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

MAT 665 (Differential Equations) Syllabus

Fall 2019, Section 1 (Class Number 5130)
3 Credit Hours, TuTh 9:35-10:50 in Adel Math Building 207

Instructor Information

Instructor: Jim Swift Adel Math Bldg. 110 523-6878 `Jim.Swift@NAU.edu`

Office Hours: MWF 10:30-12:30. If these times are inconvenient, you can make an appointment, or drop by my office any time.

Class website: `https://oak.ucc.nau.edu/jws8/classes/665.2019.7/`

Course Description

Text: *Differential Equations and Dynamical Systems*, by Lawrence Perko (Third Edition).

Prerequisite: A grade of C or better in MAT 239 (Differential Equations), and MAT 431(Real Analysis), or the equivalent.

Content/Outline: This course is about exact solutions to linear Ordinary Differential Equations (ODEs) and the qualitative theory of nonlinear ODEs. Although an undergraduate course gives a "bag of tricks" for finding analytic solutions, there is usually no closed-form solution of nonlinear ODEs. Chapter 1 covers linear systems of ODEs, and then we use this to get local information near an equilibrium point in Chapter 2. Then we will do selected topics from Chapters 3 and 4, which are about global features of solutions to ODEs.

Student Learning Outcomes: Students will learn how to solve systems of linear first order differential equations of the form $\frac{d\mathbf{x}}{dt} = A\mathbf{x}$, where A is a constant matrix. This involves quite a bit of "applied linear algebra." Non-constant matrices $A(t)$ make the ODE tricky, and the student will get some experience with these. The student will learn many qualitative techniques for analyzing solutions to nonlinear ODEs of the form $\frac{d\mathbf{x}}{dt} = \mathbf{f}(\mathbf{x})$. In particular, the student will learn to linearize about equilibrium points $\mathbf{x}^*$, which satisfy $\mathbf{f}(\mathbf{x}^*) = 0$. The student will learn qualitative techniques to study periodic solutions of ODEs, which satisfy $\mathbf{x}(t+T) = \mathbf{x}(t)$ for all t and some positive constant T. The student will learn a bit about bifurcation theory, which concerns differential equations $\frac{d\mathbf{x}}{dt} = \mathbf{f}(\mathbf{x}, \lambda)$ depending on the parameter λ.

Course Structure The class will use lecture-discussion format.

Assessment of Student Learning Outcomes

Homework: (40% of the final grade) You know by now that it is necessary to practice math to learn it. You are *allowed* and *encouraged* to work together on homework.

Midterm: (20% of the final grade) There will be 1 in-class midterm.

Final Exam: (40% of the final grade) The Final Exam is scheduled for Tuesday, December 10 from 7:30 to 9:30 (a.m.!).

Course Policies

Calculators and Computers: Most of the work in this class does not require calculators. There will be some use of computers, but no programming will be required. For example, some problems will require you to modify a Mathematica notebook that I will supply to you.

Late Homework: I will handle requests on a case-by-case basis, but please contact me before the due date.

Missed Class Days: It is important and required that you come to class every day. I will give excused absences for institutional excuses, illness, or other reasons that I approve. Please notify me of an absence by e-mail or voice mail *before* class if possible. Furthermore, if you are late and I take roll before you arrive, then you will be counted absent.

Makeup Exams: A similar policy to "Missed Class Days" holds. I will give a makeup exam for illness or other emergencies. Please notify me that you will miss an exam by e-mail or voice mail *before* the exam if possible. I may give an exam the day before Thanksgiving; if so you may take the exam early on the Tuesday before Thanksgiving.

Academic Honesty: Do not look at other people's exams during in-class tests. You may not use cell phones or other electronic communication devices during the exams. Groundrules for take-home exams will be clearly explained. You may seek help from me and other students for the homework, but please do your own work.

Department and University Policies: Our class web site has links to the Departmental and University Policies at
https://oak.ucc.nau.edu/jws8/classes/MathDepartmentPolicies.pdf and
https://nau.edu/university-policy-library/

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