HW3 Physics 321 Fall 2019
Show all work.

1. You have a signal (Voltage as a function of time, say) that can be expressed as

$$V(t) = \begin{cases} \frac{2\pi t}{T}\left(\pi - \frac{2\pi t}{T}\right) & 0 < t \leq \frac{T}{2} \\ \frac{2\pi t}{T}\left(\pi + \frac{2\pi t}{T}\right) & -\frac{T}{2} \leq t < 0 \end{cases}$$

a) Plot the function
b) Arrive at an expression for the Fourier series for this signal. Trivial integrals must be done by hand. Any non-trivial integrals you may need should be are on the class website. (Hint: It may help to remember that m is an integer…)

2. Given a*cos(x)+b*sin(x)=c*cos(x+phi), find c and phi in terms of a and b.

3. Find or record some sound and take the fft using octave. Something close to a pure tone will help you evaluate what you are doing. (Note: a few seconds is probably about the size you want. Look up the documentation on wavread to find out how to read only a section of a longer sound if you need that). Make a plot of non-redundant amplitude vs frequency data. Make sure the frequency data has meaningful physical size and units (Hertz not radians/sec). Is the result physically meaningful? (e.g. is the spectrum reasonable given the sound, etc.) Document the above completely and appropriately (e.g. pretend it's part of a research project and you are keeping a lab notebook on it), including source of sound.

4. Use Octave to generate a wav file that has a pure tone in the audible range (say 440 Hz) that has an amplitude that is decaying exponentially with a time constant of 3 seconds. Make the entire sample 6 seconds long. Be sure to play the sound to yourself to be sure it came out correctly then provide me a link to the file (Onedrive or some such). Also make a plot of non-redundant amplitude vs frequency data. Make sure the frequency data has meaningful physical size and units (Hertz not radians/sec). Interpret the graph in light of what you would expect for just a pure tone with no decaying amplitude.