Math 142: Mathematical Modeling

Syllabus

Fall 2015

General

- Lecture: MWF 9:00-9:50 AM, Geology 6704
- Textbook: R. Haberman, Mathematical Models, SIAM Paperback
- Webpage: `http://hydra.math.ucla.edu/~craig/142.1.15f/`
- Discussion: R 9:00-9:50 AM, Geology 6704

Instructor

- Craig Schroeder
- Office: MS 6310
- Hours: MWF 10:00-11:30 (after class), or by appointment
- Email: `craig@math.ucla.edu`

Goals

In this course, you will learn to

- Physical systems
  - Apply dimensional analysis as a tool
  - Construct a mathematical model that describes the motion of a physical system including such elements as masses, springs, gravity, friction, ropes, pulleys, beams, etc.
  - Analyze such a model including
    - Determining Equilibria and their stability
    - Interconverting with total/kinetic/potential energy, where these exist
    - Constructing and interpreting a phase plane diagram
  - Understanding connections between these (e.g., constructing a physical system that would display behavior similar to that shown in a phase plane diagram.)
- Traffic flow
  - Solve problems using Eulerian and Lagrangian descriptions of the motion of objects in 1D
  - Solve the 1D conservation law by the method of characteristics, including ones with shocks or rarefactions

  - Be able to apply the method of characteristics to PDE's that are similar to the conservation law
  - Qualitatively evolve the density profile resulting from conservation of cars without actually computing the solution
  - Quantitatively and qualitatively determine what will happen to traffic due to various stimuli, such as traffic lights or accidents.

- Kinetic theory
  - Draw simple conclusions based on the principles of kinetic theory
  - Apply the ideal gas law
  - Predict qualitatively how changing the underlying assumptions would alter the ideal gas law

Course elements

Lecture There are 26 regular lectures, in addition to a midterm, a midterm review, and a final review. Lectures are intended to introduce and motivate the core concepts of the course.

Homework Homework is assigned for each lecture and is posted on the website. You may work on the homework problems in groups or individually. Homework will not be collected or graded. Homework is an opportunity for you to practice applying core concepts.

Quizzes There will be seven quizzes, each given at the beginning of discussion (weeks 2-4, 6-8, 10). No make-up quizzes will be given, but the two quizzes with lowest score will be dropped when computing your course grade. The schedule of Quizzes and their coverage is listed on the website. Each quiz will be 15 minutes and contain two problems of equal value. The problems are taken from the homework (either verbatim or with limited modification). In the case of multi-part homework problems, the quiz problem would be one of those parts, perhaps two if they are particularly short.

Group work During discussion (after the quiz, if there is one), students will break into groups of 2-4 to work through additional problems, which will then be discussed as a class. These problems are somewhat different in nature from the homework problems from the book and are similar in nature and difficulty to the questions that will occur on the midterm and final.

Projects There will be two projects. These projects have a programming component. You may use any programming languages you like for these assignments, though MATLAB/octave is likely to be easiest. The difficulty and amount of programming that will be required is minimal. The projects will be posted on the website. As with any programming-related assignment, be sure to start well in advance in case you run into problems. Projects are due by the end of lecture on the day they are due. You may work on the projects alone or in pairs. If you work with a partner, submit one copy of the project with both names on it; both partners will receive the same grade for the project.

Examinations There will be one midterm on Monday, October 26, 2015, during class. The final will be Wednesday, December 9, 2015, 11:30-2:30 PM. Please bring your ID card to both exams. For both the midterm and the final exam no books, notes, smartphones, or calculators will be allowed.

Grading

Your grade will be computed according to one of the grading schemes below. The lowest two quizzes will be dropped when computing your grade. The grading scheme that produces the highest score will be chosen.

Item	Scheme 1	Scheme 2
Projects	10%	15%
Quizzes	15%	20%
Midterm	30%	25%
Final	45%	40%

Academic conduct

Your work and conduct in this course are governed by the UCLA student conduct code and can be found here. This code is designed to promote high standards of academic honesty and integrity as well as fairness. In particular, all work that you submit in this course must be your original work. Any cases of suspected academic misconduct will be addressed as defined by the conduct code.