16. Please attach a topical outline of the course

CEE 6314
Fundamentals of Environmental Modeling and Mathematics
Fall 2006 Syllabus

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Class Time: MWF, 9:05-9:55
Class Location: SEB 110
Office Hours: 3:05-4:25 Fridays

Objective. In order to understand complex environmental systems, mathematically models of the system are often employed. A first step is in developing a mathematical description, followed by its solution, either analytically or numerically. This course is intended to provide the fundamentals of such endeavors. Both approaches, analytical and numerical, are covered, as is how one might set up the systems of equations, some common mistakes and general insights that can be gained from developing a mathematical description of environmental systems. The thrust here is to look at a number of environmental systems, and identify how one might attack understanding such systems using mathematical and computational tools.

Textbook: Ramaswami, Milford and Small (2005) "Integrated Environmental Modeling: Pollutant Transport, Fate and Risk in the Environment" Wiley Interscience. ISBN#0-471-35953-X

Other useful texts include: Schnoor: Environmental Modeling, Wiley Interscience, O'Neil: "Advanced Engineering Mathematics"; Weber, "Environmental Systems and Processes: Principles, Modeling and Design"; Hildebrand, F "Advanced Calculus for Applications", Burden and Faires "Numerical Analysis", Chapra and Canale, "Numerical Methods".

Grading:		
	Exam 1:	25%
	Final:	35%
	Homework:	20%
	Project	10%
	Class participation	10%

Web site: I plan to use the course website, http:\\Courses.ce.gatech.edu\course pages\200508\CEE8813A, extensively. There, you will be able to find the syllabus, "hand outs" (virtual and otherwise), homework, presentation material and other interesting information. You should also receive e-mail from me via the associated class list.

Homework: A few notes on the homework. First**: <u>IT MUST BE NEAT AND RELATIVELY EASILY UNDERSTOOD</u>**. (You should take the use of all caps, bold and underlined as meaning that this is an important point and your grade in this class might be influenced adversely if you dismiss it.) Imagine that you are working in a consulting firm, and your homework is the final report to your client. If the client does not like what he gets for paying your company a few hundred dollars for each hour of your time, he will not use your firm again. You will be fired. This is bad news. The grader for this course and we will treat your homework as a final report to the client. It is my plan to hand out homework on Monday, and collect it on the following Wednesday, although this may not always be the case. If, for some reason, you can not hand in the homework on time, beforehand send me e-mail explaining why, and we can explore what can be done. Note, again the client does not want to be given some lame excuse as to why his project is not done as promised, and saying that another client needed his report will not hack it. You see, clients tend to think that their money is just as green as others. There will be approximately 10 homework assignments per term, plus the project.

As far as the class goes, I welcome questions whenever, and if the exposition is not clear (including the writing on the board), feel free to ask for clarification. Also, I am quite willing to address side topics in environmental engineering.

This class is being taught both to video students as well as a live class. Keep this in mind when asking questions, that is, speak clearly and realize that you may not be picked up clearly on camera. Video students: feel free to ship in questions for discussion in class.

Homework policy, academic integrity, honor code: GIT has, and I follow, an honor code. In this class, you may work together on homework. I expect any member of the class to be able to replicate, by themselves, the homework they turn in as their own. You are not allowed to plagiarize. You are not allowed to work together, or copy someone else's work, on any in-class or take-home test. Doing so will result in an F. Also, each individual is to have read and follow the Institute Honor Code: www.honor.gatech.edu. In regards to plagiarism, which will not be tolerated, note the following definition:

Plagiarizing is defined by Webster's as "to steal and pass off (the ideas or words of another) as one's own : use (another's production) without crediting the source."

Tests: One midterm and one final are planned.

Project: A small fraction of your grade is based on a term project. For those not taking the class by video, you should group together in small teams, and pick a topic that will require both mathematical and numerical analysis. Video students likely will want to do the project alone. Each team member/individual should spend 5-6 hours on the project over the term. A final report (typed) is due on the last day of class.

CEE 6314 – Fundamentals of Environmental Modeling and Mathematics:

Fall 2006 (approximate) Schedule

- Introduction
    - Why do environmental engineers need to be familiar with mathematical methods?
    - Understand how to address complex environmental systems
    - Developing and solving mathematical models
    - A formalism for communication
    - What types of methods and systems will be addressed
- Some bits of math that will be useful to us
    - Differentiation
    - Taylor series expansion
    - Integration
- Simple chemically reacting systems
    - Derivation of conservation of species equation
    - Ordinary differential equations
        - First order differential equations.
    - Simple numerical methods
    - Numerical approximations for derivatives
    - Newton-Raphson iteration
    - Numerical integration
- Intermedia Contaminant Transfer
    - Equilibrium Analysis
        - Systems of equations
    - Dynamic analysis
- Two-dimensional (including time-space) systems
    - Partial differential equations
- Receptor models
    - Systems of linear equations: So many uses its hard to know where to start
    - Introduction: When do we really use linear equations
    - Simultaneous equations
    - Least square fitting and other optimizations
    - Representing systems of equations in matrix/vector/tensor form
    - Vector and matrix methods
    - Tensor notation
- (More advanced) Numerical Methods and Environmental Modeling Methods
    - Solution of partial differential equations: finite (difference, element/volume) approaches
- Probablistic Methods and other topics
    - CDFs, PDFs, covariances and all that jazzy stuff.
    - Spatial interpolation
        - Kriging and tessalation
    - Fast Fourier transforms