

MATH 823-010
Spring 1998
MW 2:30-3:45, SMI 220

Topics in Differential and Integral Equations
(Perturbation Methods for Differential Equations)

Web Page: <http://www.math.udel.edu/~edwards/download/m823/s98home.html>
Newsgroup: udel.spring98.math823-010

Instructor: Prof. D. A. Edwards
EWG 511

Office Hours: R 1-2, F 11-12
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Introduction

Welcome to MATH 823! In this course you will be learning not only the mathematical techniques of perturbation and asymptotic analysis, but also how they can be used to simplify the analysis of physical systems. The text for this course is *Multiple Scale and Singular Perturbation Methods*, by Kevorkian and Cole. **The text is required**, since you will be assigned both reading and homework problems from the book. The following book should be on reserve in Morris Library shortly:

J. David Logan, *Applied Mathematics: A Contemporary Approach*

In addition, upon request I will put other books on reserve in the Morris Library that may prove helpful for certain sections.

If you have a problem, question about the material, or interesting application you would like me to address in class, please feel free to contact me during my office hours or make an appointment. **Extra copies of handouts are available outside EWG 511.**

Electronic Communication

The Web page for this course is listed above. There you will find copies of handouts available for downloading, as well as any important announcements (corrections to typographical errors, etc.). Also at the URL

<http://www.math.udel.edu/~edwards/download/suggest.html>

you will find an anonymous suggestion box.

Announcements will also be posted to the newsgroup for the course, which is listed above. The newsgroup gives you a chance to collaborate electronically, asking questions of your fellow students, etc. If I find a question being repeatedly asked, I will try to address it in the next class session. Though the group is unmoderated, I will be checking to make sure that answers to homework assignments and other types of inappropriate material aren't being posted. No anonymous posting is allowed. For more information on how to use electronic resources, contact the Help Center (x6000).

Exams

There will be a midterm and final exam for the course; the dates are listed on the attached schedule. You may take the exams home and you will have approximately a day to do them.

Attached to each examination will be a course evaluation form so that I may receive your suggestions for how the course could be improved. These forms will be seen only by me, so if you have comments that you wish the department to hear, please contact them directly.

Writing Assignment

As each of you proceeds in your career, you will encounter situations where you will have to communicate your ideas to others. Those in academia have to submit theses and research articles; those in industry must make presentations and write reports. In order to prepare you for this sometimes daunting task, I am giving a writing assignment. In it, you will choose a phenomenon which interests you, create a simple model to describe it, and then solve the equations governing the model using the techniques you have learned in this class. The focus of the assignment will be the clarity of the expression contained therein, rather than the mathematical sophistication of the arguments. Further details will follow.

Homework

The most effective way to succeed in this course is to do all the homework assignments. I select the problems carefully to illustrate the most important topics in the course. Even if you are registered as a listener, I recommend doing the homework, and I will review it.

In most cases, homework will be distributed every Monday during lecture and it will be due the following Monday. (The first homework assignment is attached to this sheet.) **ABSOLUTELY NO LATE HOMEWORK WILL BE ACCEPTED!** If you must miss a due date because of University business, it is your responsibility to make sure the homework gets to me *before* the due date. Since mathematics is a subject where the material for one section builds on the section before, it is critical that you keep up to date on the homework: hence the stringent policy. However, to calculate your semester-long homework average, I will drop your two lowest homework scores. Therefore, low scores for assignments where you were pressed for time can be erased as long as you don't have too many of them.

Though you may not copy directly from another's paper or use someone else's ideas as your own, I encourage you to discuss the homework problems with your classmates. Any scientific endeavor is rarely done in a vacuum; therefore it is to your advantage to learn the benefits of collaborating. Model homework solutions will be placed on reserve in Morris Library after the assignment is due. Hopefully these will assist you in learning the material.

Homework assignments should be folded like a book with the following information on the "front cover:"

Name
MATH 823—Edwards
Assignment Number
Date

You will turn in your assignments this way so that I can put your grade on the inside, thus ensuring your privacy. I will make every effort to ensure that your graded homework is returned in a timely manner. The number of points assigned to each problem will be listed.

Assessment

Your grade for the course will be determined in two stages. First your *raw score* will be calculated. Your exams will count for 80% of your grade, and the writing assignment will count for 20%. However, if including your homework grades will improve your score, I will let them count for 20% of your grade. Then each of the raw scores will be scaled to determine final grades, if necessary.

Tentative Schedule

Note: This is only a tentative schedule; there may be deviations from it. (In particular, topics near the end of the schedule may be dropped if the other topics take more than the allotted time.)

February 11: dimensional analysis

February 11: Homework 1 distributed

week of February 16: scaling arguments, asymptotic series, integration by parts

week of February 23: regular and singular perturbation methods for algebraic equations

February 23: Homework 1 due; Homework 2 distributed

week of March 2: regular and singular perturbation methods for linear ordinary differential equations

March 2: Homework 2 due; Homework 3 distributed

March 4: Topic for writing assignment due

week of March 9: singular perturbation methods for nonlinear ordinary differential equations

March 9: Homework 3 due; Homework 4 distributed

week of March 16: nonlinear oscillations and two-timing

March 16: Homework 4 due; Homework 5 distributed

week of March 23: the multiple-scaling procedure, the WKB method

March 23: Homework 5 due; Homework 6 distributed

March 25: Midterm exam

week of March 30: the WKB method, Laplace's method

April 1: Outline of writing assignment due

week of April 13: Laplace's method, stationary phase

April 13: Homework 6 due; Homework 7 distributed

week of April 20: stationary phase, steepest descent

April 20: Homework 7 due; Homework 8 distributed

week of April 27: steepest descent

April 27: Homework 8 due; Homework 9 distributed

week of May 4: singular perturbation methods for linear partial differential equations

May 6: Writing assignment due

week of May 11: singular perturbation methods for nonlinear partial differential equations

May 11: Homework 9 due; Homework 10 distributed

May 18: course review

May 18: Homework 10 due

May 20: No course meeting, final exam available (pick up outside my office along with graded homework; exam is due by 5 pm on May 21)

May 22, 1-3 pm: Discussion of papers