MATHEMATICS 2280-2
Introduction to Differential Equations
SYLLABUS
Spring semester 2001

text: *Differential Equations and Boundary Value Problems, Computing and Modeling.* second edition
by C.Henry Edwards and David E. Penney

when: MTWF 12:55-1:45

where: JTB 320

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office hours: M 2-2:50 p.m., T 10:00-11:50 a.m., W 2-2:50 p.m., Th TBA.

course home page: www.math.utah.edu/ ~korevaar/2280spring01.html

prerequisites: Math 2270, and either of 1260 or 2210 (multivariable Calculus).

course outline: This course is an introduction to ordinary and partial differential equations, and how they are used to model problems arising in engineering and science. It is the second semester of the year long sequence 2270-2280, which is an in-depth introduction to linear mathematics. The linear algebra which you learned in Math 2270 will provide a surprising amount of the framework for our discussions in Math 2280, although this will not be apparent at first.

The semester begins with first order differential equations: their origins, geometric meaning (slope fields), analytic and numerical solutions, in Chapters 1-2. The logistic equation and various velocity and acceleration models are studied closely. The next topic area, in Chapter 3, is linear DE's of higher order, with the principal application being mechanical vibrations (friction, forced oscillations, resonance).

At this point in the course we show how models of more complicated dynamical systems lead to first and second order *systems* of differential equations (Chapter 4), and study Euler's method for numerical solutions to help understand existence and uniqueness of solutions. We use eigenvalues and eigenvectors, matrix exponentials and general vector space theory, to explicitly solve these problems in Chapter 5. The concepts of phase plane, stability, periodic orbits and dynamical-system chaos are introduced with various ecological and mechanical models, in Chapter 6. The study of ordinary differential equations concludes with an introduction to the Laplace transform, in Chapter 7.

The final portion of Math 2280 is an introduction to the classical partial differential equations: the heat, wave and Laplace equations, and to the use of Fourier series and separation of variable ideas to solve these equations in special cases. This material is covered in Chapter 9 of the text. Time permitting, we may also introduce the Fourier transform.

coursework: Naturally, you will benefit by attending class regularly and by reading the text.

Homework assigned from the book will be collected each week, on Fridays, and a large proportion of the problems will be graded. You will know which problems will be collected on Friday by Tuesday of the same week, at the latest. We will arrange a *problem session* time on Thursdays, for those of you who would like to have a place to discuss the homework together and/or with me. Of course I am also available during office hours, or if necessary by appointment. You should also be aware of the *Math tutoring center* in Mines 210, see www.math.utah.edu/ugrad/tutoring.html for more information.

In addition to standard homework we will do a number (5-7) of *projects*, using Maple extensively. The projects will be posted on our web page and you will have at least a week's warning before each one is to begin. You will generally have between one and two weeks to complete each project. The subject of differential equations is driven by its applications, and we will have many interesting possibilities to choose our projects from, including logistic population models, The Tacoma Narrows bridge revisited, numerical methods of solving differential equations, earthquake shaken buildings, chaos in dynamical systems, fourier series, partial differential equation solutions. Our Math department has a strong research group working on numerical simulation of the human heart muscle, and certain aspects of the muscle excitation process can be explained using Chapter 6 techniques. I hope to convince some of our experts to help develop a lecture/project module related to this material, for our class.

There will be two in-class midterms (closed book, scientific calculator only), as well as a final exam with the same constraints The dates are as follows:

exam 1: Wednesday February 14. Probable course material is chapters 1-4.
exam 2: Wednesday April 4. Probable course material is chapters 5-7.
Final Exam: Wednesday May 2, 11:30 a.m. -1:30 p.m. in class. The exam will cover the entire course. This is the University-scheduled time.

grading: Each midterm will count for 20% of your grade, the book homework and the projects will count for a total of 30%, and the final exam will make up the remaining 30% of your grade. The value of carefully working the homework problems and projects is that mathematics (like anything) must be practiced and experienced to really be learned.

It is the Math Department policy, and mine as well, to grant any withdrawl request until the University deadline of Friday March 2.

ADA statement: The American with Disabilities Act requires that reasonable accomodations be provided for students with physical, sensory, cognitive, systemic, learning, and psychiatric disabilities. Please contact me at the beginning of the semester to discuss any such accommodations for the course.