SP352 HW #3

FS = "Fourier Series: An Example of Characteristic Behaviors" handout (with problems on pages 58 to 81)
Please also review the useful material on pages 81 to 91.

<u>due Wednesday 30 Jan by 1200:</u>

(a) FS #8—The problem spells out the integral you will need to do. Do it by integrating by parts twice. Make the final argument by sketching a graph showing how the 2nd and 3rd harmonics help (or not) correct the over/undershoots of the fundamental. (Note that whenever the problem says "$x = 0$" it should read "$t = 0$".)

(b) Do extension 1 to problem FS #8. What are the amplitudes of the derivative functions? How does that explain why we didn't get *exactly* the class forms of the triangle and square waves? Skip extension 2.

(c) FS #16—This is a square wave with 25% duty cycle. You can electronically search the FS handout to find the unit circle tool (or better yet, read the entire handout carefully). Make sure you answer the final questions about the *change* in representation of the answer!

(d) FS #17—Note that this problem is asking you *three* separate questions; be sure to answer all three! <u>Hints</u>: For the second question, see page FS-14 to understand what happens when you try to evaluate a Fourier series at a discontinuity in the function: you get the *average* of the function upon approaching the discontinuity from larger and smaller values of the independent variable, i.e., 1/2 in the present case. For the third question, you should reproduce a series we summed in class; the third answer is *different* than the first two questions (which have the same answer).

(e) Prove that $\sum_{n=1}^{\infty} n^{-4} = \pi^4 / 90$. Show all steps, starting from an appropriate FS.