EP 501 – Numerical Methods for Engineers and Scientists
Embry-Riddle University
Fall 2005

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office hours: MWF 10:30 – 11:30 and 2:15 – 3:15 (and by appointment)

Lecture: MWF 3:30 – 4:30
Required text: Numerical Methods for Engineers and Scientists, 2nd edition, Hoffman
Chapters 0, 1, 3, 5, 6, 7, parts of 8-11
Recommended: Numerical Recipes, by Press et al. (available in my office)

Grading:	45%	weekly homework	*Grading scale*:	A	90 – 100 %
	45%	three exams (15% each)		B	75 – 90 %
	10%	"take-home" component of exams		C	60 – 75 %

Homework: Assigned approximately weekly, and due at the beginning of class.
Exams: Three one-hour exams (with a take-home component).

Holidays: Mon, 5 Sep (Labor Day)
Fri, 28 Oct (University Day)
Wed – Fri, 23-25 Nov (Thanksgiving)

Programmer's Lament

I really hate this damn machine,
I wish that they would sell it.
It never does quite what I want,
But only what I tell it.

Course Description: Numerical methods for the solution of engineering physics problems; systems of linear equations, ordinary differential equations including one-dimensional initial value problems and boundary value problems; partial differential equations (PDEs) including elliptic, parabolic and hyperbolic PDEs; finite difference method. Application to problems such as diffusion, transport, remote sensing, inversion, and plasma waves. Emphasis will be on computer implementation of numerical solutions. **Prerequisites**: PS219 (or PS250), ES204, MA442.

Goals: To introduce the student to the tools of numerical methods in the solution of engineering and scientific problems. These will include problems from different application areas that can be modeled by different systems of equations.

Code of Behavior

In order for learning to take place, we all must act with civility (formal politeness) and respect (polite consideration, courtesy) toward each other. My responsibilities include coming to class prepared and on time, and evaluating you in a fair and impartial manner. Your responsibilities include coming to class prepared and on time, not disrupting the class (for example, talking without being called on, eating, reading newspapers, sleeping, shuffling papers, talking on cell phones, etc.), and treating your fellow students as colleagues (see the Student Handbook). Violations of this code can result in your removal from the class.

Academic Integrity

Issues of academic integrity are discussed on page 23 of the Student Handbook. They include plagiarism, cheating and fraud. Please read this section, and if you do not understand it, come see me. Some important passages are reproduced here:

"Sanctions [for academic dishonesty] may include failure of a test or assignment, failure of a course, suspension, or dismissal from the University."

"Plagiarism is recognized by the University as an act of academic dishonesty. It is defined as taking the ideas, writings, work, and/or words of another and representing them as one's own."

Office hours

I am always in my office during my office hours, and this is your time to speak with my about any aspect of the course. Also, I am generally in my office between 9 am and 5 pm, and available at times other than my office hours. However, I may be teaching or doing research, and not available immediately. If you need to speak with me, drop by or call me and set up an appointment.

Attendance

Class attendance is mandatory and I will take attendance. Even though I will readily allow you to miss a class for a legitimate reason, you are still responsible for the material in lectures whether you are present or not.

Homework

Homework will be assigned approximately weekly and due at the beginning of class. Late homework will be graded as follows: credit for your *j*th late homework set will be multiplied by a factor of $(4/5)^{j+k-1}$ if it is handed in *k* days late (i.e., before 5pm on the *k*th day after the due date). The penalty for late homework is modest the first time, but gets exponentially worse if you are habitually (or very) late. NOTE: The first few powers of 4/5 are 0.80, 0.64, 0.51, 0.41, 0.33.

Many of the problems will, in part, consist of writing code to solve the problem. Additional tasks will typically including showing output from that code (both text or graphical). These problem sets are **critical** to your success in this course. You may use any language that you wish. However, I suggest using Matlab, because the University has a site license, it is available on all machines, and it has sophisticated graphing capabilities (which you will need to present the results of your programs). Include a printout of your code at the end of your solution to each problem.

Many assigned problems will be analytical in nature, or there will be an analytical component. You must solve all problems according to the following rules of coherence and readability (some of these rules will not apply to this course, but since they are the way ALL physics problems should be solved, I repeat them for completeness):

- Describe briefly, but in clear and complete sentences, the basic principles used to solve the problem and explain the basic equations and/or algorithms that are used in the solution. This is the most important component of coherence.
- If a physical situation is discussed in the problem, draw an appropriate diagram.
- Identify in words, or by clear references to the diagram, all the symbols you use.
- Work through the problem symbolically, getting a simplified symbolic answer, and only substitute numbers (if appropriate at all) at the very end.
- Show explicitly that your symbolic answer has the correct units.
- If possible, check your symbolic answer by looking at limits in which the answer is obvious.
- If you obtain an explicit numerical solution, comment on whether the value you get is reasonable.
- Put boxes around your final answers.
- Write up the problem sets **neatly**.

I recommend that you form study groups and work together. While this does not mean that you can copy code from one another, it can help you through difficult sections. The "extra credit" problems are due 4 weeks after the original homework set. The latest possible date will be Wed, Dec 7.

Homework hints

When the word "code" is in the title of the problem, it means that a program is part of the required work, but not all. You still must explain what you are doing, and include the code as part of your answer (at the end of the problem).

Similarly, when I say to "plot" a quantity, that is not the only output from the code that might be useful. Actual numerical output is often necessary to understand what is going on. For example, don't just tell me that the iteration breaks down when n=40, but show me what "breaks down" means by including numerical output.

Include words to state what you are going to do (see the description of coherence and readability above). Simply a sequence of equations does not show any understanding other than mathematical. I'm looking for explanations that show you understand how the algorithm works, and why.

Finally, be neat. It is sometimes difficult to read a student's writing and therefore to follow their reasoning. Put the entire answer (including the code printout) to a single problem together, and then start the next problem on a new page.

Exams

Three one-hour in-class exams will be given. All exams are closed book and closed notes, however, there will be a take-home component for each exam. Calculators are required.

Grading System

From page 32 of the Graduate Catalog: "The following indicators are used on grade reports and transcripts." (*I have added my own interpretations in italics – including the percentage score to attain this level.*)

A = Excellent (*Performance of the student has been of the highest level, showing sustained excellence in meeting course responsibilities – 90%*)
B = Satisfactory (*Performance of the student has been adequate, satisfactorily meeting the course requirements – 75%*)
C = Passing (*Performance of the student has been less than adequate – 60%*)
F = Failure (*Performance of the student has been such that course requirements have not been met.*)

NOTE: If you do not maintain a 3.0 cumulative GPA, you will be placed on academic warning. In addition, earning two F's or three C's will result in your dismissal. Do not fall behind.

Tentative Schedule		
Week	**Topics**	**Chapters in Hoffman**
1-2	Basics and simple routines	0
3-4	Root-finding	3
5-7	Differentiation and integration	5, 6
8-9	Solving ODEs	7, 8
10-11	Linear (matrix) algebra	1
12-13	Solving PDEs	9-11

Exam schedule (tentative)	
Exam	**Date**
1	Monday, Sep 26
2	Monday, Oct 24
3	Monday, Dec 5