THE UNIVERSITY OF TEXAS AT EL PASO

COLLEGE OF SCIENCE

Department Of Mathematical Sciences

Course #:	MATH 5343 CRN 24000
Course Title:	Numerical Solutions to Partial Differential Equations
Credit Hrs:	3
Term:	Spring 2023
Course Meetings & Location:	MW 9:00-10:20 am, Classroom building C302
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:	M 1:00-2:00 pm, W 1:30-2:30 pm, 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
3. Reference: Partial Differential Equations with Numerical Methods by Stig Larsson and Vidar Thomee

Course Website: https://blackboardlearn.utep.edu/ultra/courses/_173441_1/cl/outline

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 available on the Blackboard course page. **No late homework /lab report** will be accepted. Computer programming must be done in **MATLAB**.

Final project: Students will work on a final project on a topic of their own choice, preferably related to their research. A final report should be turned in during the final exam week. More detailed instructions will follow.

Assessment of Course Objectives:

Grade will be based on homework, lab reports, and final project report.

Tentative Course Schedule:

Week 1 (1/18):

- Course introduction
- (Chapter 1) Overview of PDEs

Week 2 (1/23 - 1/25):

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

Week 3 (1/30 - 2/1):

- Finite Difference formulas-continued
- (LeVeque, Chapter 1) Finite Difference Method for two-point boundary value problems:
- Deriving the system for Dirichlet and Neumann boundary conditions
- Well-posedness issues, Error and stability analysis

Week 4 (2/6 – 2/8):

- Finite Difference Method for two-point boundary value problems: variable spacing in the grid, discontinuous coefficients, and mildly nonlinear problem
- Computer lab

Week 5 (2/13 – 2/15):

- (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 6 (2/20 – 2/22):

- 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 (2/27 - 3/1):

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

Week 8 (3/6 - 3/8):

- (Chapter 6) Finite Element Methods for Two-Point boundary-value problems:

- The piecewise-linear and higher-order Galerkin methods

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

- Spring break, No classes

Week 10 (3/20 - 3/22):

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

Week 11 (3/27 – 3/29):

- Abstract finite element theory

Week 12 (4/3 – 4/5):

- Conforming Finite Element Method
- Nonconforming Finite Element Method

Week 13 (4/10 – 4/12):

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

Week 14 (4/17 – 4/19):

- (Chapter 7) Programming Issues –Computer lab

Week 15 (4/24 – 4/26):

- Finite Element Methods for Parabolic Equations

Week 16 (5/1 – 5/3):

- Finite Element Methods for Parabolic Equations - Continued

Grading Policy:	Homework and computer lab 60%, final project 40%
Course Drop Policy:	The UTEP Spring 2023 drop deadline is **March 30, 2023**. The College of Science will remain aligned with the University and not approve any drop requests after that date.
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 or any other blue tooth devices during class. Cell phones should be set to silent or vibrate, and any calls should be taken outside of 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.
Covid 19 Precaution Statement:	Please stay home if you have been diagnosed with COVID-19 or are experiencing COVID-19 symptoms. If you are feeling unwell, please let me know as soon as possible, so that we can work on appropriate accommodations. If you have tested positive for COVID-19, you are encouraged to report your results to covidaction@utep.edu, so that the Dean of Students Office can provide you with support and help with

communication with your professors. The Student Health Center is equipped to provide COVID 19 testing.

The Center for Disease Control and Prevention recommends that people in areas of substantial or high COVID-19 transmission wear face masks when indoors in groups of people. The best way that Miners can take care of Miners is to get the vaccine. If you still need the vaccine, it is widely available in the El Paso area, and will be available at no charge on campus during the first week of classes. For more information about the current rates, testing, and vaccinations, please visit epstrong.org