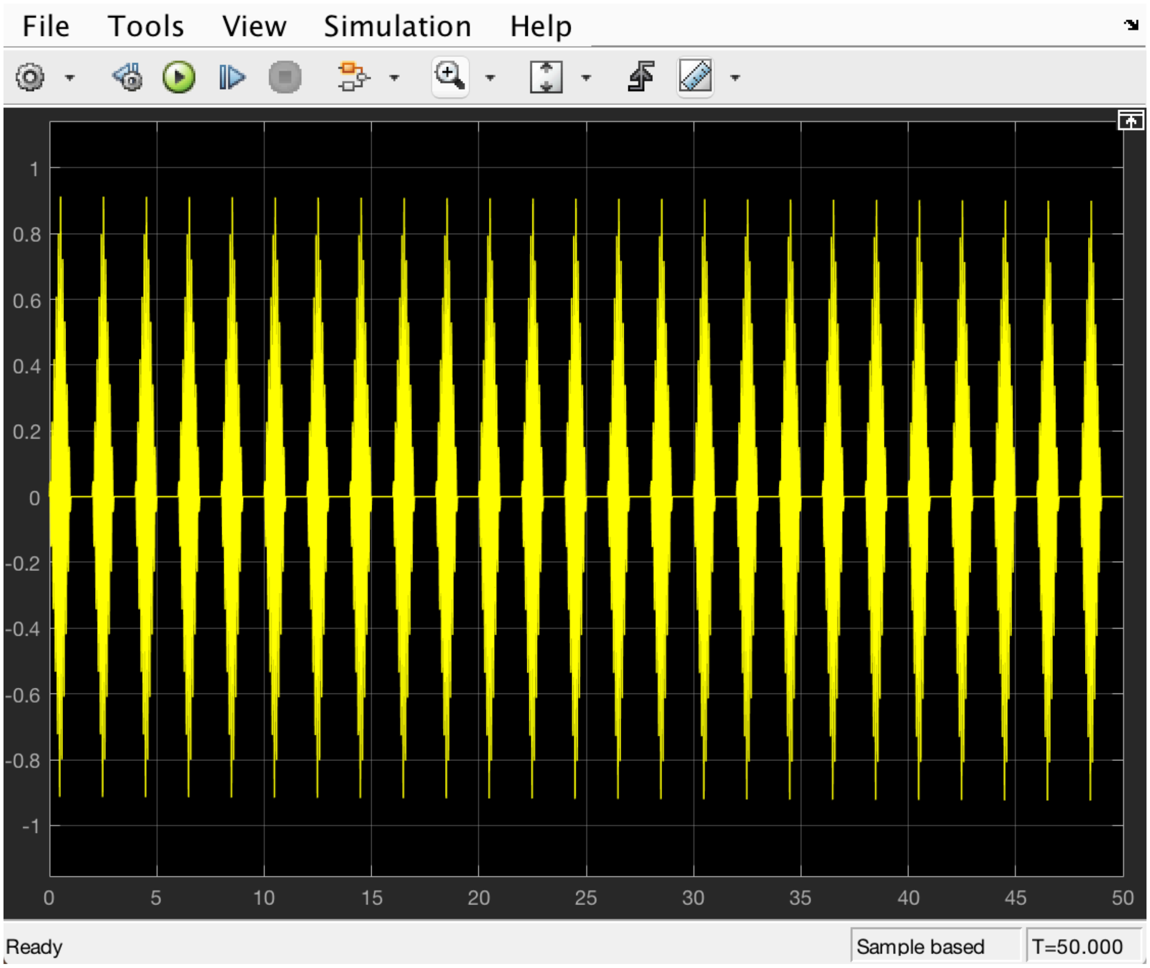
$T_0 = 1/f_0$

3.2



1. Triangular pulse duration =1 sec, Period = 2 sec, Modulating Frequency = 10 Hz:


File Edit View Insert Tools Desktop Window Help
Signal
Amplitude
Time in seconds
Spectral Density Plot
Spectral Density
Frequency in Hertz



2. Triangular pulse duration =1 sec, Period = 2 sec, Modulating Frequency = 15 Hz

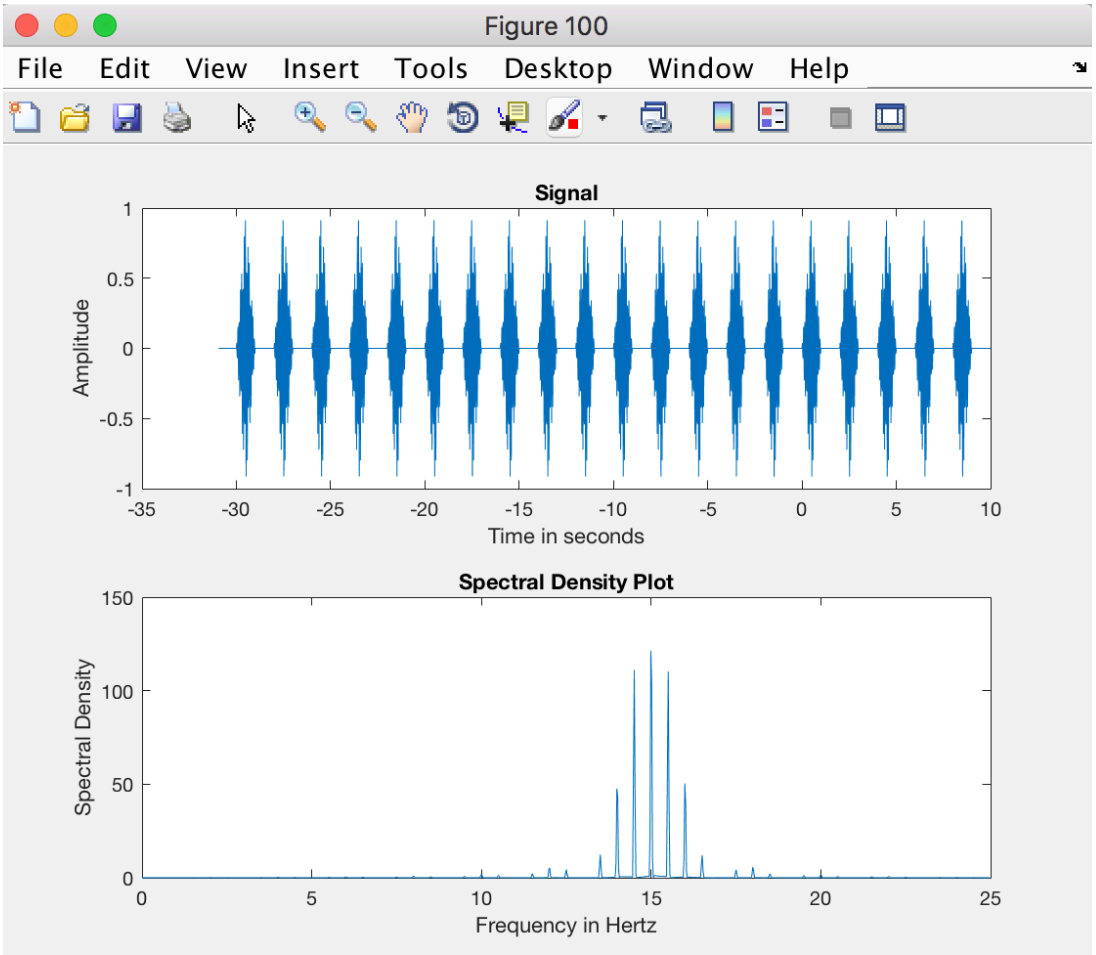
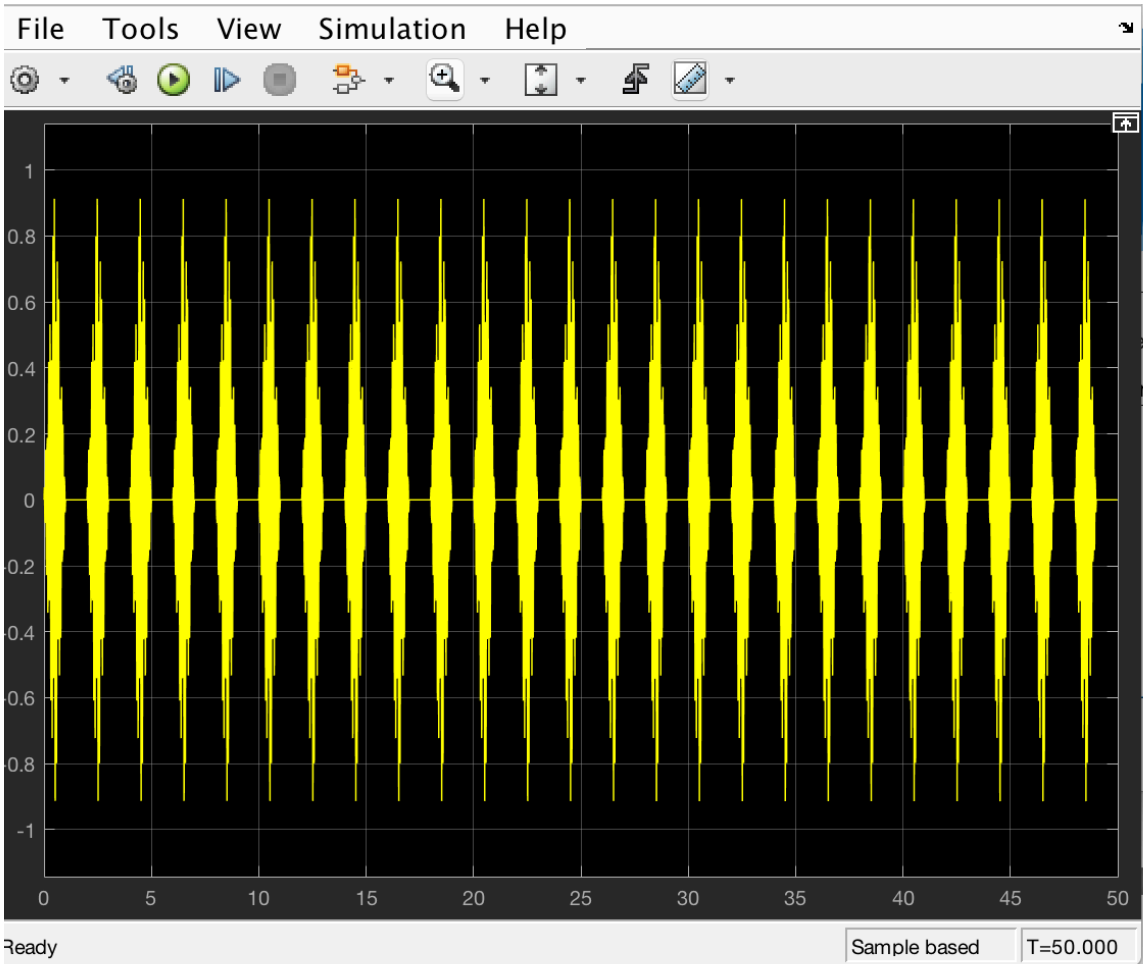
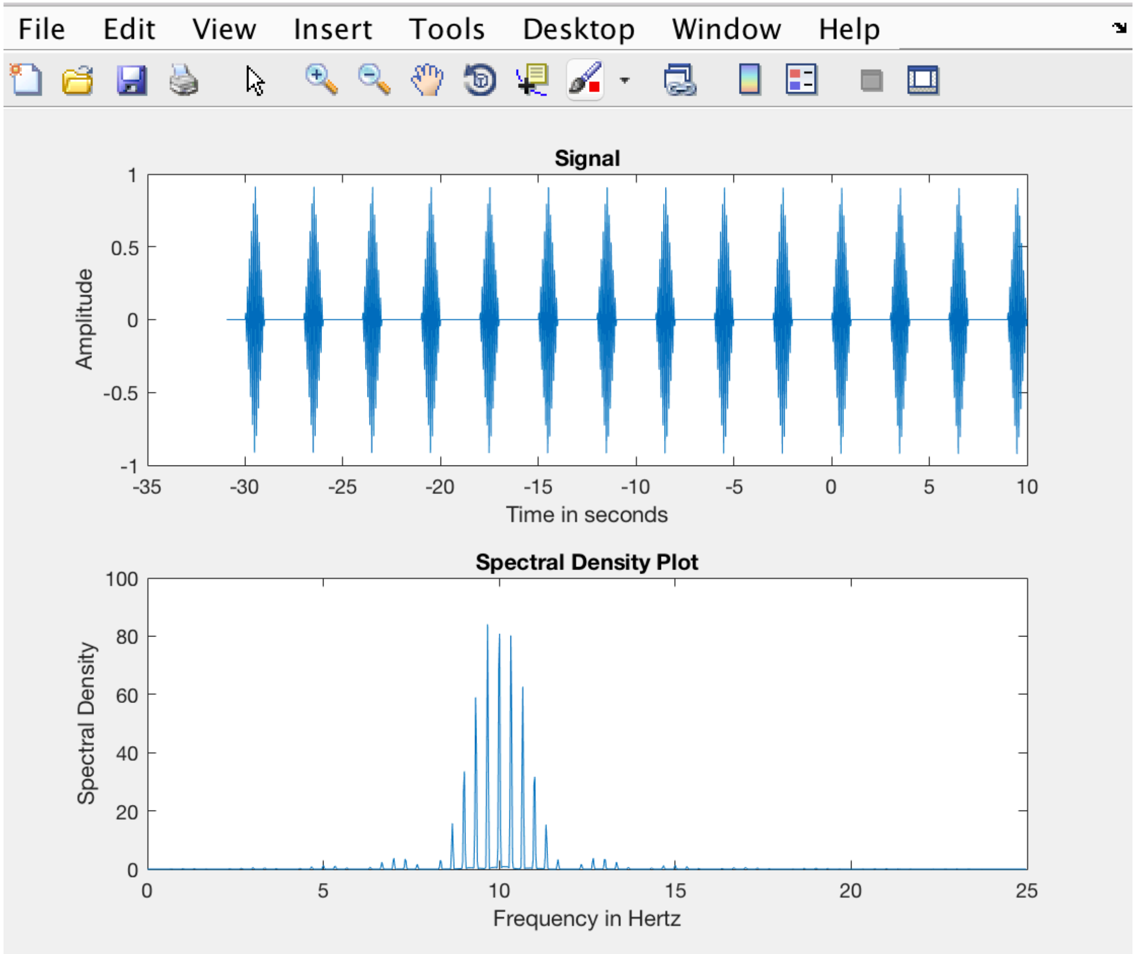
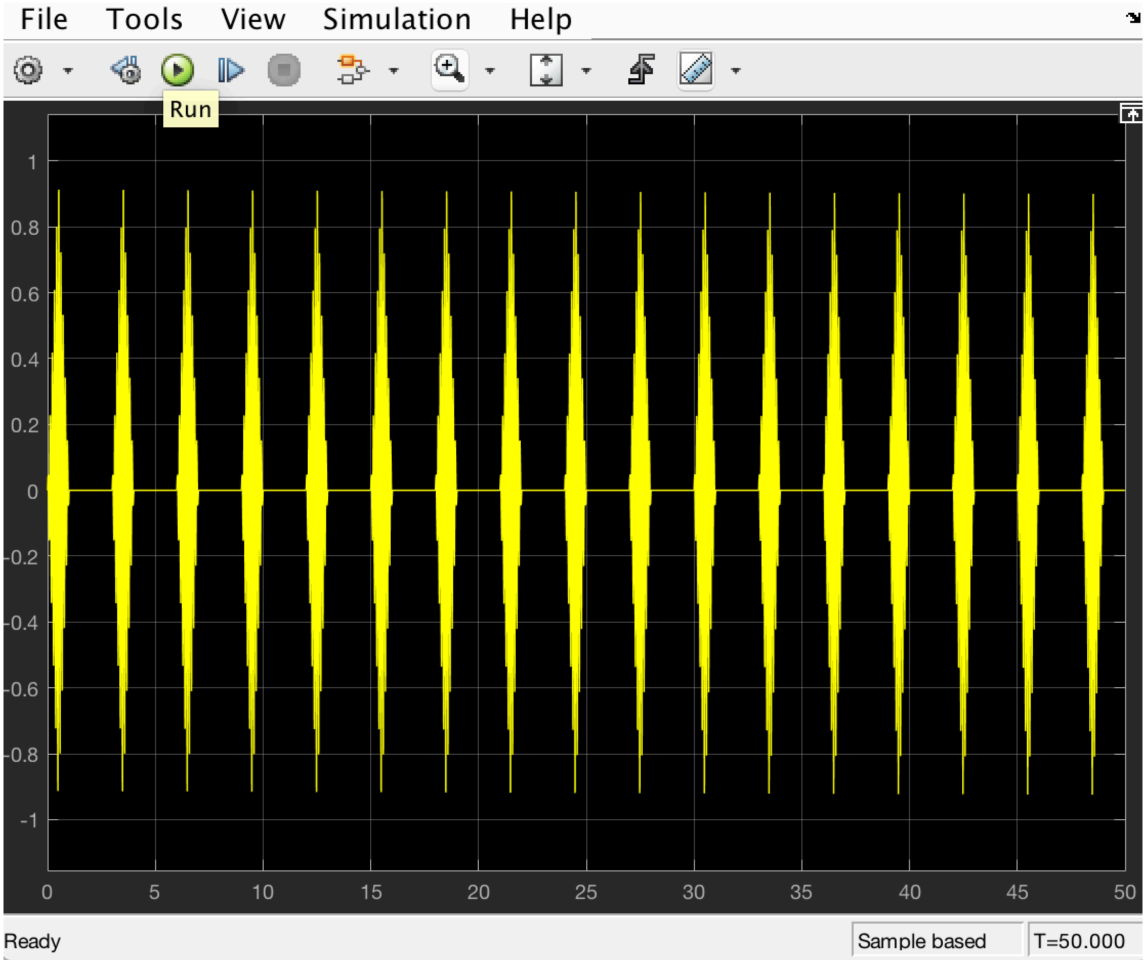


Figure 100
File Edit View Insert Tools Desktop Window Help
Signal
Amplitude
1
0.5
0
-0.5
-1
-35 -30 -25 -20 -15 -10 -5 0 5 10
Time in seconds
Spectral Density Plot
Spectral Density
150
100
50
0
0 5 10 15 20 25
Frequency in Hertz



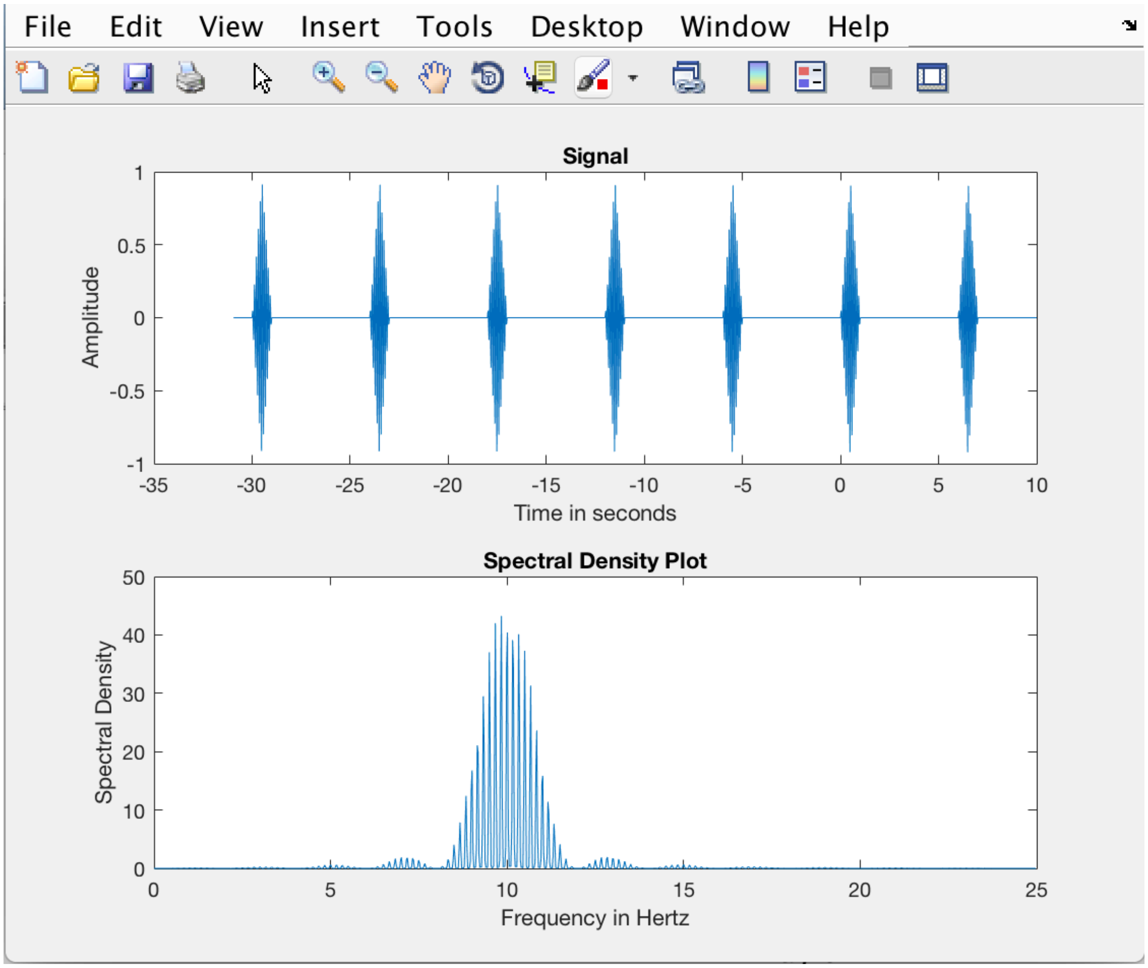
3. Triangular pulse duration =1 sec, Period = 3 sec, Modulating Frequency = 10 Hz


File Edit View Insert Tools Desktop Window Help
Signal
Amplitude
Time in seconds
Spectral Density Plot
Spectral Density
Frequency in Hertz



4. Triangular pulse duration =1 sec, Period = 6 sec, Modulating Frequency = 10 Hz

Agarwal Aash LAB REPORT #4



- Changing the modulating frequency increases the density around the center frequency.
- Spectrum have a comb structure due to the modulation property.
- If the period were to increase toward infinity within the limit, then spectral density tends to increase within the limit.

Extra Credit:

Modulation Property

$$s(t)\,p(t) \xleftrightarrow{F} \frac{1}{2\pi}\left[S(\omega) * P(\omega)\right].$$

Let our spectrum be $\cos(2\pi f_0 t)\, s(t) \rightarrow$

Then by duality & linearity -

$$\frac{1}{2}\left[S(f-f_0) + S(f+f_0)\right].$$

Multiplying by $\cos(2\pi f_0 t) \rightarrow$

$$\cos(2\pi f_0 t)\, s_0(t) + \cos(2\pi f_1 t)\,(s_1(t))$$

which gives modulation property