AMATH 575 A Sp 17: Dynamical Systems

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Instructor: Hannah Choi, hannahch at uw dot edu

Office hours: M 5:00-6:00, W 5:00-6:00 (Lewis 220 or Skype for online students)

Teaching Assistant: Felix Ye, yexf308 at uw dot edu

Office hours: F 12:00-1:30PM (on Campus and online students) LEW 129, 1:30-2:00PM (online students only)

Skype ID for online office hours (strictly for online students): THEAMATHTA

Email policy: We will not answer questions about problem sets via email. Please use the discussion board (do not post answers) and office hours. For other course related questions, *please add the header [AMATH 575] in your email title.*

We Meet: MW 3:30-4:45 in LOW216

- Note: The time schedule lists MWF. We will occasionally use Friday lectures to make up for other lectures missed.

Lectures are available for online students at:

https://mediasite6.pce.uw.edu/Mediasite/Catalog/catalogs/17amath575ds (https://mediasite6.pce.uw.edu/Mediasite/Catalog/catalogs/17amath575ds)

Please check our guidelines for **Using Mediasite**. We also recommend that you **test your device (https://support.sonicfoundry.com/Training/ViewingRequirements)** .

Links to each lecture will appear in the catalog two hours before the live broadcast begins.

Most of our Mediasite recordings are available to download shortly after the live stream has ended. Check out our advice on **Downloading Content** for more details.

If you need help accessing course recordings, please **complete the form at this link (http://uwodashboard.pce.uw.edu/help.asp)** ; Choose “Mediasite / MediaAMP video”, from the drop-down list for, “What do you need help with?”.

Prerequisites: Amath 568, 502 or Instructor Permission

Course Description: Overview of ways in which complex dynamics arise in nonlinear dynamical systems. Topics include bifurcation theory, universality, Poincare maps, routes to chaos, horseshoe maps, Hamiltonian chaos, fractal dimensions, Lyapunov exponents, and the analysis of time series. Examples from biology, mechanics, and other fields.

Grading

- Homework 60%
- Term Project 40%

Homework policy:

- Homework sets are assigned biweekly.
- Homework is due at the beginning of class on its due date.
- Due Wednesdays, collected in class. Otherwise, submit electronically via Canvas by Wednesday 3:30pm.
- Online students: Please submit homework sets electronically via **Canvas.**
- Late homework is not accepted. Your homework should be neat and readable. The TA is allowed to subtract points (or fractions thereof) for presentation.

Final project:

- Class-related group project
- 2 people per group (occasionally 1 person or 3 people, if needed)
- You will present your project (15 min-presentation + 5 min Q&A).
- We will use last two classes (extended) for presentations.
- You are expected to be present for the presentations of your colleagues.
- EDGE students who cannot be present for the presentations will do a (individual/group) term paper (~10 pages, submit via Canvas) instead of a project presentation.

Textbook

- Steven Wiggins' "Introduction to Applied Nonlinear Dynamical Systems and Chaos" (2nd edition, 2003) (Springer Texts in Applied Mathematics 2)".
- *Note: This is an 800 page volume with much more material than we will be able to cover.*
- The book is also available electronically through the UW library (some restrictions).
- Notes by Bernard Deconinck available **here (https://docs.google.com/fileview?id=0B257UW6wJ3euNzFlMDQ1NGQtYmM4Yi00ZGZlLThlMTAtODEyNGM3YTg2MjJi&hl=en)** .

Tentative Contents

1. Introduction. Terminology. Flows and maps.
2. Equilibrium solutions. Periodic orbits. Poincare maps.
3. Linear Stability. Nonlinear stability definitions.
4. Asymptotic behavior of solutions of dynamical systems. The Poincare-Bendixson theorem.
5. Hamiltonian systems. The KAM theorem.
6. Center manifolds.
7. Normal forms. Bifurcation theory.
8. The Smale Horseshoe. Symbolic dynamics.
9. Stable and unstable manifolds. Homoclinic and Heteroclinic connections.
10. Establishing chaos: Liapunov exponents, fractal dimensions.

Group work and Academic Honesty policy:

You are encouraged to discuss and work in groups to solve problem sets.
You must write up your own solution and your own code. Copy, pasting, and editing will be considered plagiarism. Do not be a cheater, it does not help you learn the material and I will have you do something harder to make up the grade, give you a zero, and/or report you for academic misconduct depending on the situation.

Please read the UW policy **here** **(https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0ahUKEwjRkOKTwobKAhWDMz4KHUc4AJcQFggdMAA&url=https%3A%2F%2Fdepts.washingto** . By staying registered in the class you indicate your acceptance of all its terms. We do not accept late homework or absence without official reasons (medical, etc.) approved by a student dean. If you miss class, please coordinate with colleagues to find out what you missed (do not email the instructor to help you catch up).

Course Summary:

Date	Details	
Wed Apr 12, 2017	**Homework 1** **(https://canvas.uw.edu/courses/1137037/assignments/3692394)**	due by 3:30pm
Wed Apr 26, 2017	**Homework 2** **(https://canvas.uw.edu/courses/1137037/assignments/3717439)**	due by 3:30pm
Wed May 10, 2017	**Homework 3** **(https://canvas.uw.edu/courses/1137037/assignments/3728287)**	due by 3:30pm
Wed May 24, 2017	**Homework 4** **(https://canvas.uw.edu/courses/1137037/assignments/3738831)**	due by 3:30pm
Fri Jun 2, 2017	**Final Project** **(https://canvas.uw.edu/courses/1137037/assignments/3747796)**	due by 11:59pm