**Mathematics 4347 Introduction to Partial Differential Equations Course Description**

Fall, 2011 (MWF 2:00 in Skiles Room 154)

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**Instructor**: Evans Harrell, Office Skiles 218D, 894 3300, harrell at math.gatech.edu
**Instructor's office periods**: MW, 3:00-4:30 pm, in Skiles 218D.

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## Course Description

It is a profound and mysterious fact that most of the fundamental laws of physics have the form of partial differential equations. The Schrödinger equation of quantum physics, Clerk Maxwell's synopsis of electromagnetism, and the essential equations of both fluid and solid mechanics are all in the form of PDEs, and a vast number of other PDEs arise when these and other physical laws are used to generate practical models in engineering.

The underlying reason for this is that we use derivatives to describe change, and when, for example, change in time is related to variation in space, or temperature, or pressure, or any other continuous variable, that must be described by an equation containing different partial derivatives. Voilà - a PDE. We expect different physical laws to be connected to different types of PDEs. It will also turn out that if we can classify PDEs intelligently, we will understand what to expect of their solutions by analogy with prototypes we know from basic physical laws. Therefore the course will begin with a discussion of important model PDEs and their classification.

After classification and modeling we will turn to the enormous subject of methods of solution, and some related matters of theory, concentrating on:

- The method of characteristics
- Conservation laws
- Boundary and initial value problems for second order equations.
- Separation of variables and series solutions
- Green's fuctions and fundamental solutions

The lectures will relate to the textbook *Introduction to Partial Differential Equations*, by Zachmanoglou and Thoe, and to web resources, especially parts of the on-line text by Evans Harrell and James Herod.

## Prerequisites

Students should be familiar with calculus through vector analysis, linear algebra at the level of Tech's Math 2406 and ordinary differential equations at the level of Tech's Math 2403. Helpful, but not required, background would include some parts of science or engineering where partial differential equations arise as laws of nature or models..

## Class web page

The class will be coordinated through T-Square, but you can also consult the Class web page directly. It is your responsibility to look at the web page regularly for information about the class, such as homework assignments. (It will be mirrored at T-Square, if you prefer.)

## Grading and requirements

There will be exams on

1. **Monday, 19 September**,
2. **Wednesday, 19 October**, and
3. **Monday, 14 November**,

as well as a final exam, and there may be short pop quizzes on other days. You will be able to review your class standing after each test from the Web page. Homework problems will be posed in the lectures or on the Web, and will be collected on Mondays, or Wednesdays when Monday is a holiday.

## Missed tests, special accommodation, etc

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There will never be an opportunity to retake a missed exam after the event. Any special accommodations must be requested by electronic mail at least two weeks in advance of any scheduled event. It is the student's responsibility to take the initiative for all such accommodations.

Tests may vary as to what materials are permitted, and whether part of the test can be prepared at home. In all cases work on the test is to be done by the student without collaboration and without consultation of materials other than those explicitly permitted.

## Learning Disabilities

It is the right of any student with a certified learning disability to request necessary accommodation. Such requests must be made well in advance of the time that the accommodation is required and a letter of documentation from the ADAPTS office must be presented at the time of any request.

## Academic Integrity

Students are expected to abide by the Georgia Tech Academic Honor Code. You are encouraged to discuss the homework and solutions with classmates, but you must later write up the work independently, without consultation or copying. No collaboration is permitted on quizzes or exams.

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## Grading and requirements

There will be exams on

1. **Monday, 20 September**,
2. **Monday, 25 October**, and
3. **Monday, 15 November**,

as well as a final exam, and there may be short pop quizzes on other days. You will be able to review your class standing after each test from the Web page. Homework problems will be posed in the lectures or on the Web, and will be collected on Mondays, or Wednesdays when Monday is a holiday.

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MATH 4347, PARTIAL DIFFERENTIAL EQUATIONS I
COURSE SYLLABUS
FALL 2006

INSTRUCTOR: ANDRZEJ SWIECH
LECTURES: MWF 3:05-3:55 pm, SKILES 246
OFFICE: SKILES 235B
OFFICE HOURS: MWF 1-2 PM
PHONE: (404) 894-2705
E-MAIL: swiech@math.gatech.edu
COURSE WEB PAGE: http://www.math.gatech.edu/ swiech/4347.html

TEXTBOOK: E. C. Zachmanoglou and D. W. Thoe, *Introduction to Partial Differential Equations with Applications*

MATERIAL TO BE COVERED AND COURSE OBJECTIVES: The course introduces the students to the basic theory of first and second order partial differential equations. Its main objective is to develop the students' skills in solving certain partial differential equations and build their intuition about the nature of solutions. The main themes of the course are the following:

(1) First order equations: the method of characteristics and the concept of solutions with shocks, conservation laws.
(2) Introduction to the general theory of second order equations.
(3) Wave equation and hyperbolic equations in dimensions one, two, and three.
(4) Systems of first order equations.
(5) Methods of exact solutions: separation of variables, series solutions.

As the course progresses you should work on problems given in the textbook. They will not be collected. A separate homework assignment will be given. The textbook contains enough problems so that you can determine what part of the material you have mastered and what you still need to work on.

GRADING: There will be three tests (September 15, October 13, and November 15), one homework assignment (due on November 22), and the final exam. Each test and the homework assignment will count for 15% of the final grade, and the final exam will count for 40%. Your grade will be based on how well you can solve problems and compute using the theory. You will not be asked to reproduce proofs. To get an A, respectively B,C, and D, your final score will have to be greater than 85%, respectively 70%, 55%, and 40%.

Please be aware of the Georgia Tech Honor Code and follow it carefully. In particular please make sure that all the work you submit is your own.

# Math 4347 Partial Differential Equation I. Fall 2007

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| Schedule: 3:05 pm - 4:25 pm MW | Classroom: Skiles 268 |
| Office: Skiles 102A | Phone: 404-894-4750 |
| Email: zengch@math.gatech.edu | Webpage: **www.math.gatech.edu/~zengch** |
| Office hours: 11am - 12 pm MW | |

## Syllabus

*Instructor:* Chongchun Zeng

*Prerequisites*: **MATH 2403** and **MATH 2406** or permission of the instructor

*Participation:* Attendence in classes is mandatory. Students are expected to read the materials before and/or after the classes. It is suggested that you start to work on homework problems right after they are assigned.

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*Text book:* Introductions to PDEs with Applications by E. C. Zachmanoglou and D. W. Thoe, Dover Publications, 1986.

*Topics*: In this semester, we shall discuss basic first and second order PDEs and their applications.

- First order PDEs:
  - The method of characteristics
  - Conservation laws and shocks
- Constant coefficient second order PDEs:
  - Derivations and boundary conditions
  - Laplace's equation
  - The heat equation
  - The wave equation

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***Grades:*** **1 final exam 55%. 1 midterm 33%. 6 homework assignments**

***Grades:*** **1 final exam 55%, 1 midterm 33%, 6 homework assignments 12%.**

- *Final:* The final will be take-home test. It will be handed out in the lecture on Mon. Dec. 3 (the second to the last lecture of this course) and it will be due at 12pm (noon) on Wed. Dec. 12. It is "open notes" and "open textbook". Scientific calculators are allowed. However, other reference books and discussing the problems with others are strictly prohibited. Please write your exam solutions in **ink** and **circle** the final answer of each problem in a box with no corrections inside. Writing exams in pencil would automatically forfeit your right to argue for credits after the exam is given back to you. There will be **no** make-up for a missed exam, except under provable impossibility to complete the exam.

- *Exams:* The 80-minute midterm will be given during a lecture in early October, which will be announced at least 9 days in advance. All the exams are "closed book" and "closed notes". You will be allowed to bring with you a one page (8.5 X 11, both sides) "cheat sheet" with anything you want written on it. Please write your exam solutions in **ink** and **circle** the final answer of each problem in a box with no corrections inside. Writing exams in pencil would automatically forfeit your right to argue for credits after the exam is given back to you. There will be **no** make-up for a missed exam, except under provable impossibility to attend the exam.

- *Homework:* Homework will be assigned at the end of each lecture and then put on this webpage in the below. You may discuss the homework problems with other students *in this class*, but you should write down the solutions and complete the homework independently. The homework will be collected roughly every 2 weeks. On each collecting day, the homework is due in the classroom at the beginning of the lecture. The corresponding assignment includes all the problems assigned before that collecting day and after the previous assignments. Some selected problems from each assignment will be graded and the score will be given based on both the graded problems and the completion of the whole assignment. Due to the holiday schedules, the specific homework collecting dates are:

  9/5 (Wed), 9/19(Wed), 10/3(Wed), 10/22(Mon), 11/5(Mon), 11/19(Mon)

- *Letter grade:* in general, the letter grade will be given based on the total score (homework + midterm + final) in a curved fashion with the following exceptions:

1. Total score 90/100 or above will always be an **A**
2. Final score 51/55 or above will always be an **A**
3. Total score 60/100 or above will always be a **C** or higher.
4. Final score 38/55 or above will always be a **C** or higher.

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## Homework assignments:

- Homework Assignment #1 (due Wed, 9/5):
  - Assigned on Mon. 8/20: Page 5. 1.1, 1.2, 1.5(a), 1.6
  - Assigned on Wed. 8/22: Page 10. 2.2, 2.4, Page 16 . 3.5
  - Assigned on Mon. 8/27: Page 21--22. 4.1, 4.4(b), 4.8, 4.9
  - Assigned on Wed. 8/29: Page 33. 1.1, 1.4, 1.7
- Homework Assignment #2 (due Wed. 9/19):
  - Assigned on Wed. 9/5 Page 42. 2.2, 2.7(b), 2.8(a); Page 43, 3.1(c), 3.2(c)
  - Assigned on Mon. 9/10: Page51. 4.1bd, 4.2b
  - Assigned on Wed. 9/12: Page 55--56. 5.1, 5.5(b).
  - Assigned on Mon. 9/17: Page 59. 1.1, Page 62--63. 2.1adg, 2.4
- Homework Assignment #3: (due Wed. 10/3):
  - Assigned on Wed. 9/19: Page 68--69. 3.1 bd
  - Assigned on Mon. 9/24: Page 71. 4.1; Page 75. 5.1, 5.4
- Homework Assignment #4: (due Mon. 10/22):
  - Assigned on Wed. 9/26: Page 83--84. 6.2, 6.7
  - Assigned on Wed. 10/3: Page 99--100. 1.1, 1.4a, 1.5, 1.8ac; Page 107. 2.1abf, 2.5
  - Assigned on Mon. 10/15: Page 123--124. 2.1a, 2.2b, 2.5
- Homework Assignment #5: (due Mon. 11/5):
  - Assigned on Wed. 10/24: Page 142. 7.4, 7.7ac
  - Assigned on Mon. 10/29: Page 148. 8.1, 8.2; Page 151. 9.1, 9.2
  - Assigned on Wed. 10/31: Page 156. 1.2, 1.4; Page 160. 2.1, 2.3
- Homework Assignment #6: (due Mon. 11/19)
  - Assigned on Wed. 11/7: Page 173. 1.3, 1.4
  - Assigned on Mon. 11/12: Page 178. 2.4, 2.7
  - Assigned on Wed. 11/14: Page 186. 3.4, 3.5
- Homework recommended: (not due date)
  - On Mon. 11/19: Page 196. 5.1, 5.2
  - On Wed. 11/28: Page 205. 7.3, 7.4, 7.5, 7.7b; Page 221. 8.5, 8.9, 8.10bc