

Course Outline

Math 503 - Advanced Calculus

Fall 2006

Instructor: Prof. John A. Pelesko

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Course Web Pages: www.math.udel.edu/~pelesko,

Office Hours: MWF 9-10, M 3-4

Software: Maple, Excel, Matlab

Textbooks: *Calculus of Variations* by Gelfand & Fomin, *Nonlinear Dynamics and Chaos* by Strogatz

This is a course in *advanced calculus*. But, what exactly does that mean? Over the last several years, you have taken multiple courses called “Calculus.” For the most part, they have been concerned with the notion of a derivative and the notion of an integral. Almost all other topics were built upon these. In some sense, this course is an extension of that idea. However, there are so many topics that could fit into “advanced calculus” that we must use some discretion in our choice of topics. In this class, we will focus on three broad areas - the calculus of variations, nonlinear dynamics, and advanced integral calculus. You will find that the tools we develop in this course are of broad applicability. You should also be aware that we will rely upon material from many of your prior mathematics courses this semester. If you feel rusty on some topics, a review is in order.

If you choose to take this class and develop your mathematical skills you should be prepared to:

- *Read regularly and critically* - You will have a text for this course, notes that I will prepare, and outside references to consult. In order to master the material it is necessary that you read these materials regularly and critically.
- *Attend Class* - If you choose to take this class, you’ll need to attend. A good portion of the material we cover will not be in your text. Don’t decide to take this class without committing yourself to attending each and every class.
- *Complete Problem Sets* - The heart of this course is the homework problems. It is in doing the homework that you will master the material. There will be 12 homework sets handed out during the

course of the semester. The due date for each homework assignment is firm; no late homework will be accepted. You should write your answers clearly. If I cannot understand an answer, it is wrong.

Tentative Schedule:

Exam dates are firm. Lecture dates and topics will be adjusted as needed.

Week	Key events & topics
Aug 28	Overview, some basic variational problems, function spaces, notion of a functional.
September 4	Euler's equation and examples, brief review of partial derivatives.
September 11	Green's theorem, minimal surfaces.
September 18	Variational derivatives, invariance of Euler's equation.
September 25	Gradient, directional derivative, Lagrange multipliers, Exam #1 on 9/29.
October 2	Isoperimetric problems.
October 9	General variation, second variation, Weierstrass-Edman conditions.
October 16	Variational problems leading the PDE's, direct methods.
October 23	Direct methods, Exam #2 on 10/25.
October 30	Linear systems, phase plane analysis.
November 6	Limit cycles and nonlinear oscillators.
November 13	Introduction to bifurcation theory and stability.
November 20	More bifurcation theory. Exam #3 on 11/22.
November 27	The Lorenz equations and chaos.
December 4	More chaos.

Assessment: Your final grade will depend on each of the components in the course. In particular,

Homework/Problem Sets	40%
In-class exams (3 X 10%)	30%
Final Exam	30%