

NEEP 602
Engineering Problem Solving II

University of Wisconsin - Madison

Spring 2005

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<http://courses.engr.wisc.edu/ecow/get/need/602/hoerr/>

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Meeting Times: TR 9:30-10:45, 2261 Engineering Hall

Final (Project): 12:25 PM Wednesday May 11 – Project Due

Office Hours: 1:00-2:30pm, TR

Course Description: We will focus on using computers to solve ordinary and partial differential equations that appear in typical engineering problems. Historically this has been done using procedural programming languages (usually FORTRAN, but also Pascal, C, and C++). We'll use engineering applications, which are easier to use and thus more efficient, particularly with respect to development time, and less prone to error. The primary drawback to these applications is speed, but they should be sufficient for most of what you do here, and much of what you might require at work. Equations to be solved include systems of ordinary differential equations, both as initial and boundary value problems, elliptic and parabolic partial differential equations, and eigenvalue problems. We'll also spend some time getting acquainted with "Monte Carlo" methods that can be used to solve engineering problems and model various systems or processes involving random factors.

Prerequisites: Math 319, NEEP 271 or CS 310 or consent of instructor

Computers: We will work extensively with computers in this course, so you should set up your account at CAE as soon as possible.

Course Goals: After completing this course, you should be comfortable with the solving differential equations numerically and applying the solutions to realistic engineering problems.

The Applications: We'll use Microsoft Excel and Matlab on Windows PC's.

Lectures: You will spend a lot of time in class working on problems. Sometimes I will lecture and then we will experiment with the topics we just discussed, while other class sessions will be devoted primarily to working on the homework assignments.

Course requirements:

Textbook: None. I'll hand out notes as we go along

Attendance: Doesn't count in the grades, but you'll fall behind quickly if you skip classes

Examinations: None

Projects: One project, topic of your choice, due scheduled day of Final, 25% of grade

Homeworks: 8 assignments, 75% of grade

Turning in homeworks: All homework files will be e-mailed directly to the grader (emprewett@wisc.edu) with a copy to me. The subject line of your e-mail must include the homework assignment number. All files for all problems in an assignment should be sent together as attachments to one e-mail. **DO NOT SEND MORE THAN ONE E-MAIL PER HOMEWORK SET!**

Every homework problem file should be named as follows:

Lastname##.m for Matlab script files, Lastname##.xls for Excel files

where ## is the number of the homework **problem**. (There will be 8 homework sets, with a total of approximately 16 problems.)

In Matlab, you will also need various function m-files; these should be named like so:

Lastname##func#.m

where again ## is the problem number, and # is a number designating which function in the list of functions that you need to define for a particular problem.

For every homework assignment, you must also hand in a printed copy of your script. In the case of Excel spreadsheets that don't use a VBA script, hand in a printout of your spreadsheet showing the array of cells used in your solution. This should be scaled down (usually) to fit on one page per problem. Each hard copy you turn in must include your name, and that of your partner if you are working with someone, the assignment number, the problem number, and the date. The hard copy will be returned to you with your score and any comments or corrections.

For each assignment, you have the option of working alone or completing the assignment with a partner (one only). If you do work with a partner, you must clearly state that you have done so and you must include both your names on your hard copies and in your e-mail with the files. One set of files and one set of hard copies per team is sufficient.

Topics

Ordinary Differential Equations - Initial Value Problems

Ordinary Differential Equations - Boundary Value Problems

Eigenvalue Problems (BVP)

Monte Carlo Techniques

Partial Differential Equations - Parabolic Problems

Partial Differential Equations - Elliptic Problems

Partial Differential Equations - Hyperbolic Problems

Course schedule (subject to change)

Week	Class	Exercise/Topic	HW H/O	HW Due
1/18	1	Ex. 0, Euler's Method in Excel		
	2	Ex. 0, Ex. 1 in Matlab: 1 st order and coupled ODEs		
1/25	3	Ex. 1, Ex. 2: Lorenz equations		
	4	Ex.2 continued, phase plots, loops,parametrics	HW 1	
2/1	5	Ex. 2 continued		
	6	Work on HW 1		HW 1
2/8	7	Ex. 3, Event location		
	8	Ex. 4, Error propagation, stiff ODEs	HW 2	
2/15	9	Debugging in Matlab		
	10	Ex. 5, Runge-Kutta in Excel, HW 2		HW 2
2/22	11	Ex. 5 continued, Excel topics	HW 3	
	12	Excel topics, work on HW 3		
3/1	13	Ex.6, Boundary Value Problems in Excel		HW 3
	14	Ex. 6 continued, Matlab		
3/8	15	Excel and Matlab topics for BVPs	HW 4	
	16	Ex. 7, BVPs with 1 st derivative BCs		
3/15	17	Ex. 8, Eigenvalue problems, work on HW 4		HW 4
	18	Ex. 8 continued		
3/22		Spring Recess		
		Spring Recess		
3/29	19	Eigenvalues, 4 th order ODEs	HW 5	
	20	Misc. topics, work on HW 5		
4/5	21	Ex. 9, Parabolic PDEs		HW 5
	22	Ex. 9 continued		
4/12	23	Work on HW 6	HW 6	
	24	Ex. 10 Elliptic PDEs		
4/19	25	Ex. 11, Plate problems	HW 7	HW 6
	26	Ex. 12, SOR, Hyperbolic PDEs		
4/26	27	Ex. 13, Monte Carlo Method	HW 8	HW 7
	28	Ex. 14, Monte Carlo continued		
5/3	29	Projects, misc.		HW 8
	30	Project work		

Final Project due: 12:25 PM Wednesday May 11