Applied Asymptotic Analysis, Fall 2014
APMA 1360
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http://www.dam.brown.edu/people/jgemmer/APMA-1360S15.html
Office: 182 George Street, Room 328 **Phone:** (401) 863-2114
Office Hours: Tuesday 1:00-3:00, Thursday 1:00-3:00 (and by appointment)
Class Meeting Times: MWF: 1:00-2:00
Class Location: Barus & Holley 161

Prerequisites: Advanced calculus and linear algebra. Students should be comfortable with proofs at the level of advanced calculus or beginning mathematical analysis. In addition, students should be comfortable with computer programming of numerical algorithms (MATLAB or Mathematica code usually).

Textbook: *Nonlinear Dynamics and Chaos 2nd Edition*, S.H. Strogatz, 2014.

Course Description: An introduction to nonlinear dynamics and chaos. Topics covered will include: one dimensional flows, phase plane analysis, limit cycles, bifurcations, and chaos. Most of the book will be covered in the course.

Course Rationale: Many dynamical models of complex phenomena in biology, chemistry, and physics are nonlinear. The purpose of this course is for students to learn how to extract quantitative and qualitative information from such models. Moreover, since modern applied mathematics is intrinsically interdisciplinary a secondary purpose of this course will be to introduce techniques to students outside of their field.

Class Delivery: The course material will be delivered through lectures. Evaluation of the students understanding of the material will be assessed through written homework assignments, in-class exams and a semester project.

Course Policies:

✦ **Grading:**

Your grade will be based on:

- Weekly Homework: 20%
- Class Works: 5%
- Two in-class exams: 15% each
- Term paper proposal: 5%
- Term paper: 15%
- Final Exam: 30%

✦ **Homework:**

Homework will be assigned most weeks on Wednesday and will be due Friday of the following week. The assigned homework problems will be posted on my website.

✦ **Class Works:**
Throughout the course there will be several "class works". These consist of structured group assignments that should be completed during class time. These assignments will generally be exploratory allowing students to learn a new concept through a "hands on" approach.

✦ **Exams:**
There will be two exams and a comprehensive final in the course. All exams will be in-class.

✦ **Modeling Project:**
A significant portion of the student's progress towards completion of the course goals will be evaluated through a modeling project. The project should apply techniques from this course to your field of interest. Ideally, the student should select a research paper to read in detail, reproduce some of the results in the paper and produce results of their own by modifying or extending the paper. The project consists of a proposal and a term paper. The proposal should be a rough sketch of the topic the student has selected and is due in class March 13. The term paper should be written in the form of a research article with all mathematical details fully written out.

Tentative Course Schedule:

1. Flows on the line (1 week).
2. Bifurcations in one-dimensional systems (1-2 weeks).
3. Flows on the circle (1-2 weeks).
4. Two-dimensional linear systems (1 week).
5. Phase plane (2 weeks).
6. Limit cycles (1-2 weeks).
7. Bifurcations in two-dimensional systems (1-2 weeks).
8. Chaotic dynamics (rest of the semester).

Important Dates:

1. February 20: Exam 1.
2. March 13: Term paper proposal due.
2. April 3: Exam 2.
3. May 4: Term paper due.
5. Final Exam: TBD