Mathematics 2250
Differential Equations and Linear Algebra
Course Description and Instructor Notes

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1 Text:

Differential Equations & Linear Algebra, 2nd edition, C. H. Edwards and D. E. Penney. ISBN: 9780555014134. We have moved to a custom edition of this text which is bound together with the student solution manual for all odd exercises, although students are free to buy (used) copies of the stand-alone text. Additionally, we will use several sections from a different Edwards Penney text, to cover electrical circuits and extra Laplace transform material. Students who buy the new text from the bookstore will receive an access code to download this supplementary material. Students who buy a second hand text may request copies from us.

2 Course description.

Every instructor should be familiar with the Departmental teaching policy, which is posted on-line at `http://www.math.utah.edu/schedule/procedures/`.

Mathematics 2250 is an introduction to differential equations, and how they are used to model problems arising in engineering and science. Linear algebra is used as a tool for solving standard linear equations as well as for understanding the structure of solutions to linear (systems) of differential equations. Computer projects are integrated into the course material. For a more detailed course description, see the following sections of this document. Also, a sample syllabus posted at `http://www.math.utah.edu/~korevaar/coord2250`

3 Changes for the 2008-2009 year.

This fall we are moving to a 4-credit version of Math 2250, from the previous 3-credit version. This articulates us to the number of credit hours used in other Utah schools for Math 2250. Our hope is that this extra credit hour will enable us to cover the core material in more depth, and to cover additional topics such as matrix exponentials, non-linear systems of differential equations and phase-portrait analysis. Topics which will be added this year are indicated with an asterix in the course outline at the end of this document.

There will be optional problem sessions held on Thursdays, which will articulate well to the MTWF classes which collect homework on Fridays. These will be held at the regular class times (7:30-8:20 a.m., 8:35-9:25 a.m., 12:55-1:45 p.m.), and we will also schedule a late afternoon session. Students may attend any of these sessions, not just the ones which meet at the same time as their class. The room locations are posted on the University class schedule page.

There are several natural demonstrations which enhance the course material: Toricelli's law, tuning forks, pendulum, mass-spring, multiple mass-spring systems. Contact the course coordinator for more information on using these demonstrations to enhance and motivate the mathematical modeling to which they relate. We are looking for other demonstration possibilities.

4 Prerequisites.

Mathematics 1210 and 1220, together with Mathematics 2210 or Physics 2210 (or 3210); alternately Mathematics 1250-1260 (or 1270-1280). Thus students are expected to know 1-variable Calculus (1210-1220), including the particular topics of Taylor Series (Chapter 11 of *Calculus*, 7th Edition, by D. Varberg and E.J. Purcell), linear first order and constant coefficient linear second order differential equations (Chapter 18 of Varberg-Purcell). Students are also expected to be familiar with vectors, curves, tangent (velocity), acceleration and force vectors (from Math 2210 or Physics 2210).

5 Computer projects.

By agreement with the College of Engineering, part of the course requirement consists of computer projects. The computer projects assigned in this course will be written in Maple. **There is no class time scheduled specifically for computer projects, but it is not an instructor option to ignore the computer component.**

Grant or I will provide computer project ideas for the fall term, as well as solution documents. If you wish to modify, expand upon, or create alternate ones you may do so! In addition to the course-wide projects below, whenever I teach Math 2250 I expect to assign Maple as part of my section's homework, and to make use of technology or its output in many of my lectures.

The projects for this fall will be written in Maple, but other programs are acceptable, e.g. matlab. Typical projects for the previous 3-credit version of the course are:

1. Project Iab: tutorial, combined with chapter 1-2 material such as line fields, trajectories, in the context of the house temperature model in section 1.5
2. Project II: Linear algebra project (or homework problems in which technology is to be used)
3. Project III: Mechanical oscillations (chapter 5.4-5.6)
4. Project IV: Earthquake induced vibrations of a multistory building (7.4).

It will make sense this year to also consider a project (perhaps using pplane) related to phase-portrait analysis and linearization. We have not yet made final decisions on which precise projects to pursue, and when the exact handout and due dates will be.

Angie Gardiner and/or the course TA's will run some introductory computer classes in the second and third weeks of this term, in which she will get students started on their first project.

We should be able to run these in our classroom lab LCB 115. I will advise you when we have set up these sessions.

6 Grading policy.

Instructors are expected to give at least two in-class midterms as well as a comprehensive in-class final exam. The computer projects are to be graded. In addition, there is to be regularly assigned homework, of which either a large representative sample is graded, or regular quizzes are administered and graded which test classroom and homework material. The department provides instructors with homework graders - contact Angie Gardiner to request such a grader as early as possible.

In addition to the special problem sessions which we will run on Thursdays, free tutoring is available for students from about 8am to 8pm M-Th and 8am to 4pm F. The tutoring center is in the Rushing Student Center, between JWB and LCB. There is more tutoring center information on our web pages, `http://www.math.utah.edu/ugrad/mathcenter.html`.

7 Topics and suggested lecture distribution

Starred sections are new to the 4-credit class. This schedule is ambitious. In the event of unanticipated time pressures, consider using only one lecture for RLC circuits, omitting section 6.3, surveying the last two Laplace transform sections in one lecture, and possibly giving an abbreviated treatment of chapter 9. This fall semester 2008 is in some sense an experiment.

54 lectures + 2 exams + 1 or 2 reviews = 57 (spring) or 58 (fall) standard class meetings

- **First-Order Differential Equations** - 5 lectures
  - 1.1 Mathematical modeling and differential equations
  - 1.2 Integrals as general and particular solutions
  - 1.3 Slope fields and solutions curves
  - 1.4 Separable differential equations
  - 1.5 linear first order differential equations
- **Mathematical Models and Numerical Methods** - 4 lectures
  - 2.1 Population models
  - 2.2 Equilibrium solutions and stability
  - 2.3 Acceleration-velocity Models
  - 2.4 & 2.6 Numerical techniques survey
- **Linear Systems and Matrices** - 7 lectures
  - 3.1 Introduction to linear systems
  - 3.2 Matrices and Gaussian elimination