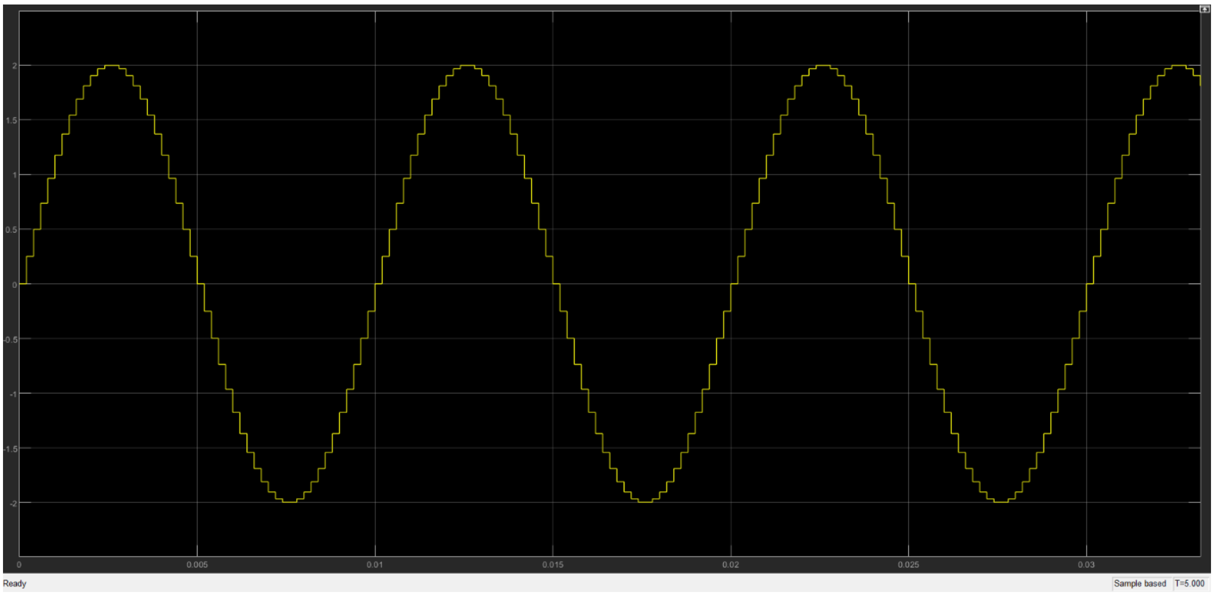
ELEC301 Project 3 – Report

Kerem Girenes

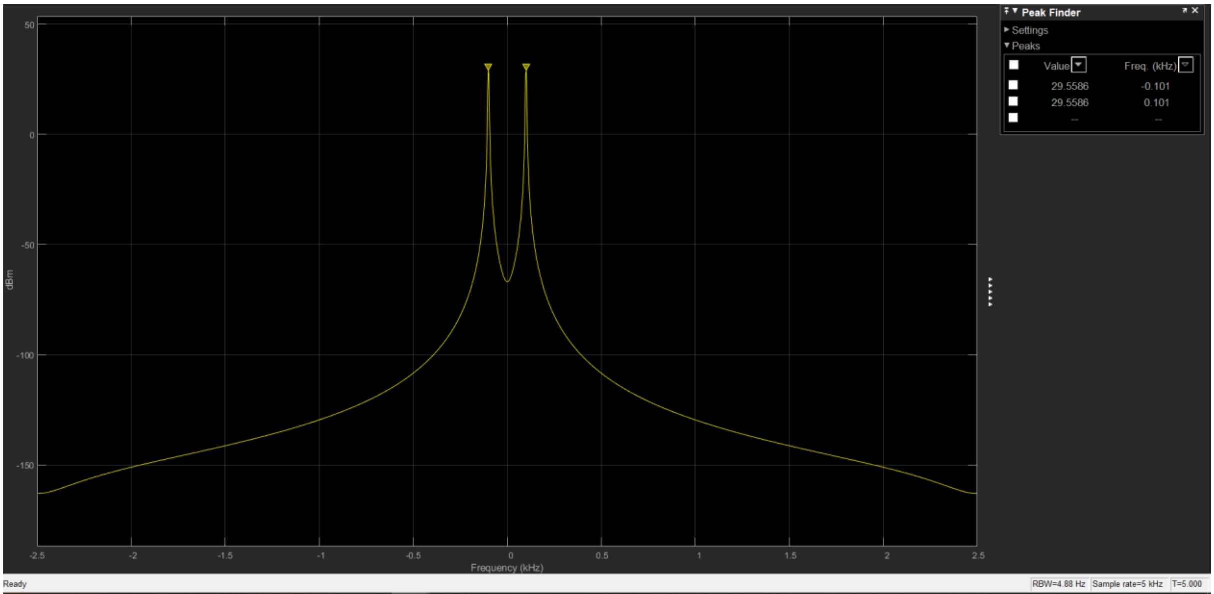
PART 1

A.



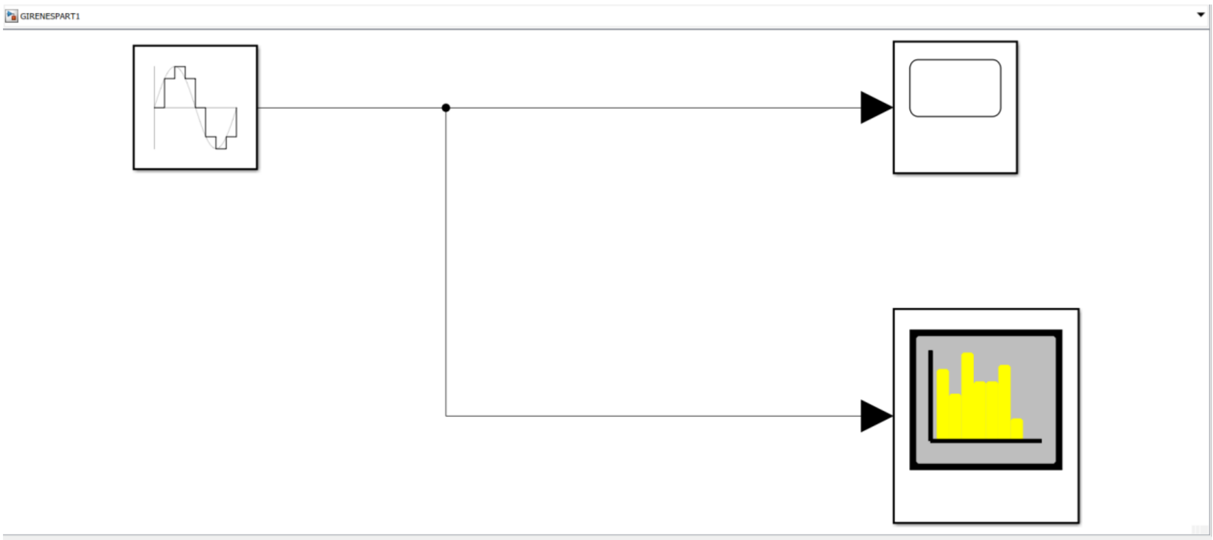
Frequency was 200*pi. Therefore the period of 0.01s was as expected.

B.



In Simulink results, the peaks are at +- 0.101 kHz. The fourier transform of sine wave is two peaks at +- frequency. The ideal peak would be at 0.100 kHz, as we provided 200*pi as omega. Also, the ideal magnitude would be at 30 dBm.

C.



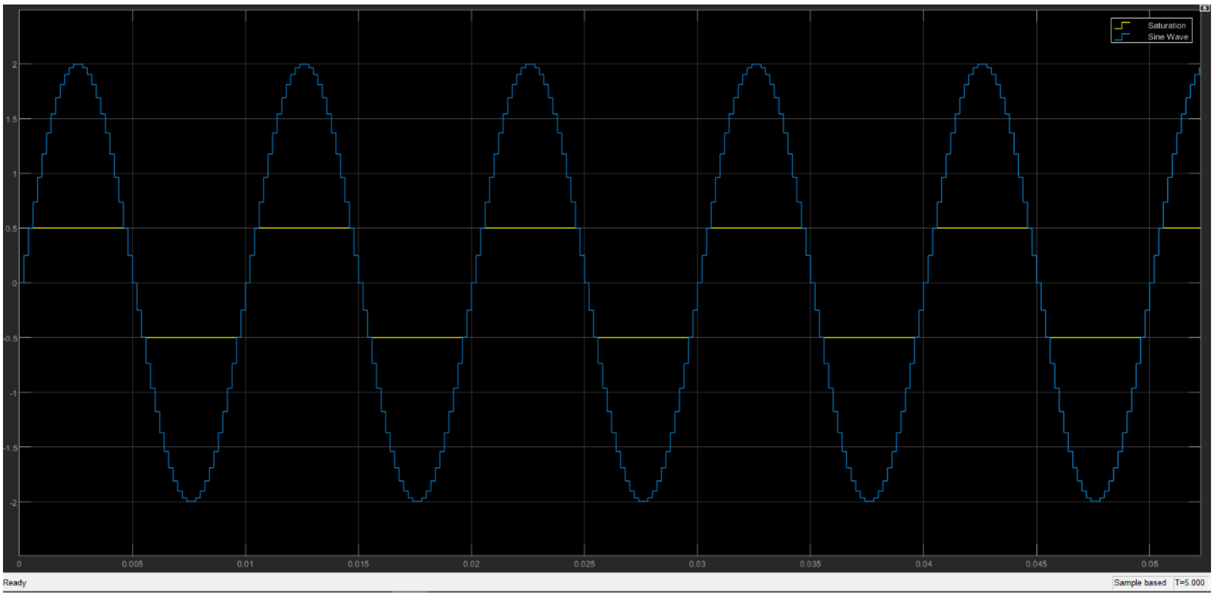
D.

Saved the model as seen above.

PART 2

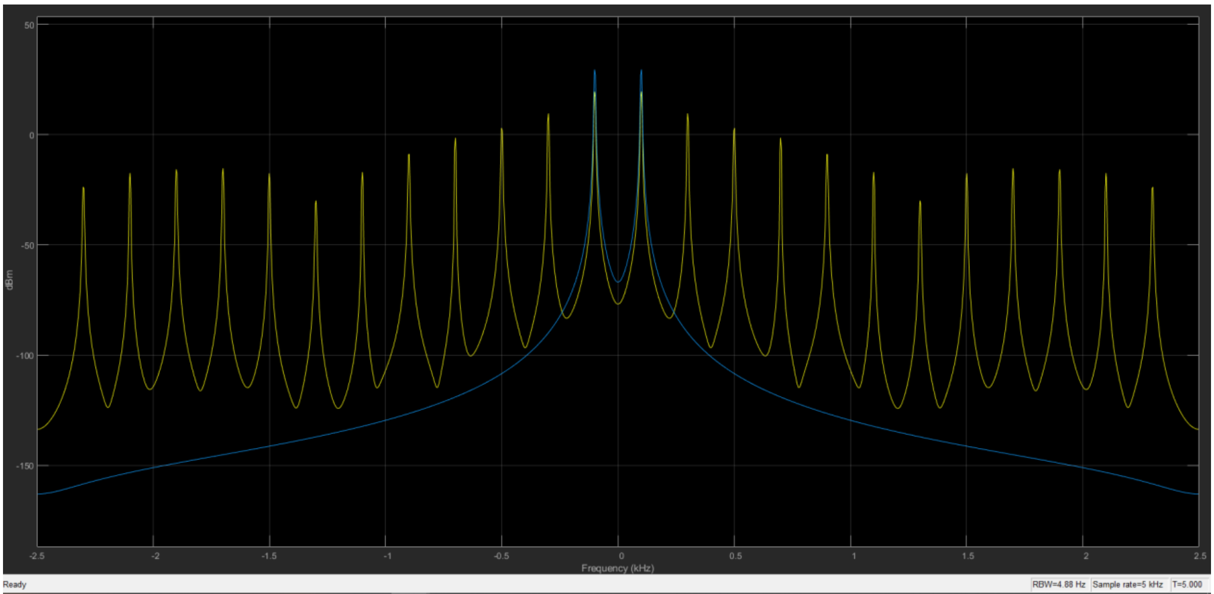
As Saturation Block upper and lower limits, I chose 0.5 and -0.5 respectively.

A.



Yellow Line: Saturated Sine Wave

B.

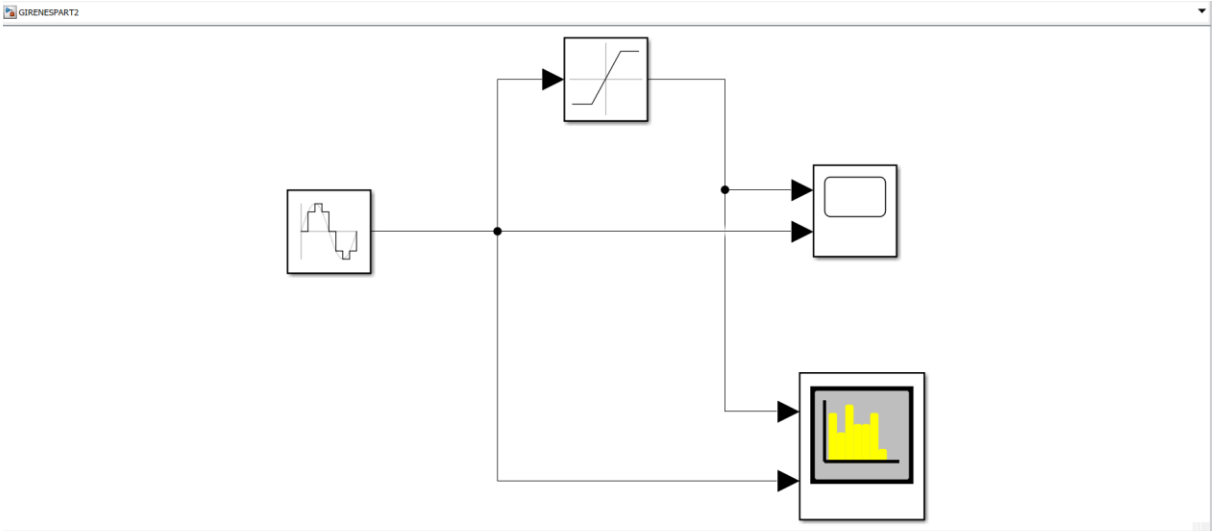


Blue Line: Sine Wave, Yellow Line: Saturation

We have a regular and a saturated sine wave in the scope. We had set the saturation limit to 0.5 so saturated sine wave is flat on +-0.5 whenever the regular sine wave is out of those bounds.

As we have flat lines on saturation limits, the spectrum of the saturated wave has close values that are smaller peaks on corresponding frequencies. Of course, still the frequency of where the regular sign value had its peak is again the highest peak.

C.

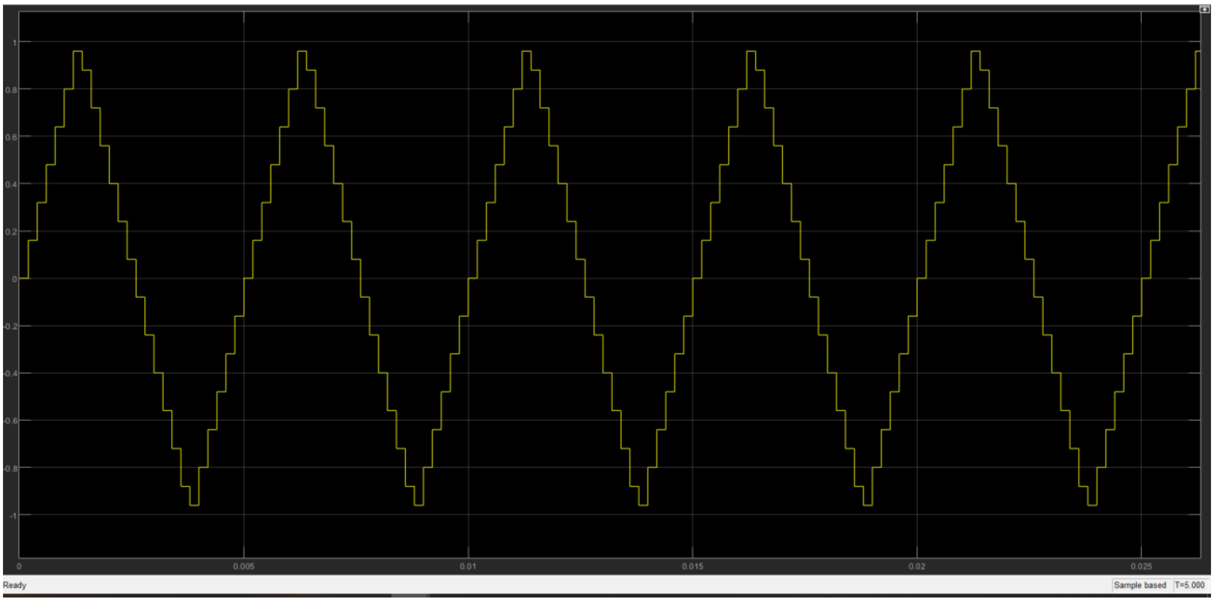


D. Saved model as seen above.

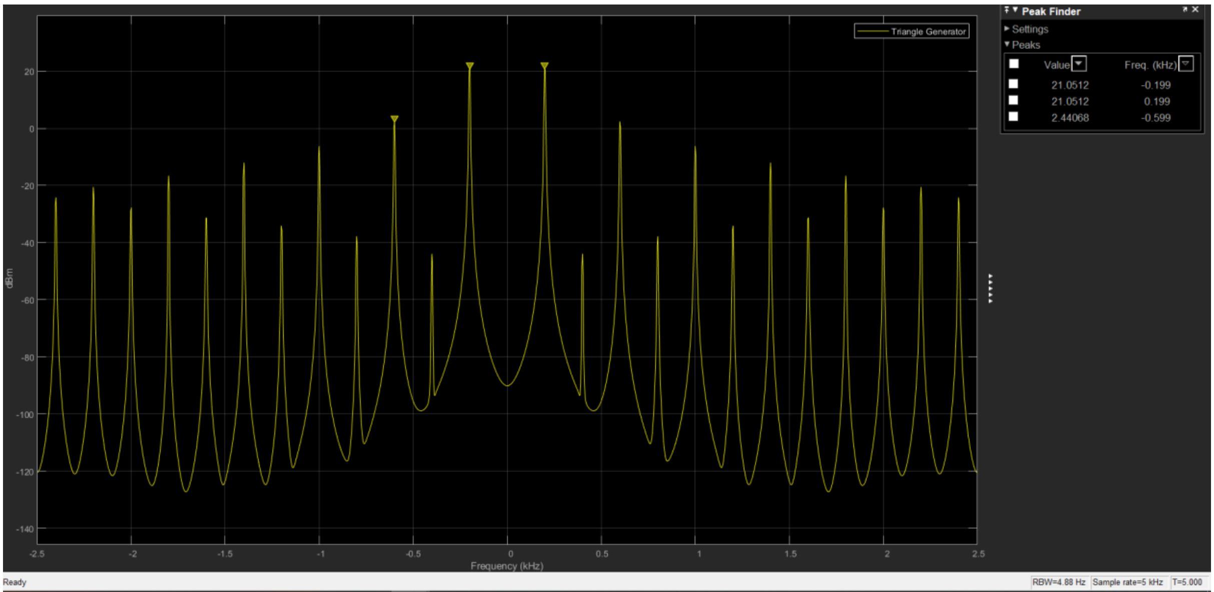
PART 3

For this part, I have utilized the Simscape/Electrical Library for its triangular wave generator.

A.



Scope View



Spectrum View

B.

I tried to find the coefficients by hand. I utilized the formula for finding the coefficients of a continuous time fourier series. I could not complete the solution. I'm adding the part I have done. The experimental value for $20\log(a_k / a_{k+1})$ was 8.521.

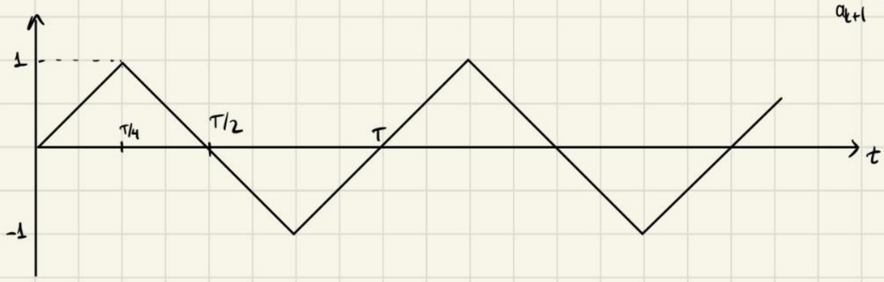
$f = 200\,\mathrm{Hz}$, $T = 0.05$ sec , $\theta = \frac{\pi}{2}$

$\omega = 2\pi f = 400\pi$

$20\log\left(\frac{a_k}{a_{k+1}}\right) = 21.05 - 2.44 = 18.61$

$\frac{a_k}{a_{k+1}} = 10^{\frac{18.61}{20}} = 8.521$

experimental



$$x(t) = \begin{cases} t & , -T/4 + kT < t < T/4 + kT \\ -t & , T/4 + kT < t < \frac{3T}{4} + kT \end{cases}$$

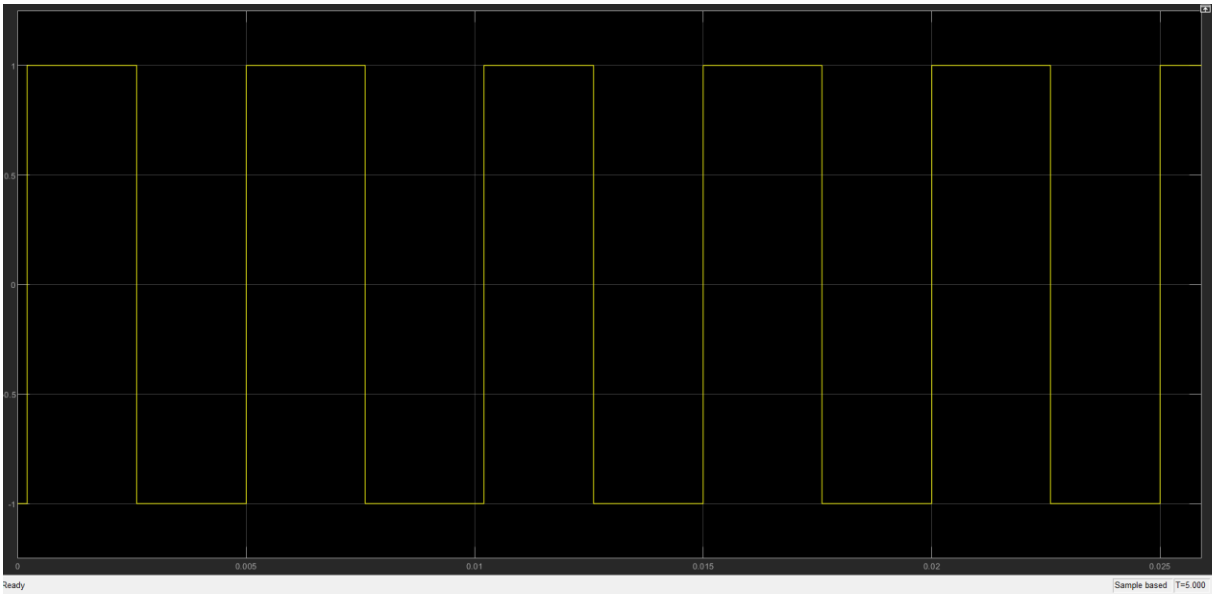
$k = \ldots, -2, -1, 0, 1, 2, \ldots$

$$a_k(t) = \frac{1}{T}\int_{\langle T\rangle} x(t).\, e^{-jk(2\pi f)t}\, dt$$

$$= \frac{1}{T}\left(\int_{-T/4}^{T/4} t.\, e^{-jk\omega t}\, dt - \int_{T/4}^{3T/4} t.\, e^{-jk\omega t}\, dt\right)$$

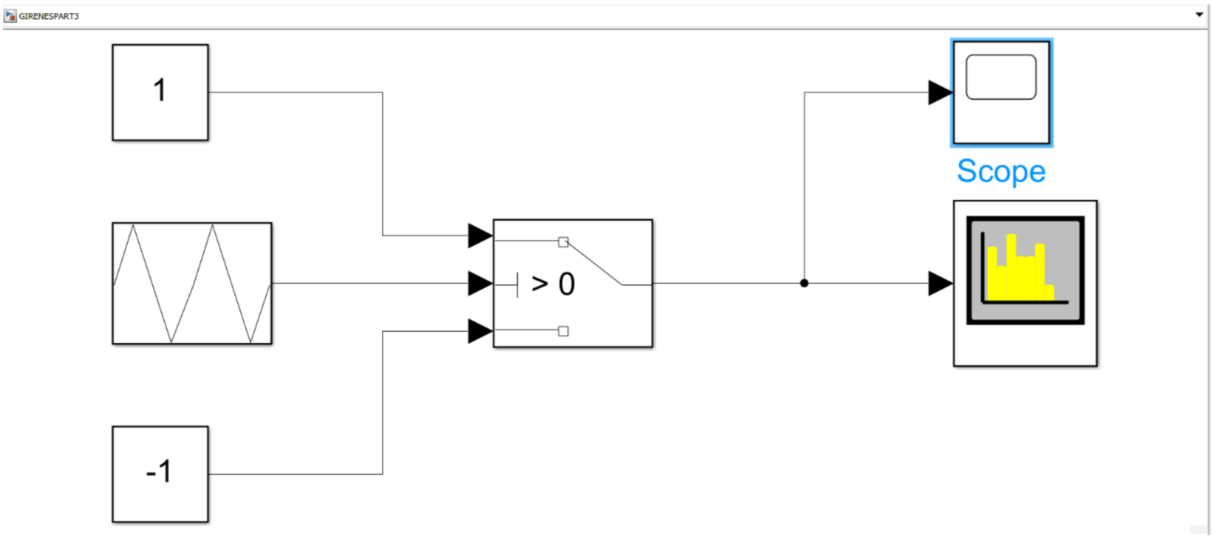
$$\int t.\, e^{-jk\omega t}\, dt = \xrightarrow[\text{by parts}]{\text{integral}}$$

C.



I have utilized a Switch block to get a square wave out of a triangular wave. It produces constant 1 when triangular wave is positive, and -1 when negative. Model is below.

D.



E. Saved model as seen above.