MAT 563 Ordinary Differential Equations

Instructor

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Course Description

Applied mathematics topics encountered in the physical sciences and engineering disciplines: Fourier series and orthogonal functions; Fourier and Laplace transforms; elementary applications to differential equations and boundary value problems; introduction to complex variables and residue theory.

Course Content

Required Text: *A Second Course in Ordinary Differential Equations: Dynamical Systems and Boundary Value Problems,* R. Herman. This set of notes is found at `http://people.uncw.edu/hermanr/mat463/ODEBook`.

Optional Materials: Additional readings are posted at the course web site. These include references to several on-line lecture notes and applets. The course site is `http://people.uncw.edu/hermanr/mat463`. Also, you may want to look at my site for the first course in differential equations for links to review topics:

`http://people.uncw.edu/hermanr/mat361`.

In this class we will cover a variety of topics in ordinary differential equations. These will include linear systems of differential equations, qualitative behavior and stability of nonlinear systems, chaos, boundary value problems, Green's functions, Fourier series, Sturm-Liouville eigenvalue problems, and possibly perturbation theory.

Course Philosophy

You can think of this as the second half of a course in differential equations, which means that you will probably need to review some basics about solving simple initial value problems.

We will develop techniques for studying differential equations. In the process we will see deep connections between differential equations and other areas of mathematics. In particular, we will see that linear algebra provides much of the background to the theory of linear systems and to solving some boundary value problems.

A study of differential equations would not be complete without reference to the enormous number of applications. We will see applications in physics, chemistry and biology. You will be called upon to explore some of these applications in your homework and in group projects. Hopefully, these explorations will enhance your understanding and appreciation of this field. Of course, this is only the beginning of the study of differential equations. There are many other topics that you can explore once this course is done, such as further investigations of dynamical systems and chaos, partial differential equations, etc.

Finally, in order to fully appreciate solutions of differential equations, we will need to use a variety of software packages and modules to visualize the behavior of these solutions. So, you will be exposed to some elementary programming in Matlab and/or Maple as well as make use of applets over the web.

Student Learning Outcomes

- Demonstrate the differences between initial value and boundary value problems.
- Solve Linear Systems of ordinary differential equations.
- Analyse nonlinear dynamics of systems of differential equations.
- Solve two point boundary value problems.
- Obtain approximate solutions of ODEs using graphical and numerical techniques.
- Use Fourier analysis to solve differential equations.
- Solve differential equations using computer software.
- Construct models of the physical world using ordinary differential equations.
- Demonstrate knowledge of special functions (Legendre, Bessel, etc.).
- Construct and use Green's functions.
- Graduate students will demonstrate a deeper understanding of the theory and application of ODEs.

Group Work

In this course you will occasionally work with other students to complete a task. For many of you group work will be a new experience. In order to make this experience both productive and enjoyable, we offer the following suggestions:

- Start the project as soon as it is assigned. Do not put it off until the last minute. Some of the assignments will take time and working in a group may require more time due to scheduling difficulties.
- Read over the entire assignment, carefully before discussing or completing any part of it.
- Initially, you may have no idea as to how to get started. Don't panic! Discuss the lab with the group and generate some ideas.
- Project work is not always as straightforward as standard homework assignments. You may need to make some assumptions and later justify these assumptions, indicating how they affect your results.
- The final report should be thoughtful, well-written and neatly organized. It should summarize your approach to the problem, present your results and conclusions, and be furnished with full explanations.
- If you have investigated the project as far as possible and still have questions, or there is a need for clarification of some point, then discuss them with your instructor before writing the report.

Course Requirements

Homework: Homework assignments will be collected on a regular basis and you will be told when the work is due. As doing homework is very important for learning the material in this course, it will count as 35% of your grade.

Projects: One of the most important tools in applied mathematics is the use of computer software. In this class you will be exposed to more advanced techniques of using the software we have around campus. This will include Maple, Matlab and some specialized packages. You will have some assignments using this technology and at least one in-depth group project. This work will count 15% of your grade.

Exams and Grades: There will be three exams and a final for this course. These exams will cover the basic material up to the date of the exam. The tentative dates for the exams are below.

Exams	Date
Exam I	Feb 7
Exam II	Feb 28
Exam III	Mar 28
Final Exam	May 7, 8:00 AM

Your final grade will be based on the following distribution

Homework	30%
Project	15%
Exams	30%
Final	20%

and grade scale

90-100	A
80-89.5	B
70-79.5	C
60-69.5	D
0-59.5	F

Plus-minus grading may be used in special cases.

This syllabus is subject to change!

Academic Honor Code: All members of UNCW's community are expected to follow the academic Honor Code. Please read the UNCW Honor Code carefully (as covered in the UNCW Student Handbook). Academic dishonesty in any form will not be tolerated in this class. Please be especially familiar with UNC-W's position on plagiarism as outlined in the UNCW Student Handbook. Plagiarism is a form of academic dishonesty in which you take someone else's ideas and represent them as your own.

Student Disabilities: UNCW Disability Services supplies information about disability law, documentation procedures and accommodations that can be found at `www.uncw.edu/disability`. To obtain accommodations the student should first contact Disability Services and present their documentation to the coordinator for review and verification.

Campus Respect Compact. UNCW has recently instituted a Respect Compact to affirm our commitment to a civil community, characterized by mutual respect. That Compact will soon be affixed to the wall of each classroom and can be accessed at: `https://uncw.edu/about/know-us/respect-compact`.