HW#10 —Phys374—Fall 2013 Prof. Alessandra Buonanno
Due before class, Tuesday, Dec. 3, 2013 Room 4212, (301)405-1440
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1. Consider the "rectified cosine function" defined by

$$f(x) = \cos(\pi x/2L), \qquad -L \le x \le L, \tag{1}$$

   and continued periodically so that $f(x + 2L) = f(x)$. [2+3+5+5=15 pts.]

   (a) Sketch the function $f(x)$ over several periods.

   (b) Use the symmetry to explain why the Fourier coefficients b_n vanish.

   (c) Find the non-vanishing Fourier coefficients. (*Hints*: (i) To clean things up, change variables to $\theta = \pi x/L$. (ii) You'll need to do a probably unfamiliar integral, which you can look up or work out for yourself.)

   (d) Using a computer program (Mathematica, Maple, Matlab, or something else) plot the sum of the first few terms in the Fourier series, together with (1), for $\theta \in (-2\pi, 2\pi)$. Show the result with 1 (just the constant part), 2, 5, and 20 terms included. With 5 terms the sum should already be quite close to (1), except near the zeros where the slope is discontinuous.

2. Find the Fourier transform of $f(t) = A\sin(\omega_0 t + \varphi)$. [10 pts.]

3. Problems 15.6 g,h (Fourier transform of correlation and Parseval's theorem) [10 pts.] (*Note*: The conventions (15.42), (15.43) are used here.)