Applied Nonlinear Dynamical Systems, Spring 2017
Math 383/683

Dr. John Gemmer, gemmerj@wfu.edu
Office: 360 Manchester Hall **Phone:** (336) 758-5386
Course Website: http://users.wfu.edu/gemmerj/Math383-683.html
Office Hours: Tuesday 3-5, Wednesday 1-2, Tursday 2-4
Class Meeting Times: MWF 9:00-9:50
Class Location: Manchester Hall 124

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

Prerequisites: Ordinary differential equations and linear algebra. Students should be comfortable with computer programming of numerical algorithms (MATLAB or Mathematica code usually).

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. The course will be equal parts theory and applications with the applications drawn from classical areas such as physics, biology, and chemistry as well as nontraditional areas such as the the spread of infectious diseases, population growth, extinction events, etc.

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 have students apply techniques from the course to a specific problem of scientific interest.

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.

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

Course Policies:

✦ **Grading:**

Your grade will be based on:

- Weekly Homework: 10%
- Quizzes: 5%
- Class Works: 5%
- Two in-class exams: 30% (15% each)
- Term paper proposal: 5%
- Term paper: 15%
- Final Exam: 30%

You are guaranteed the following grades if your final percentage lies within the following ranges:

90-92.9: A-	**93-100: A**	
80-82.9: B-	**83-86.9: B**	**87-89.9: B+**
70-72.9: C-	**73-76.9: C**	**77-79.9: C+**
60-62.9: D-	**63-66.9: D**	**67-69.9: D+**

✦ **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.

✦ **Quizzes:** On most Fridays there will be a short 10 minute in-class quiz. These quizzes will consist of a very short problem that will test your knowledge of the prior lectures. These quizzes are to help both the students *and* the instructor understand concepts that students may be struggling with. All quizzes will be announced in class. *There will be no "pop" quizzes*. There are no retakes for missed quizzes, however I will drop the lowest quiz score from your final grade. Quizzes are often indicative of how the instructor grades and what concepts will be emphasized on exams.

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

✦ **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 February 24. 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 10: Exam 1.
2. February 24 : Term paper proposal due.
2. March 17: Exam 2.
3. April 24: Term paper due.
5. Final Exam: TBD

The Honor Code: At Wake Forest, we expect you to behave as honorable citizens of the class, the university, and the world as a whole. When you complete an assignment with your name on it, you are representing that everything you are turning in is your own work. That means that you do not copy from other students, textbooks, or websites. If at any time I become aware of cheating or plagiarism in this course, I will submit the information to the honor council.