Sergei Shabanov
Department of Mathematics

# MAP 4341/5345 Introduction to Partial Differential Equations

## Description and Goals

**Course Texts:** R. Haberman, Applied Partial Differential Equations, 4th edition (optional)
**S.V. Shabanov, Lecture Notes on Partial Differential Equations (PDEs)**

**Chapter 1: Preliminaries** (Lectures 1-3)
**(the rest of Notes to be posted here in due course; last updated on 01/05/2020)**

**Course Content:** Review of Euclidean spaces and functions on them. Sets in Euclidean spaces. A boundary of an open set. Smooth boundary. Partial differential Equations (PDEs). A solution to a PDE. Wave equation. Heat equation. Laplace equation. Helmhotz equation. Separation of variables in a PDE. Principle of superposition for a linear PDE. Change of variables in a PDE. Boundary conditions. The method of characteristics for first-order PDEs. Classification second-order PDEs. Hyperbolic, elliptic, and parabolic equations. Initial and boundary value problems. The existence and uniqueness of the solution. Differential operators in the space of square integrable functions on a bounded region. The eigen-value problem for a differential operator. The Sturm-Liouville problem. Complete sets of functions. The Fourier method for hyperbolic, parabolic, and elliptic problems in two variables for rectangular regions. Separation of variables in polar and spherical coordinates. Harmonic functions and harmonic polynomials in two and three variables. Spherical harmonics. The Fourier method for hyperbolic, parabolic, and elliptic problems in circular, cylindrical, and spherical regions.

**Goals:** Learning basics techniques to solve first and second-order PDEs with emphasis on the Fourier method for solving initial and boundary value problems for hyperbolic, parabolic, and elliptic second-order linear PDEs.

**Prerequisites:** Students are expected to be familiar with ordinary differential equations and methods to solve them. Basic knowledge of differentiation and integration of functions of several variables is necessary (Calculus 3). The knowledge of basic ideas of linear algebra is not mandatory but will be helpful to comprehend the content of the course.

## Exams

There will be 3 exams and the final exam. Dates of the exams will be posted a week in advance in the

course webpage. Each exam (regular or final) will have two parts, one given in class and the other is a take-home part. The problems will be similar or identical to the homework problems. The take-home part will be posted in the course page. Each of the first 3 exams covers topics discussed in class during 3 weeks or so prior the exam. The exact dates of the exams and topics covered in each exam will be posted in the course page. The final exam is cumulative. One formula sheet is allowed on in-class exams (no restriction on the content; it may include formulas, math love mantras, or anything that helps). No electronic devices are permitted on the exams. Makeups for missed exams only with written medical excuse. If all students agree, the exams can be arranged in evening hours (to eliminate a time limit "pressure" of in-class exams).

**Special accommodation:** Students requesting special accommodation for exams must first register with the Dean of Student Office. The Dean of Student Office will provide documentation to the student who must then provide this documentation to me when requesting accommodation.

**Student honor code:** Zero tolerance to any kind of cheating on written assignments (such as use of any unauthorized written or printed notes, copying solutions from your class mates, and similar). When caught cheating, the course grade is an F, no exception.

## Homework

Homework assignments will be posted in the course webpage. Homework is not turned in. Some of the homework problems will be discussed in class. Solving these problems is essential for understanding the course and attaining a good grade. Do homework regularly as it makes over a half of your grade (via tests). You may ask for help and hints to solve homework problems during office hours.

## Grading

Each assignment is graded out of 100 pts (if no extra credit problem is offered). All regular problems are worth the same, that is, each problem gives you 100/N pts, N is the number of problems in the assignment, when solved correctly. There is a small partial credit for incomplete solutions. Students who score 90 and above on each of the three exams may take only a take-home final exam (the in-class part of the final exam is not required). The take-home final will posted on the last day of classes and has to be turned in 2-3 days (the exact date will be posted). Its score counts as the final exam score. Your course score is the exam average

**G = (E1+E2+E3+F)/4**

where **E1, E2, E3,** and **F** are the scores of the three midterm exams and final exam, respectively.

**Extra credit:** One extra non-standard question in all exams, if answered correctly, adds 10-20 pts toward your assignment score. One extra non-standard problem will be given in the final exam. The perfect score can therefore exceed 100 pts when the extra credit question is correctly answered.

## Grading Scale

The grade thresholds

**A: G>85; A-: G>80; B+: G>75; B: G>70; B-: G>65; C+: G>60; C: G>55; C-: G>50; D+: G>45; D: G>40; F: G<40**

## Attendance and Late Policy

No credit for class attendance. You may leave or come any time without asking my permission. However the class attendance is strongly recommended as the lectures will contains examples that are not given in the lecture notes. These examples are relevant for written in-class assignments and take-home assignments.