MSE 510 Course Syllabus

A. Course Details

MSE 510 Mathematical and Numerical Problem Solving Skills for Materials Scientists and Engineers

Meeting Place: Room 511, Ferris Hall
Meeting Time: Tuesday & Thursday at 3:40-4:55

Instructor: Prof. David Keffer, room 301 Ferris Hall, dkeffer@utk.edu
Teaching Assistant: None

Recommended Reference Text: "Advanced Engineering Mathematics", 10th Edition, Kreyzig, Wiley, 2011.

Course Website: http://utkstair.org/clausius/docs/mse510/index.html

Catalog Description:

- 3 credit hours
- Formulation and solution of problems in materials science, including linear and nonlinear algebraic equations, ordinary and partial differential equations, and integral equations. Emphasize on use of modern computational tools.

B. Course Philosophy:

In the life of a scientist or engineer, we model the behavior of systems with mathematical tools. Invariably, these models reduce to (i) algebraic equations, (ii) ordinary differential equations, (iii) partial differential equations, and (iv) integral equations. For centuries, mathematicians and scientists have developed analytical techniques to solve each of these four types of equations. In more recent decades, mathematicians have coupled with computer scientists to develop numerical techniques to solve each of these four types of equations on the computer. Our philosophical approach in this class is that, using our training as an engineer or scientist, we can derive a mathematical model that describes the system of interest. This model is then composed of a set of equations. Analytical and or numerical tools to evaluate and solve those equations already exist. In this course, we will use a very practical and hands-on approach to solving (i) algebraic equations, (ii) ordinary differential equations, (iii) partial differential equations, and (iv) integral equations using existing numerical techniques. Moreover, we will investigate the origin of the method, with an understanding that none of the techniques are magical and all can be tinkered with to tackle specific problems of interest.

C. Course Objective:

The objective of this course is to be able to obtain solutions to (i) algebraic equations, (ii) ordinary differential equations, (iii) partial differential equations, and (iv) integral equations. In each of the four kinds of equations, we should be able to obtain solutions for linear and non-linear cases, and for single equations and systems of equations. We will study both analytical and numerical techniques. The focus of the analytical studies will be to further our capabilities with the numerical techniques.

The goal of this course is to shift the emphasis in evaluating problems from the numerical solution to the more interesting challenge of model formulation. Thus, the course seeks to empower graduate students with the ability to say, "If I can formulate the model, I can solve the problem." The course is designed to serve both experimentalists who seek to develop a broad understanding of the strengths and weaknesses of these tools as well as modelers who are curious about the nuts and bolts of the underlying algorithms.

D. Grading Policy

D.1. Grade Breakdown

- Exams (1 mid-term and 1 final exam @ 25% each): 50%
- Homeworks (6 assignments, totaling 25%): 25%
- Computer Project and Report (1 project @ 25%): 25%
- Total: 100%

D.2. Course Grades

Course grades will be assigned on the following basis:

90.0 - 100.0	A
85.0 - 89.99	B+
80.0 - 84.99	B
75.0 - 79.99	C+
70.0 - 74.99	C
60.0 - 69.99	D
00.0 - 59.99	F

This course grade basis may (at the instructor's discretion) be shifted uniformly down, should the overall performance of the class require it. This course grade basis will not be shifted up. (That is, if an exam proves to be too hard and the average is low, an 89% may make an A. However, if an exam proves to be too easy and the average is high, a 90% will always make an A.)

D.3. Homework

- Homework assignments are due at the beginning of class.
- Late homework assignments are not accepted.
- Students can work together to solve homework assignments. However, each student must turn in his/her own work in his/her own handwriting. For homework

assignments where computer-generated code or graphs are required, each student must generate their own codes and graphs.
- Instances of plagiarism will be dealt with as stipulated by University guidelines. Please do not force me to have to deal with plagiarism. Remember, you are here to learn.

D.4. Exams

- There are 2 exams, as indicated on the schedule.
- Each exam counts 25% of the course grade.
- Exams cannot be made up unless there is a serious explanation, extreme illness, death in the family, etc.

D.5. Computer Project

- There is one computer project worth 25% of the course grade.
- The computer projects will be done individually and will be assigned at least one month before it is to be collected.
- In each project, students are encouraged to substitute a problem of specific interest to them in place of the default project assigned by the instructor.
- The projects will be performed using the programming platform of your choice. Recommended platforms are FORTRAN, C, and MATLAB. Other platforms and languages are discouraged and will not be supported by the instructor .

E. Getting Help

Although lectures and text are the primary means of instruction in this course, the instructor is here to help you successfully complete this course. When you do not understand something in class or have difficulty with an exam or homework, you are encouraged to seek out the instructor. Extra-effort will be made to meet with students who regularly attend lecture.

E.1. Email

The best way to contact the instructor is via email.

- Questions regarding course content, grading of homeworks, and grading of exams should be sent via email to the Instructor.
- To guarantee that the email is read promptly, make the subject of the email "MSE 510" Emails with the subject "Help Me!" or similar subjects are identified as spam and deleted without being opened.

E.2. Office Hours

- The office hours for this course will be determined.

F. Course Schedule:

The schedule for this course is provided in a separate document located at

http://utkstair.org/clausius/docs/mse510/pdf/schedule.pdf