ChE/MSE 505 Syllabus

A. Course Details

ChE/MSE 505 Advanced Mathematics for Engineers

course website: http://clausius.engr.utk.edu/che505/index.html

Meeting Place: Dougherty Engineering Building
Meeting Time: MWF 8:00-8:50

Instructor: Dr. David Keffer, room 617 Dougherty Hall, dkeffer@utk.edu
Teaching Assistant: None

Required Text: "Advanced Engineering Mathematics", 9th edition, Kreyszig, Erwin, John Wiley & Sons Inc., New York.

Recommended Text: "Numerical Recipes", any edition, any language, Press, William H., Flannery, Brain P., Teukolsky, Saul A., Vetterling, William T., Cambridge University Press, Cambridge, 1986 (1st Edition).

Optional Text: A MATLAB guide, such as "Essential MATLAB for scientists and engineers", Brian D. Hahn, John Wiley & Sons Inc./Arnold, 1997.

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.

D. Grading Policy

D.1. Grade Breakdown

- Exams (1 mid-term and 1 final exam @ 20% each): 40%
- Homeworks (7 assignments): 20%
- Computer Project and Report (2 project @ 20% each): 40%
- Total: 100%

D.2. Homework

- Homework assignments are made each Wednesday and due in two weeks unless a change is announced in class.
- 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.3. Exams

- There are 2 exams, as indicated on the schedule.
- Each exam counts 20% of the course grade.
- Do not miss exams. Make-up Exams are not given. In the event of a serious problem, e.g. extreme illness, death in the family, etc., a substitute will be assigned on a case-by-case basis, totally at the instructor's discretion. A cold is not a satisfactory excuse for missing an exam. The University Student Health Clinic does not write medical excuses for prescribing common cold prescription medicine. Therefore, do not expect a prescription slip to get you anything but a zero on a missed exam.

D.4. Computer Projects

- There are two computer projects are assigned worth 20% each of the course grade.

- The computer projects will be done individually and will be assigned approximately 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. Efforts will only 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 should be sent via email to the Instructor
- To guarantee that the email is read promptly, make the subject of the email "ChE 505"

E.2. Office Hours

- The Instructor holds office hours on Friday afternoon 3:30-5:00 in the instructor's office, 617 Dougherty.

F. Attendance

- Attendance at lectures is mandatory.
- Students are expected to be in their seats at 8:00 AM. The instructor synchronizes his clock to www.time.gov. Students who come late will be repeatedly harassed by the instructor until they arrive in a timely manner.

F. ChE 505 Content

We will cover
(i) algebraic equations,
(ii) ordinary differential equations,
(iii) partial differential equations, and
(iv) integral equations.

In each case, we will study both analytical (when available) and numerical techniques. We will study both single equations and systems of equations. We will examine both linear and

nonlinear problems. The procedure will be methodical. For example, the course content for algebraic equations is given below.

I. Algebraic Equations
- I.A. single equation
  - I.A.1. linear
    - I.A.1.a. analytical solution techniques: trivial
    - I.A.1.b. numerical solution techniques: trivial
  - I.A.2. non-linear
    - I.A.2.a. analytical solution techniques: not covered in this course
    - I.A.2.b. basic numerical solution techniques (review from ChE 301)
    - I.A.2.c. advanced numerical solution techniques
- I.B. systems of equations
  - I.B.1. linear
    - I.B.1.a. analytical solution techniques (review from ChE 301, Part 1: the basics)
    - I.B.1.b. analytical solution techniques (review from ChE 301, Part 2: includes eigenanalysis)
    - I.B.1.c. analytical solution techniques (review from ChE 301, Part 2: includes example applications)
    - I.B.1.d. analytical transformations
    - I.B.1.e. numerical solution techniques (in MATLAB)
  - I.B.2. non-linear
    - I.B.2.a. analytical solution techniques: not covered in this course
    - I.B.2.b. basic numerical solution techniques (review from ChE 301)
    - I.B.2.c. advanced numerical solution techniques

Outlines for ODEs, PDEs and integral equations are analogous and are available on the course website.