Topics in Mathematical Physics (PHYS 320): QPS 3 Spring 2009 v1.0

Welcome to the QPS on our study of Fourier series and Laplace transforms.

- Please submit your solutions before midnight Thursday, April 9.
- You may consult Maple, Boas, your Phys 320 class notes, and standard references such as Schaums. Please *cite any references* (source, page number and formula number, or a printout of a maple worksheet, as appropriate).
- You may not consult any other resources such as the internet.
- Please do check your results.
- Your solutions must be entirely your own work.

Ask questions when you have them! Try email: smajor@hamilton.edu or stop by my office.
Enjoy!

(1) Using Laplace transforms, solve this differential equation

$$u'' + 4u' + 8u = 0 \text{ subject to the initial conditions } u(0) = 2, u'(0) = 0.$$

(2) Solve the initial value problem

$$u'' + 2u' + 10u = -6e^{-x}\sin(3x) \text{ with initial conditions } u(0) = 2, u'(0) = 1$$

using Laplace transforms.

(3) Find the Fourier series and sketch the periodic extension (which means "repeat the function") of

$$f(t) = \begin{cases} -t, & -\pi \le t \le 0 \\ t, & 0 \le t \le \pi \end{cases}$$

(4) Find the Fourier series and sketch the periodic extension of

$$f(t) = \begin{cases} \sin t, & 0 \le t \le \pi \\ 0, & 0 \le t \le \pi \end{cases}$$

(5) A 2 kg mass is suspended from a $k = 76$ N/m spring. The system is damped, with a damping coefficient of 8 kg/s. Suppose that when $t = 0$ the mass hangs at rest in equilibrium. When $t = 2$ s a 2 N force pulls down on the mass. What is the solution for $y(t)$? Please use Laplace transforms to solve this initial value problem.