Physics 505
Topics in Physics
Chaos and Time-Series Analysis
Fall 1997

Content and Level: This course is an introduction to the exciting new developments in chaos and related topics in nonlinear dynamics, including the detection and quantification of chaos in experimental data. Emphasis will be on the physical concepts rather than mathematical proofs and derivations. The course will be taught at a level that should be accessible to graduate and advanced undergraduate students in all fields of science and engineering.

Prerequisites: Consent of instructor (calculus and some programming experience will be assumed)

Materials Needed:

- **Text:** Chaos and Nonlinear Dynamics: An Introduction for Scientists and Engineers, by Robert C. Hilborn (Oxford University Press, 1994)
- **Computer:** Any type will do, but you will need a compiler (or interpreter) for the machine in the language of your choice and a printer capable of printing graphics.

Lectures: 3:30-5:10 pm, Tuesdays, 1313 Sterling. Prof. Clint Sprott (3285 Chamberlin Hall, 263-4449, sprott@juno.physics.wisc.edu). The lectures supplement but do not substitute for the reading. They will be used mainly to motivate the material and to show demonstrations, computer animations, slides, and videos.

Homework: Homework will consist of weekly programming assignments that are due at the beginning of the lecture the following week. An elaborate writeup is not required, but you should provide evidence that you completed the assignment. In many cases, a screen print may be all that is required. You should fill out the cover sheet and turn it in with each assignment. You may work with others, but be sure the work you turn in is not simply copied from someone else.

Exams: There will be no exams in the course.

Grading: The grading will be based entirely on the homework. You will receive one point for each assignment that you complete, and one point for handing it in on time. With 15 assignments, your total possible score is thus 30. Letter grades will be assigned as follows: A = 26-30, AB = 21-25, B = 16-20, BC = 11-15, C = 6-10, D = 1-5, F = 0

Home Page: Lecture notes and other useful course information can be found on the World Wide Web at http://sprott.physics.wisc.edu/phys505/

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References are to Robert C. Hilborn, *Chaos and Nonlinear Dynamics: An Introduction for Scientists and Engineers* (Oxford University Press, 1994).

Week	Date	Reading	Topic
1	9/2	Chapter 1	Introduction and Overview
2	9/9	Chapter 2	One-Dimensional Maps
3	9/16	Chapter 3	Dynamical Systems Theory
4	9/23	Chapter 4	Chaotic Dissipative Flows
5	9/30	Chapter 5	Iterated Maps
6	10/7	Chapter 6	Strange Attractors
7	10/14	Chapter 7	Stability and Bifurcations
8	10/21	Chapter 8	Hamiltonian Chaos
9	10/28	Chapter 9	Lyapunov Exponents and Entropy
10	11/4	Chapter 9	Nonlinear Prediction and Noise Reduction
11	11/11	Chapter 9	Fractals
12	11/18	Chapter 9	Calculation of Fractal Dimension
13	11/25	Chapter 10	Multifractals
14	12/2	Chapter 11	Non-Attracting Chaotic Sets
15	12/9	Chapter 12	Spatiotemporal Chaos and Complexity