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 & solns 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 of DE's)	
Chapter 6	10-25%	(non-linear systems of DE's)	} new since last midterm
Chapter 7	10-20%	(Laplace transform)	
Chapter 9	10-20%	(Fourier series, springs revisited)	

topics:

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

3: linear DE's
- theory
  - IVP ∃!
  - homog. linear
  - non-homog linear
  - undet'd coef's
  - ~~var params~~
- applications
  - springs
    - undamped, damped, forced
    - resonance, practical resonance

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

5. $\frac{d\vec{x}}{dt} = A\vec{x} + \vec{f}$
- $\vec{x}''(t) = A\vec{x} + \vec{f}$
- $e^{\lambda t}\vec{v}$, cases, Euler; springs & tanks !!
- ~~chains~~
- $\cos \omega t\, \vec{v}$
- e^{At}
- $x' - Ax = f$

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

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

9. Fourier series & applications (9.1-9.4)
- Fourier coef'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 $y=y_p+y_H$
  - superposition principle (is just a restatement of linearity!)
  - relating $\exists!$ theorems to dimension of sol'n space for homog. linear DE's & systems of DE's
- algebra & calculus of exponentials & trig
  - Euler
  - addition angle formulas
  - amplitude/phase
  - e^{At}

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

$$x''+5x'+4x=0 \qquad\qquad x''+5x'+4x=3\cos 2t$$

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