

MATH 7326, DYNAMICAL SYSTEMS, FALL 2019

Dr. Vaughn Climenhaga

|                             |  |
|-----------------------------|--|
| <b>Contact details</b>      | <i>Website:</i> <a href="http://www.math.uh.edu/~climenna/math7326.html">www.math.uh.edu/~climenna/math7326.html</a> |
| <i>Office:</i> PGH Room 665 | <i>Email:</i> <a href="mailto:climenna@math.uh.edu">climenna@math.uh.edu</a>   |

**Course times:**

- *Lectures:* MWF 12:00–12:50pm, AH 202
- *Office hours (subject to change, check website for current information):*  
Monday 9–9:50am, Wednesday 1–1:50pm, or by appointment

**Textbook:** There is no required textbook. The more in-depth arguments in the course will largely be drawn from the primary literature (references will be provided) or from the book "One-dimensional dynamics" by Wellington de Melo and Sebastian van Strien, which is out of print but available free in pdf form from the second author's website: <http://www.imperial.ac.uk/~svanstri/> Some of the history of the subject is discussed in "Chaos: Making a New Science" by James Gleick, and an undergraduate-level introduction to some of the topics is given in "Nonlinear Dynamics and Chaos" by Steven Strogatz, so these books are worth looking at and I will draw from both to some extent, but neither is required for this course.

**Course Description:** This course will introduce the qualitative study of dynamical systems via historically and scientifically important examples such as the three-body problem, nonlinear oscillators, the Lorenz system, and the logistic map.

These examples illustrate how systems evolving in time according simple deterministic rules can exhibit complicated "chaotic" behavior. Each of these systems depends on one or more parameters, and a central part of the course will be to study how the qualitative behavior of the system changes (or does not change) as the parameters vary. This will lead us to discuss topics such as KAM theory, phase locking, bifurcations, period-doubling cascades, renormalization, and parameter exclusion.

The topics to be covered in this course are largely distinct from the topics covered in previous edition of Math 7326 that I taught in Spring 2017, so students who took that class would benefit from taking this one as well.

**Class notes:** In order to have a record of the lectures and of the class we will be producing a set of class notes as we go along. To this end, for each lecture there will be one student designated as the "scribe" for that day, and that student will be responsible for typing up the notes from that lecture (using  $\text{\LaTeX}$ ) and sending them to me for inclusion in the main document.

- I will provide a template file with the general  $\text{\LaTeX}$  setup, so that all you need to do is type the material from the lecture itself, rather than worrying about preamble, etc.
- Depending on exactly how many students end up taking the class, I expect each person to be responsible for between four and six lectures.
- I do not expect the notes to be particularly polished or to contain a great deal of "smoothing out" text; the main point is to have a record of exactly what we cover, and to give you practice in using  $\text{\LaTeX}$ , since this is an essential skill for a mathematician.

**Grading:** Your final grade will be determined by the following components (in equal measure).

- (1) Attendance and participation – be at the lectures, ask and answer questions when necessary.
- (2) Contribution to class notes – see previous item.
- (3) Occasional homework assignments.
- (4) Final exam/project – likely a take-home exam, but more details to come later.

**General expectations:** This is closer to a “special topics” course than a “prelim preparation course”. On the one hand, this means fewer homework assignments and tests, since I am less concerned with evaluating your performance and more concerned with giving you an overview of the field of dynamical systems. On the other hand, this means that I will at times move rather more quickly than would be appropriate for a prelim-level course; some topics will not be treated in the detail that they really deserve, since this is the only way that I can tell the story I want to tell in the span of a single semester.

My goal is that by the end of the semester, you will have a reasonable bird’s-eye view of how the qualitative behavior of dynamical systems changes as the parameters governing the system vary. Your part in this is to attend lectures regularly, ask questions when something I say is not clear to you, and to think about the material outside of class time: think about answers to informal questions that I pose; think of questions that I might have asked but didn’t; talk to your classmates and to me about all of those questions, about the homework, about how all of this fits together.<sup>1</sup>

**Email communications:** When the need arises to contact students individually or as a group, I will do so via the email addresses recorded in the official class list; typically this a “@uh.edu” address, unless the student has changed it to something else. I will send a test message to these addresses during the first week of class, and thereafter will assume that any email I send to these addresses has been received by the student. Thus, you are responsible for the content in emails sent to your UH account, regardless if your external (non-UH) email provider filters or blocks them. Emails lost to external providers shall not be used as a justification to claim faculty are unresponsive, to appeal grades, etc.

**Academic honesty and dishonesty:** You are expected to follow the Academic Honesty Policy in the Student Handbook. In particular, the following are expected in this course.

- You are permitted and encouraged to work collaboratively with your classmates on homework assignments to discover and understand solutions – working together and teaching each other is one of the best ways to fully learn the material. However, the final write-up of the solutions must be in your own words.
- Academic dishonesty on exams includes but is not limited to copying work and using prohibited materials such as notes, calculators, or cell phones. Cheating on tests or exams will result in disciplinary action both in this course and at the department and college levels.

**Special needs:** Whenever possible, and in accordance with 504/ADA guidelines, the University of Houston will attempt to provide reasonable academic accommodations to students who request and require them. Please call the Center for Students with DisAbilities (CSD) at 713-743-5400 for more assistance. Do not hesitate to meet with me to discuss such concerns/needs.

**UH CAPS Statement:** Counseling and Psychological Services (CAPS) can help students who are having difficulties managing stress, adjusting to the demands of a professional program, or feeling sad and hopeless. You can reach CAPS ([www.uh.edu/caps](http://www.uh.edu/caps)) by calling 713-743-5454 during and after business hours for routine appointments or if you or someone you know is in crisis. No appointment is necessary for the “Let’s Talk” program, a drop-in consultation service at convenient locations and hours around campus. [http://www.uh.edu/caps/outreach/lets\\_talk.html](http://www.uh.edu/caps/outreach/lets_talk.html)

---

<sup>1</sup>Of course I expect any written solution on an assignment or exam to be in your own words, and no one else’s.