Physics 7305 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) List the first four nonzero terms in the Fourier expansion.

   (c) Sketch an ODD periodic function that is identical to the given function in the interval $0 < x < 1$.

   (d) List the first four nonzero terms in the Fourier expansion.

   (e) Which converges to $f(x)$ the fastest? Why?

Choose 2 of the next 3 problems.

2. Consider the differential equation: $t^2y''(t) + 4ty'(t) + 2y(t) - t^2 = 0$.

   (a) Solve it in general. (Hint: try polynomials in t.)

   (b) Solve it subject to the boundary conditions: $y(1) = 1$ and $y'(1) = 1$.

   (c) How does the particular solution depend on the boundary conditions? Explain.

3. (a) 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 a driving force proportional to a delta function: $F(t) = A_0\delta(t)$

   (b) What are the metric system units of A_0?

   (c) 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 a driving force proportional to the first derivative of a delta function: $F(t) = B_0\delta'(t)$

   (d) What are the metric system units of B_0?

4. (a) Sketch the function $f(x) = 2\theta(x)\theta(2-x) + (6-2x)\theta(x-2)\theta(3-x)$

   (b) Decompose the Cartesian vector (2,3,4) into a piece parallel to (1,1,5) and a piece perpendicular to (1,1,5).

   (c) Evaluate $\int_{x=-\infty}^{+\infty} \delta'(7x)(5x^3 + 4x + 2)\cos(x)dx$

   (d) Evaluate $\int_{x=-\infty}^{+\infty} \theta(1-x^2)(5x^3 + 4x + 2)dx$