

**PHYS 240 homework #16 – due Mar 22 2013, 5:00pm, upload to Canvas**

**Fourier analysis and class project**

1. Modify `ftdemo.py` to compute the Fourier transform and power spectrum for the function:

$$(a) \quad y_j = \theta_j/2\pi \quad (\text{sawtooth wave})$$

$$(b) \quad y_j = \begin{cases} 1 & 0 \leq \theta_j < \pi \\ -1 & \text{otherwise} \end{cases} \quad (\text{square wave})$$

$$(c) \quad y_j = \begin{cases} 1 & 0 \leq \theta_j < \pi \\ 0 & \text{otherwise} \end{cases} \quad (\text{square pulses})$$

$$(d) \quad y_j = \begin{cases} \theta_j/\pi & 0 \leq \theta_j < \pi \\ (2\pi - \theta_j)/\pi & \text{otherwise} \end{cases} \quad (\text{triangle wave})$$

where  $\theta_j = 2\pi f_s j \Delta t$  modulo  $2\pi$ . Find the transform and spectrum for  $f_s = 0.2$ , 0.2123, and 0.8, taking  $\Delta t = 1$  for  $N = 50$ , 512, and 4096 data points.

2. Submit an idea for your class project:

- Give background for the problem, and as many specifics as possible for how you could tackle it.
- The project will be worth 10% of your course grade, and should be the equivalent amount of work to 3 homework assignments.
- You may team up with other classmates, but the project should then be proportionately larger, and your individual contributions distinguishable.
- If you want your project to be part of an existing project for another class or a research job, then it should not duplicate an aspect that you would be doing anyway, but instead provide “bonus” value to the project.
- If you’re stuck for ideas, some suggestions will be provided.
- The project should be completed and presented toward the end of the semester, but there will also be regular checkpoints along the way.

3. Include any discussion in a report generated in  $\text{\LaTeX}$  and submitted in PDF format. Also submit your Python code separately.