**You must show all of your work to receive full credit!**

# CMPEN 462

## Homework #2: Fast Fourier Transform

## Due: Tuesday, February 13, 2025, by 3:05PM

## (3% of final grade)

**FFT**

1. (30 pts) In Matlab or Python, make a 250 msec discrete time version of a square pulse train with a repetition/pulse rate (fundamental frequency) $f_o = 240KHz$ (fyi - the maximum subcarrier BW in 5G NR is 960KHz) and a max amplitude of +2.5V and min of 0.0V, with a sample rate, $f_s = 4096 * f_o$ and take its FFT.
    a. Do not implement the "fftshift" (Matlab's function name) command
    b. Do not remove the FFT gain from the result
    c. Plot the time domain and frequency domain results (both plots should be linear amplitude) and label the x & y axes appropriately (time scale and amplitude label must be correct). For the time domain plot, show 4 pulses only rather than the entire pulse train.
2. (15 pts) Repeat #1 but use the "fftshift" command (for Matlab) or equivalent command/implementation in Python and also remove the FFT gain from your results.
3. (15 pts) What are the frequencies and amplitude values of the DC term and the first four harmonics?
4. (15 pts) Replot your frequency domain result from #2 using an appropriate log scale for the **magnitude** rather than a linear scale as above.
5. (25 pts) Repeat #2 for a rectangular pulse train where the width of the pulse, $\tau = \frac{1}{3}T_o$. What is/are the main difference(s) with these time and frequency domain plots and those you generated in #2?

**Make sure you submit plots and a copy of the Matlab script or Python code that you used**.