

THE UNIVERSITY OF TEXAS AT EL PASO

COLLEGE OF SCIENCE

Department Of Mathematical Sciences

Course #: MATH 5343 CRN 24611
Course Title: Numerical Solution of Partial Differential Equations
Credit Hrs: 3
Term: Spring 2016
Course Meetings & Location: MW 9:00 ~ 10:20, Education Building 110
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 (915) 747-6864

Office Hours: MW 10:45 – 11:45 or by appointment

Textbook(s), Materials:

1. Text book: Computational Partial Differential Equations Using MATLAB by Jichun Li and Yi-Tung Chen
2. Reference: Finite Difference Methods for Ordinary and Partial Differential Equations by Randall J. LeVeque

Course Website <http://www.math.utep.edu/faculty/yi/math5343s16.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/Lab assignments will be collected throughout the semester. **No late homework /lab report** will be accepted. Computer programming must be done in MATLAB.

Final project: In addition to homework/lab assignments, students will work on a final project and write a report. Detailed instructions will follow during the semester.

Assessment of Course Objectives: Grade will be based on homework and final project.

Tentative Course Schedule:

Week 1 (1/20):

- Course introduction
- (Chapter 1) Overview of PDEs

Week 2 (1/25 – 1/27):

- Sec. 1.5: Overview of Numerical methods for PDEs
- Finite Difference Method:
 - (LeVeque, Chapter 1) Introduction and finite difference formulas

Week 3 (2/1 – 2/3):

- (LeVeque, Chapter 1) Finite Difference Method for two-point boundary value problems:
 - Deriving the system for Dirichlet and Neumann boundary conditions
 - Well-posed-ness issues, Error and stability analysis
 - Variable spacing in the grid, discontinuous coefficients, and mildly nonlinear problem

Week 4 (2/8 – 2/10):

- (Chapter 4) Finite Difference Method for 2-D Elliptic Equations
- (Chapter 2) Finite Difference Method for Parabolic Equations:
 - Forward, Backward and Crank- Nicolson methods, ADI methods
 - Stability analysis

Week 5 (2/15):

- Computer lab

Week 6 (2/22 – 2/24):

- Finite Difference Method for Parabolic Equation continued
- (Chapter 3) Finite Difference Methods for the 1st order Hyperbolic Equations:
 - The upwind scheme, the Friedrichs scheme, and the Lax-Wendroff scheme

Week 7 (2/29- 3/1):

- Numerical solution of linear systems
 - Classical iterative methods
 - Conjugate Gradient (CG)

Week 8 (3/7 - 3/11): [Spring break, No classes](#)

Week 9 (3/14 - 3/16):

- (Chapter 6) Finite Element Methods for Two-Point boundary-value problems:
 - The piecewise-linear and higher-order Galerkin methods

Tentative Course Schedule
-Continued

Week 10 (3/21 - 3/23):

- Computer lab
- Finite Element Methods for 2-D Elliptic Equations:

Week 11 (3/28 – 3/30):

- Abstract finite element theory
- Conforming Finite Element Method

Week 12 (4/4 – 4/6):

- Conforming Finite Element Method (Continued)
- Nonconforming Finite Element Method

Week 13 (4/11 – 4/13):

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

Week 14 (4/18 – 4/20):

- (Chapter 7) Programming Issues –Computer lab

Week 15 (4/25 – 4/27):

- Finite Element Methods for Parabolic Equations
- Discontinuous Galerkin Method

Week 16 (5/2 – 5/4):

- (Chapter 8) Mixed Finite Element Methods

Week 17 (5/11):

- Final presentations (10:00 – 12:45 pm)

Grading Policy:

Homework: 70%, Final project: 30%

More information on the final project will be given in class.

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 you have a disability and need classroom accommodations, please contact The Center for Accommodations and Support Services (CASS) at 747-5148, or by email to cass@utep.edu, or visit their office located in UTEP Union East, Room 106. For additional information, please visit the CASS website at www.sa.utep.edu/cass.

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.