

THE UNIVERSITY OF TEXAS AT EL PASO

COLLEGE OF SCIENCE

Department Of Mathematical Sciences

Course #: MATH 5343
Course Title: Numerical Solution of Partial Differential Equations
Credit Hrs: 3
Term: Spring 2010
Course Meetings & Location: MW 15:00 – 16:20, BART 210
Prerequisite Courses: MATH 2326, 3323, 4329 or equivalent, and programming experience
Course Fee (if applicable) None
Instructor: Dr. Son-Young Yi
Office Location: Bell Hall 218
Contact Info: E-mail syi@utep.edu
Phone 747-6864

Office Hours: MW 13:30 – 14:20
Textbook(s), Materials: Computational Partial Differential Equations Using MATLAB by Jichun Li and Yi-Tung Chen

Course Website <http://www.math.utep.edu/faculty/yi/math5343s10.html>

Course Objectives
(Learning Outcomes): The objectives of the class are to understand

1. the mathematical and qualitative properties of three basic types of PDE (elliptic, parabolic and hyperbolic equations).
2. the basic principles of Finite Element Method and Finite Difference Method
3. how to implement and test the numerical schemes in a computer language (MATLAB)
4. how to apply these methods to application problems

Course Activities/Assignments: **Homework:** Homework assignments will be collected approximately every three weeks. Assignments will be posted on the website and announced in class as well. Homework problems will be both theoretical and programming. **No late homework** will be accepted. Computer programming problems must be done in MATLAB. You should turn in a complete printout of the program and of the output along with detailed explanation of solutions.
Course project: In addition to the homework assignments, students will work on a final project on a topic of their own choice, preferably related to their research. A project proposal and a final report should be turned in and each student will present his/her final project during the last week of the semester (week of May 3). Detailed instructions will follow.

Assessment of Course Objectives: Final project presentation is scheduled for the week of May 3 in class.

Tentative Course Schedule:

Week 1 (1/19): Course introduction, Overview of PDEs

Week 2 (1/25 – 1/27):

- Overview of Numerical methods for PDEs,
- Finite Difference Method for two-point boundary value problem:
 - Introduction, maximum principle

Week 3 (2/1 – 2/3):

- Finite Difference Method for two-point boundary value problems:
 - Variable spacing in the grid, discontinuous coefficients, tridiagonal linear algebraic equations, mildly nonlinear problem

Week 4 (2/8 – 2/10):

- Finite Difference Method for 2-D Elliptic Equations
- Finite Difference Method for 1-D Parabolic Equations:
 - Forward, Backward and Crank- Nicolson methods

Week 5 (2/15 – 2/17):

- Finite Difference Method for 1-D Parabolic Equations-continued
- Finite Difference Method for 2-D, 3-D Parabolic Equations:
 - ADI methods

Week 6 (2/22 – 2/24):

- Finite Difference Methods for the 1st order Hyperbolic Equations:
 - The upwind scheme, the Friedrichs scheme, and the Lax-Wendroff scheme
- Finite Difference Methods for the 2nd order Hyperbolic Equations

Week 7 (3/1 - 3/3):

- Numerical solution of linear systems
 - Basic iterative methods
 - Conjugate Gradient(CG) and Preconditioned CG

Week 8 (3/8 – 3/10):

- Finite Element Methods for Two-Point boundary-value problems:
 - The piecewise-linear and higher-order Galerkin methods
- Finite Element Methods for 2-D Elliptic Equations:
 - Abstract finite element theory

Week 9 (3/15 – 3/17): Spring break, No classes

Week 10 (3/22 – 3/24):

- Conforming and Nonconforming finite element spaces

Week 11 (3/29):

- Galerkin methods for the Neumann and the Dirichlet problem
- Curved boundaries

Week 12 (4/5 – 4/7):

- Finite Element Methods for Parabolic Equations
- Finite Element Methods for Wave Equations

Tentative Course Schedule
-Continued

Week 13 (4/12 – 4/14):

- Quadrature rules
- Programming Issues

Week 14 (4/19 – 4/21):

- Mixed Finite Element Methods:
 - Abstract formulation
 - The 2nd order elliptic equations

Week 15 (4/26 – 4/28):

- Mixed Finite Element Methods –Continued:
 - Stokes problem, Linear elasticity

Week 16 (5/3 – 5/5): Final Project Presentations

Grading Policy:

Homework: 50%, Final project: 50%

Attendance Policy:

It is student's responsibility to attend every class. Students are expected to arrive for class on time and to remain for the class entire period.

Academic Integrity Policy:

The University policy is that all suspected cases or acts of alleged scholastic dishonesty must be referred to the Dean of Students for investigation and appropriate disposition. Any student who commits an act of scholastic dishonesty is subject to discipline. Scholastic dishonesty includes, but is not limited to cheating, plagiarism, collusion, submission for credit of any work or materials that are attributable in whole or in part to another person, taking an examination for another person, any act designed to give unfair advantage to a student or the attempt to commit such acts. For further information, please refer to:

<http://academics.utep.edu/Default.aspx?tabid=23785> or

<http://www.lib.iastate.edu/commons/resources/facultyguides/plagiarism/dishonest.html>.

Civility Statement:

Please do not use cell phones, pagers, iPods, MP3 players, blue tooth devices, etc. during class. Cell phones and pagers should be set to silent or vibrate, and any calls should be taken outside of class. Please do not wear headsets or blue tooth devices during class.

Disability Statement:

If a student has or suspects she/he has a disability and needs an accommodation, he/she should contact the Disabled Student Services Office (DSSO) at 747-5148 or at <dss@utep.edu> or go to Room 106 Union East Building. The student is responsible for presenting to the instructor any DSS accommodation letters and instructions.

Military Statement:

If you are a military student with the potential of being called to military service and/or training during the semester, please contact me by the end of the first week of class.