Math 2280-1
Wed 4/27

- Final exam is this Friday, April 29, 8-10:00 a.m. (or 10:30), in our classroom.
- Session to go over this week's HW (§ 9.3-9.4), today Wed 3:30-5 pm JTB 110
- Session to go over last spring final exam, 8:35-9:35 Thurs, here; (usual time & locale)
- Practice exams & sol's are posted. (But, review & outline course for yourself before using practice exams & other resources as diagnostics for further study.)

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

(chapters 6, 7, 9:) new since last midterm!

topics: (we'll talk about how they're interconnected)

1-2: 1^{st} order DE's
- slope fields, phase portraits
- equil. sol's
  - stability
- methods
  - separable
  - linear
- applications
  - populations
  - vel-accel. models
  - tanks

3: linear DE's
- theory
  - IVP $\exists !$
  - homog. linear
  - non-homog. linear
  - superposition $x_p + x_H$
  - undetermined coeff's
    - var pars → see 5.
- applications
  - springs
  - mechanical systems which are conservative; derivations
  - undamped, damped, unforced/forced
  - resonance, practical resonance

4: 1^{st} & 2^{nd} order systems of DE's
- equivalence of any DE or sys. of DE's to a 1^{st} order system
- $\exists !$ for 1^{st} order linear systems
  - consequences for dim of homog. sol. spaces
- input/output models
- spring models

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

6. Phase plane
   - equilibria for autonomous systems
   - linearization
   - stability
   - phase portraits
   - population models
   - mechanical vibrations reconsidered

7. Laplace transform (7.1-7.3)
   - def.
   - using table for $\mathcal{L}, \mathcal{L}^{-1}$
   - IVP's for linear DE's & systems
     - esp. partial fractions

9. Fourier Series & applications (9.1-9.4)
   - Fourier coef's & projection
   - Fourier series
   - sine & cosine series
   - springs (mechanical vibrations) 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!