

Math 511
Numerical Methods for Partial Differential Equations
Winter Semester 2010

Professor: *Vianey Villamizar*
Office: 366 TMCB

Class: 11:00 - 11:50 a.m. MWF 136 TMCB
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Office Hours: Monday 4:00 - 5:30 p.m. (at my office)
Wed 5:00 - 6:30 p.m. (at my office) or by appointment.

Texts: 1) **Finite Difference Methods for Ordinary and Partial Differential Equations**
by Randall J. LeVeque, SIAM, 2007
2) **NUMERICAL SOLUTIONS OF PARTIAL DIFFERENTIAL EQUATIONS**, by J. Flaherty.

Tentative Class Schedule

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|----------------------------------------|----------------------------------------------------------------------------------------|
| Week 1 (Jan 4 – Jan 8): | Chapter 1 (LeVeque): Finite Difference Approx. |
| Weeks 2 – 5 (Jan 11 – Feb 5): | Chapter 2 (LeVeque): Steady State. Two Point BVP |
| Weeks 5 – 6 (Feb 1 – Feb 12): | Chapter 3 (LeVeque): Elliptic Equations |
| Weeks 6 – 7 (Feb 8 – Feb 19): | Chapter 4 (LeVeque): Iterative Methods and Elliptic Grid Generation (Own Notes) |
| Weeks 8 – 9 (Feb 22 – Mar 5): | Chapters 2 and 3 (Flaherty): Theoretical Concepts for Time-Dependent Problems |
| Weeks 10 – 11 (Mar 8 – Mar 12): | Chapters 4 and 5 (Flaherty): Parabolic Equations |
| Week 12 (Mar 22 – Mar 26): | Acoustic Scattering in Generalized Coordinates |
| Weeks 13 – 14 (Mar 29 – Apr 9): | Chapter 6 (Flaherty) and Chapter 10 (LeVeque): Hyperbolic Equations (If time permits). |

Important Dates

- Fri Jan 15 Add/Drop Deadline.
- Monday, Jan 18: Martin Luther King Holiday
- Monday, February 15: Presidents Day Holiday
- Tuesday, February 16: Monday Instruction
- **Midterm Feb 26 - Mar 1 Friday - Saturday and Monday**
- Tuesday, Mar 16 Withdraw Deadline
- Reading Days: Wed-Thu, Apr 14-15
- **Final Exam: Wednesday, April 21 11:00 a.m. -2:00 p.m. in our classroom 136 TMCB**

Pre-requisite: Math 410 (Introduction to Numerical Methods), [Math 313](#) (Elementary Linear Algebra), [Math 447](#) (Introduction to Partial Differential Equations); or equivalent. Computer literacy is expected. Good programming skill. Strong undergraduate linear algebra background preferred.

Course Objectives: This course is designed to prepare students to solve mathematical problems modeled by partial differential equations that cannot be solved directly using standard mathematical techniques, but which are amenable to a computational approach. Students are introduced to the discretization methodologies, with particular emphasis on the finite difference method that allows the construction of accurate and stable numerical schemes. In depth discussion of theoretical aspects such as stability, analysis, and convergence will

enhance the students' understanding of the numerical methods. Students will also be required to perform programming and computation so as to gain experience in implementing the schemes and to be able to understand the numerical performance of the various numerical methods.

I believe that my role as your instructor is to help and assist you in the process of learning mathematics. I will do my best to fulfill this role. I know that we will enjoy this class as we go along by making a consistent effort throughout the semester. **My best advice to you is found in D&C 4:2 replacing the first line by ... O ye that embark in Math 511, see that ye work with all**

Homework: Homework will consist of some theoretical questions and applications of the numerical methods learned in class to some initial and/or boundary value problems. They will be more like small projects. You will need to use a computer to implement the algorithms needed for the homework. I expect that you have good programming skills. Programming is an important part of this class. I strongly recommend that you use MATLAB as your programming language, but you can also use FORTRAN, JAVA, or C++. **Late homework will not be accepted.**

Homework website: <http://www.amath.washington.edu/~rjl/fdmbook>.

Midterm Exam and Final Project: The Midterm exam will be based on the material covered until the previous Monday. **The midterm exam will be given in the testing center on February 26-Mar 1 (Fr-Sat, Mon).** I expect that most students will finish it in at most three hours. However, the time limit will be up to four hours. Only basic scientific calculators (no graphic or symbolic ones) will be allowed in this exam. Also, a one-sided card of notes, no larger than 8" by 5", will be permitted. No books and no other notes will be allowed.

Grading: Grades will be based on cumulative points earned as follows:

**Homework 40%, Midterm Exam 20%, Midterm Project 10%,
Final Exam and Project 30% (10%+20%)**

At the end of the semester, **I will make an average based on each one of the above forms of evaluations with their corresponding weights. Then, a Gaussian curve will help me to determine your final grade.** In any event, the Gaussian curve will not hurt your grade. I will guarantee the following letter grades:

| | | | | |
|--------------|--------------|--------------|--------------|-----------|
| | B+ = 89-87%, | C+ = 79-77%, | D+ = 69-67%, | |
| A = 100-93%, | B = 86-83%, | C = 76-73%, | D = 66-63%, | E = 59-0% |
| A- = 92-90%, | B- = 82-80%, | C- = 72-70%, | D- = 62-60%. | |

Keep in mind that a good grade is the end result of a good learning process. All of you can get a good grade by successfully experiencing this learning process.

Sexual harassment: BYU's policy against sexual harassment extends not only to employees of the university but to students as well. If you encounter sexual harassment, gender-based discrimination, or other inappropriate behavior, please talk to your professor, contact the Equal Employment Office at 422-5895 or 367-5689, or contact the Honor Code Office at 422-2847.

Students with disabilities: BYU is committed to providing reasonable accommodation to qualified persons with disabilities. If you have any disability that may adversely affect your success in this course, please contact the University Accessibility Center at 422-2767. Services deemed appropriate will be coordinated with the student and instructor by that office.

TENTATIVE HOMEWORK ASSIGNMENTS
Math 511: Introduction to Numerical Methods for PDE's – Winter 2010
Instructor: Vianey Villamizar

| Chapter | Problems | Due* | Chapter | Problems | Due* |
|---------|----------|----------|------------|-------------|---------|
| 1 (LV) | 1.1, 1.2 | Fri 1/15 | Iter Meths | To | Fri 3/5 |
| 2 (LV) | 2.3-2.4 | Fri 1/22 | Grid Gen. | Be Assigned | |
| 2 (LV) | 2.1-2. 2 | Fri 1/29 | 2-6 | To | |
| 2 (LV) | 2.5-2.7 | Fri 2/5 | Flaherty | Be Assigned | |
| 3 (LV) | 3.1-3.2 | Fri 2/12 | | | |

* Homework is due at the beginning of class on the designated Friday.