Math 454 Ordinary Differential Equations and Stability Theory

Fall 2008 Sect. 1

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Course web page: http://math.arizona.edu/~klin/nonlinear
Office hours: Thu. 9:00-12:00 or by appointment

Prerequisite: MATH 254 or MATH 355 or MATH 250B

Required text: *Nonlinear Dynamics and Chaos* by Steven H. Strogatz

Recommended (fun) reading:
- *Chaos* by James Gleick
- *Newton’s Clock: Chaos in the Solar System* by Ivars Peterson
- *Sync* by Steven H. Strogatz

Course and grade policy. Your grade will be based on homework, quizzes, a midterm exam, and a final exam. The percentages are

- 25% Homework & quizzes
- 30% Midterm
- 45% Final

Homework & quizzes. Homework problems from the text will be assigned and collected on a weekly basis. In-class quizzes, based on the homework, will be given regularly. You are encouraged to work together on homework problems. However, the final write-up must be your own. No collaboration or electronic devices, except for hand-held calculators, are allowed on quizzes and exams.

Attendance. Students are expected to attend every scheduled class, and to be familiar with the University Class Attendance policy as it appears in the General Catalog. It is the student’s responsibility to keep informed of any announcements, syllabus adjustments, or policy changes made during scheduled classes. These will be posted regularly on the course web page (see above).

Academic integrity. Students are responsible to be informed of University policies regarding the Code of Academic Integrity. Students found to be in violation of the Code are subject to sanctions that will be determined by the severity of the infraction. The Code of Academic Integrity will be enforced in all areas of the course, including projects, tests, and homework.

Incomplete grades. The grade of I will be awarded if all of the following conditions are met:

1.
The student has completed all but a small portion of the required work.

The student has scored at least 50% on the work completed.

The student has a valid reason for not completing the course on time.

The student agrees to make up the material in a short period of time.

The student asks for the incomplete before grades are due, 48 hours after the final exam.

For general information on grades and the grading system, see the University Policy.

_Students who require reasonable accommodations based on disability._ Students planning to use accommodations for this course should privately identify themselves to their instructor within the first few days of class. These students must also provide the instructor with a letter of identification from the Disability Resource Center. This letter should include information about any accommodation that will be needed for the class, including accommodations for test taking. Students are also invited to discuss specific issues with the course instructor during regular office hours or by appointment.

**Important dates.**

- Aug. 29: _Last day to add this course on WebReg_
- Sept. 19: _Last day to drop course resulting in deletion of course enrollment from record_
- Oct. 17: _Last day to drop course with a grade of W (instructor’s signature on a Change of Schedule form is required). After this date, a dean’s approval is required for any schedule changes._
- Oct. 9: _Midterm exam._ Note that this coincides with Yom Kippur. Please let me know if you will need to take a make-up exam.
Syllabus (tentative)

Week 1: 8/26, 8/28  Review of ODEs. Flows on the line: fixed points & their stability.
     Sects. 2.1, 2.2, 2.4

Week 2: 9/2, 9/4  Existence, uniqueness, and consequences. Introduce saddle-node bifurcations.
     Sects. 2.5, 2.6; 3.1

     Sects. 3.2, 3.3; 3.4, 3.5

Week 4: 9/16, 9/18  More on bifurcations; catastrophes.
     Sects. 3.5, 3.6

     Sects. 4.1, 4.2, 4.3; 5.2

     Sects. 6.1, 6.3, 6.4; 6.5, 6.6; 6.7

Week 7: 10/7, 10/9  Index theory. MIDTERM on 10/9 (note Yom-Kippur)
     Sects. 6.7

Week 8: 10/14, 10/16  Limit cycles, Poincaré-Bendixon Theorem. Relaxation oscillations.
     Sects. 7.1, 7.2, 7.3; 7.4, 7.5

Week 9: 10/21, 10/23  Weakly-nonlinear oscillators and perturbation theory.
     Sects. 7.6; 8.1

Week 10: 10/28, 10/30  Bifurcations in two dimensions. Introducing Hopf bifurcation.
     Sects. 8.1; 8.2

     Sects. 8.3, 8.4, 8.5

Week 12: 11/11, 11/13  Poincaré maps. Introduction to chaos; Lorenz equations; strange attractors.
     Sects. 8.7; 9.2, 9.3
Week 13: 11/18, 11/20  | Lorenz parameter space; chaotic scrambling.
                        | *Sects. 9.5; 9.6*

                        | *Sects. 10.1, 10.2*

Week 15: 12/2, 12/4    | Bifurcations of the logistic map, periodic windows. Lyapunov exponents.
                        | *Sects. 10.3; 10.5*

Week 16: 12/9          | TBA