Math 2280-1
Friday Dec 12

- Final exam is Wed. Dec. 17 in our classroom NS 204 (here)
- Do you want a review session?
- Practice exam & solutions are posted (Spring 2006 actual final. Disregard #8)

Exam is inclusive, somewhat weighted on later material

Chapters 1-3 20-30% (single DE's)
Chapters 4-5 20-40% (systems & DE's)
Chapter 6 10-25% (non-linear systems & DE's)
Chapter 7 10-20% (Laplace transform)
Chapter 9 10-20% (Fourier series, springs revisited)

New since last midterm

Topics:

1-2: 1st order DE's
- slope fields, phase portraits
- equ. solns
- stability
- methods
- separable
- linear
- applications
- populations
- velocity, acceleration
- tanks

3: Linear DE's
- theory
- IVP 3!
- homog. linear
- non-homog. linear
- undetd. coeffs
- ramps
- applications
- springs
- undamped, damped, forced
- resonance, practical resonance

4: 1st & 2nd order systems of DE's
- conversion of higher order DE's to systems to 1st order
- 3! for 1st order linear systems
- dim. of homogeneous (1st order linear) soln. space
- tank, spring models

5. \( \frac{dx}{dt} = Ax + \beta \)
   \( x''(t) = Ax + \beta \)
   \( e^{At} \) cases, Euler, springs & tanks
   \( e^{At} \) chains, cos & sin
   \( e^{At} \) cos, sin
   \( x' - Ax = \beta \)

6. Phase plane
   - equilibria
   - linearization & stability
   - phase portraits
   - population models
   - springs & pendulums

7. Laplace transform (7.1-7.3)
   - def. using tables & verifying entries IVP's for DE's & systems esp. via partial fractions

8. Fourier series & applications (9.1-9.4)
   - Fourier coeff's & series
   - sine & cosine series
   - springs revisited
In addition to the kinds of problems you've come to expect, I may ask you to explain (or prove) key ideas related to

- linearization
  - hypothesized force functions (Hooke's law, linear drag & damping)
  - linearization near equilibria for autonomous systems
- vector space framework for understanding (linear DE's & PDE's)
  - solution to $L(y) = f$ is $y = yp + yh$
  - superposition principle (is just a restatement of linearity!)
  - relating E1 theorems to dimension of solution space for homogeneous linear DE's & systems of DE's
- algebra & calculus of exponentials & trig
  - Euler
  - addition angle formulas
  - amplitudes/phase $e^{At}$

If you run out of questions, let's study the DEs

$x'' + 5x' + 4x = 0$ \hspace{1cm} x'' + 5x' + 4x = 3 \cos 2t$

in ways which review key ideas from each of chapters 3, 4, 5, 6, 7, 9!