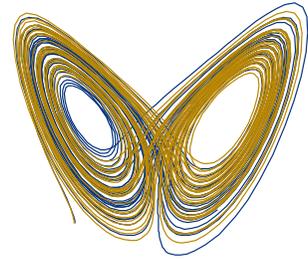


## APMA 1360: Topics in Chaotic Dynamics (Spring 2017)

**Lectures:** MWF 9:00-9:50am, 85 Waterman Street, room 015  
**Instructor:** Björn Sandstede  
**Office:** 182 George Street, room 105  
**E-mail:** bjorn\_sandstede@brown.edu  
**Canvas:** <https://canvas.brown.edu/courses/1070972>



### Learning goals and objectives:

This course gives an overview of the theory and applications of dynamical systems modeled by differential equations and maps. We will discuss changes of the dynamics when parameters are varied, investigate periodic and homoclinic solutions that arise in applications, and study the impact of additional structures such as time reversibility and conserved quantities on the dynamics. We will also study systems with complicated "chaotic" dynamics that possess attracting sets which do not have an integer dimension. Applications to chemical reactions, climate, epidemiology, and phase transitions will be discussed.

By the end of the course, you will

- be a critical reader and writer of scientific essays and papers;
- have intuition into the dynamics of planar differential equations;
- be able to extract and sketch dynamical features of differential equations in two and three dimensions;
- be able to predict qualitative changes in the dynamics of mathematical models triggered by parameter changes;
- be able to interpret solutions to mathematical models in the original context.

This course can be used as a senior seminar. It also satisfies the second writing requirement.

**Textbook:** No textbook is required. Here are a few resources that provide additional perspectives on the material:

- Steven Strogatz. *Nonlinear Dynamics and Chaos*. Westview Press.  
[This book provides many examples and intuition but does not cover much theory]
- James Meiss. *Differential Dynamical Systems*. SIAM. (available for free)  
[This book provides covers very solid theoretical foundations and applications]

**Prerequisites:** APMA 0350 and Math 0520/0540

### Time expectations:

Class time	39 hours
Reviewing class (2hr/week)	26 hours
Homework (4hr/week)	52 hours
Writing Assignments (5hr/assignment)	10 hours
Midterms (7hr/midterm)	14 hours
<u>Final project</u>	<u>40 hours</u>
<b>Total for semester</b>	<b>181 hours</b>

**Writing assignment:** We will use reading assignments and in-class discussions to learn about scientific writing and use three writing assignments to practice writing in the discipline. You will receive substantive detailed feedback on these essays and be able to revise your writing assignments after receiving feedback.

- The first assignment will be a short (~500 words) popular science essay on a topic drawn from class.
- The second assignment will be a longer (~2000 words) scientific paper that combines theoretical material from class with a specific application.
- The report for the final project constitutes the last writing assignment, with a length of approximately 8-12 pages. You use the experience gained in the first two essays to write an accessible introduction and the main scientific content of the project report.

**Assessment:**

Homework	30%
Writing assignments	10%
Midterm exam 1	15%
Midterm exam 2	15%
Final project	30%

The final projects will be carried out by small teams of 2-4 students and involve a written report.

**Provisional grading scale:**

A	90-100%
B	80-89%
C	70-79%

This grading scale is subject to adjustment, especially in borderline cases; adjustments may take into account improvements over the semester. Minimum percentages for grade cut-offs will not be higher than in the scale above.

**Accommodations for students with disabilities:** If you need accommodations for classes, assignments, or exams, please contact me as soon as possible. Please also contact the Student and Employee Accessibility Services (by phone 401-863-9588 or online at [http://brown.edu/Student\\_Services/Office\\_of\\_Student\\_Life/seas/index.html](http://brown.edu/Student_Services/Office_of_Student_Life/seas/index.html))

**Diversity and inclusion statement:** I would like to create a learning environment for you that supports a diversity of thoughts, perspectives, and experiences, and honors your identities (including race, gender, class, sexuality, religion, ability, ...). To help accomplish this:

- If you have a name and/or set of pronouns that differ from those that appear in your official Brown records, please let me know!
- If you feel that your performance in the class is being impacted by your experiences outside of class, please do not hesitate to come and talk with me. I want to be a resource for you. If you prefer to speak with someone outside of the course, Dean Bhattacharyya (Associate Dean of the College for Diversity Programs) is a great resource.
- I am still in the process of learning about inclusion and diverse perspectives & identities. If something was said in class (by anyone) that made you feel uncomfortable, please talk to me about it.
- As a participant in course discussions, you should also strive to honor the diversity of your fellow classmates.

**Anonymous feedback:** You can provide anonymous feedback for this class here:

<https://goo.gl/forms/SmabusM4b3EbKvOD2>

**The fine print ...**

- Canvas: All announcements and assignments will be posted exclusively on Canvas: please make sure you receive notifications from Canvas so that you stay informed of announcements and deadlines.
- Lectures: I urge you to come to all class meetings. Attending class allows you to see the material firsthand and to ask questions; we will also have small-group discussions during class that enable you to spot any conceptual difficulties quickly.
- Homework:
  - Assignments will be available on Canvas on Wednesdays; homework will be due on Wednesdays at 10am.
  - Late homework assignments will not be accepted unless you have a legitimate excuse (illness/emergency), together with verification.
  - Students can, and are encouraged to, collaborate on homework assignments: however, assignments must be written up separately and individually.
- Midterm exams will not be given at times other than the scheduled slots, except in cases of illness, emergency, or some other crisis; documentation verifying the excuse will be required, such as a note from your doctor. You need to contact me as soon as you can, before the midterm exam whenever possible, if a serious conflict arises.