PHYS 301
HOMEWORK #5

Due : 17 Feb. 2014

On this homework assignment, you may use Mathematica to compute integrals, but you must submit your Mathematica output with your assignment.

1. For $f(x) = \begin{cases} -1, & -1 < x < 0 \\ 1, & 0 < x < 1 \end{cases}$

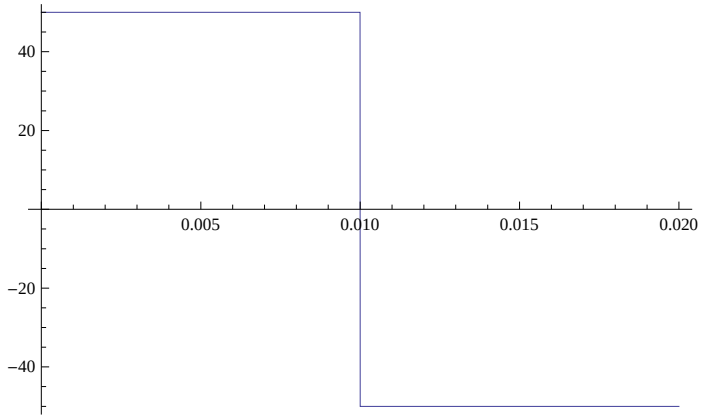
Find the Fourier coefficients and write out the first three non - zero terms of the series expansion.

2. For $f(x) = \begin{cases} x, & 0 < x < 1 \\ 2 - x^2, & 1 < x < 2 \end{cases}$

extend f to construct a) an odd function on (-2, 2) and b) an even function on (-2, 2). Compute the Fourier coefficients for each series and write out the first three non - zero terms of each expansion. (20 pts for this problem).

3. Problem 24, p. 371 of the text.

4. Consider the following graph of one complete cycle of voltage vs. time :



corresponding to $V(t) = \begin{cases} 50, & 0 < t < 1/100 \\ -50, & 1/100 < t < 1/50 \end{cases}$

where V is measured in volts and t in seconds.

Write the Fourier series representing this pattern (assume this part of the graph is repeated 50 times/second).

5. Use the function in problem 1 of this assignment to find the value of

$$\sum_{\text{odd } n}^{\infty} \frac{1}{n^2}$$

6. You are familiar with Fibonacci numbers (fib[n]). Let' s define a similar set of numbers, the so called Loyola U numbers which have the properties :

lu[0] = 2
lu[1] = 1
lu[n] = lu[n - 1] + lu[n - 2]

(Note that the lu numbers start at n = 0). Write a short Mathematica program to test the conjecture :

lu[n] = fib[n - 1] + fib[n + 1]

for $n \leq 30$. If the conjecture is true for a given value of n, your program should output the ratio of lu[n]/fib[n]. If the conjecture is false for a given value of n, your program should print "The conjecture is false." Your printout should include both your program and all results. (20 pts for this question)