Physics 4321 Professor Scalise
Midterm Examination Fall 2008

1. Consider the function $f(x) = x, 0 < x < 1$.
   (a) Sketch an EVEN periodic function that is identical to the given function in the interval $0 < x < 1$.
   (b) What is the period?
   (c) Is the periodic function continuous or discontinuous? How do you expect the nth term in the Fourier expansion to behave with respect to n?
   (d) List the first four nonzero terms in the Fourier expansion.

Choose 2 of the next 3 problems.

2. Consider the differential equation: $t^2y''(t) + 4ty'(t) + 2y(t) - t^2 = 0$.
   (a) Characterize it: linear or non-linear; order; homogeneous or non-homogeneous; ordinary or partial.
   (b) Find the complementary solution by guessing the form t^n.

3. Evaluate
   (a) $\int_{x=-\infty}^{+\infty} \delta(x)(5x^3 + 4x + 2)dx$
   (b) $\int_{x=-\infty}^{+\infty} \delta(7x)(5x^3 + 4x + 2)dx$
   (c) $\int_{x=-\infty}^{+\infty} \delta'(x)(5x^3 + 4x + 2)dx$
   (d) $\int_{x=-2}^{+2} \theta(x-1)(5x^3 + 4x + 2)dx$

4. Use the Green function derived in lecture for the underdamped SHO with zero displacement and zero velocity initial conditions to find the general solution $x(t)$ for an exponentially decaying driving force $F(t) = \theta(t)F_0e^{-\beta t}$.