MATH/MAPL473 Methods and Models in Applied Mathematics II
TuTh 2-3:15, MTH 0106 Spring 1996
Prof. D. A. Edwards Office Hours: W 2-3, F 10-11 or by appointment
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Introduction

Welcome to MATH/MAPL 473! In this course you will be learning how to model all sorts of physical phenomena in order to obtain reasonable mathematical equations to describe the relevant dynamics. We will also be learning various simplification techniques that will make the often complicated models analytically tractable.

The text for this course is *Mathematics Applied to Deterministic Problems in the Natural Sciences*, by C. C. Lin and L. A. Segel. **The text is required**, since you will be assigned both reading and homework problems from the book. Due to circumstances beyond my control, as of January 26 neither the Book Center nor the Book Exchange had copies in stock. However, they do think that copies will be available by February 2. I have placed a copy of the text on reserve in the Engineering and Physical Sciences Library. Not having the book for a few days will not be much of a problem, since I will not be following the text closely; it is to be used mostly as a reference work where you can find discussion of the topics I will be presenting in class. In addition, upon request I will put other books on reserve in the Engineering and Physical Sciences 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 MTH 4305.**

Exams

The number of exams in the course will depend on the number of topics covered. Though there will be at least one exam during the semester, I will try to give exams at natural breaks in the course; for instance, when we have concluded our study of a particular topic. You will receive at least two weeks'notice for each exam. In addition, there will be a final exam at the end of the course. If you need to make special arrangements through the Disabled Support Service, please let me know as soon as possible. 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 assigning a mandatory 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. 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.

Assessment

Your grade for the course will be determined in two stages. First your *raw score* will be calculated. Your exams will count for 90% of your grade, and the writing assignment will count for 10%. However, if including your homework grades will improve your score, I will let them count for 20% of your grade. Therefore, doing the homework *can only help* your grade. Then each of the raw scores will be scaled to determine final grades, if necessary.

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 auditing the course, I would recommend doing the homework, and I will grade it. At the present time the policy regarding homework scores and grades is lenient. If I feel that people are taking advantage of the leniency, the homework will become mandatory.

In most cases, homework will be distributed every Thursday during lecture and it will be due the following Thursday. **ABSOLUTELY NO LATE HOMEWORK WILLBE 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. In addition, some homework assignments may be directly indicated as group assignments. Model homework solutions will be placed on reserve in the Engineering and Physical Sciences 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/MAPL473—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.

Tentative Schedule

week of January 29: dimensional arguments, introduction to modeling
January 30: Homework 1 distributed
February 1: Homework 1 due; Homework 2 distributed
week of February 5: regular and singular perturbation methods for algebraic and linear ordinary differential equations
February 8: Homework 2 due; Homework 3 distributed
week of February 12: stochastic processes and the derivation of the diffusion equation
February 15: Homework 3 due; Homework 4 distributed
week of February 19: singular perturbation methods for nonlinear ordinary differential equations
February 22: Homework 4 due; Homework 5 distributed
week of February 26: nonlinear oscillations and two-timing
February 27: Topic for writing assignment due
February 29: Homework 5 due; Homework 6 distributed
March 5: Exam I (covers the diffusion equation and perturbation methods for boundary-value problems)
March 7: the multiple-scaling procedure
week of March 11: mathematical biology
March 14: Homework 6 due; Homework 7 distributed
March 18-22: Spring Break
week of March 25: mathematical biology; the WKB method
March 26: Outline of writing assignment due
March 28: Homework 7 due; Homework 8 distributed
week of April 1: quantum mechanics
April 4: Homework 8 due; Homework 9 distributed
week of April 8: conservation of mass and momentum
April 9: Exam II distributed (due by 5 pm on April 10; covers the multiple-scale expansion procedure and mathematical biology)
week of April 15: incompressibility, unidirectional flows
April 18: Homework 9 due; Homework 10 distributed
week of April 22: thin films and nearly inviscid flows
April 25: Homework 10 due; Homework 11 distributed
week of April 29: nearly inviscid flows and dimensional analysis
April 30: Writing assignment due
May 2: Homework 11 due; Homework 12 distributed
week of May 6: bifurcation and risk theory
May 9: Homework 12 due
May 13: Final exam available (pick up outside my office along with graded homework 12; exam is due by 2 pm on May 15)
May 16, 10:30 am-12:30 pm: Discussion of papers, MTH 2400