Northern Arizona University
College of Engineering, Forestry, and Natural Sciences
Department of Mathematics and Statistics

MAT 667 (Dynamical Systems)
Syllabus for Spring 2017

Class 7558, MWF 11:30-12:20 in AMB 207

Instructor Information

Instructor: Jim.Swift@NAU.edu AMB 110 523-6878 www.nau.edu/Jim.Swift

Office Hours: MTuWF 10:30-11:20. If these times are inconvenient, you can make an appointment, or drop by my office. Of course, you can send me e-mail any time.

Websites: Go to my home page (www.nau.edu/Jim.Swift) and follow the "Instructor Information" link. That link takes you to the instructor information page, where there is a link to the web site for this class, as well as a link to official U.S. time, http://www.time.gov, that our class will observe.

Course Description

Textbook: Chaos: An introduction to dynamical systems, by Alligood, Sauer, and Yorke. This is available as an eBook through Cline Library, with a link in BbLearn.

Prerequisite: MAT 239 and MAT 431, or consent of instructor.

Content and Course Objectives: The course is about iterated mappings and, to a lesser extent, Ordinary Differential Equations (ODEs). These model time evolution, hence the name "dynamical systems." We will explore deterministic chaos as well as regular (nonchaotic) dynamics. Much of the course is based on examples. The logistic map, the solenoid, and the Smale horseshoe are examples of iterated mappings, also called discrete dynamical systems. The Lorenz equations is a chaotic system of ODEs. The course will emphasize the concepts of structural stability and bifurcation theory.

Student Learning Outcomes: The student will gain an appreciation for the fact that simple systems can have complicated behavior. They will also learn that diverse models have similar behavior that is described by bifurcation theory.

Course Structure: Lecture format. Twice during the semester, students will give 15-20 minute presentations on their projects.

Course Outline:

One-Dimensional Maps: Cobweb diagrams, the logistic map, period three implies chaos, Sharkovskii's Theorem, period doubling and Feigenbaum's constants.

Higher-Dimensional Maps: Linear Maps, The Hénon Map, the Smale Horseshoe, Arnold's cat map, the Solenoid, Liapunov exponents.

Differential Equations: Linear ODEs, Nonlinear ODEs and linearization about fixed points, Gradient systems and Liapunov functions, Hamiltonian Systems, the Lorenz equations, Liapunov exponents for flows.

Assessment of Student Learning Outcomes

The grade for the course will be determined by the following three components:

Homework: (40%) You know by now that it is necessary to practice math to learn it. You are *allowed* and *encouraged* to work together on homework. Some of the homework problems will require computer work. Some of the homework will involve computer work.

Project: (20%) You will do a research project, and make a presentation to the class. This is not a Masters thesis, and it is OK if you are reproducing known results. However, it is not too hard in this relatively young field to find things that have not been done before. The textbook has many suggestions for projects. The projects can be computer-based or not, depending on your inclination.

Exams: (40%) There will be two midterm exams. Together, these will have the same weight as the comprehensive Final Exam, which is scheduled for Wednesday, May 10, from 10:00 to 12:00. No notes or books are allowed at the exams.

Course Policies

University and Departmental Policies: Links to University and Departmental Policies are at the class website.

Amendments: Any changes to this syllabus will be announced in class, and an updated version will be posted at the class website.