Syllabus

Math UN3028 Partial Differential Equations
Spring 2023

Instructor: Elena Giorgi (elena.giorgi@columbia.edu)

Course Hours and Location: Tuesdays and Thursdays, 1:10-2:25pm, in room 203 Mathematics

Overview of the Course: This is an introductory course in Partial Differential Equations (PDEs) designed for students with a strong mathematics background.

Topics of the Course: We will focus on the main properties of the most important PDEs, of elliptic, parabolic and hyperbolic type. We will present various techniques used to solve the equations, as well as derive general estimates on the solutions.

A more detailed list of topics covered in the class is the following:

- Linear / non linear PDEs and examples
- Transport equations
- The Cauchy problem for PDEs and types of second order equations.
- The wave equation: D'Alembert formula, causality and energy, reflections of waves, waves with a source.
- The heat equation: maximum principle, the fundamental solution, heat equation with a source.
- Separation of variables
- Fourier series: convergence and Gibbs phenomenon
- The Laplace equation: maximum principle, separation of variables, Poisson's formula
- Green's identities and Green's functions.
- The wave equation in 3D: principle of causality, Kirchhoff's formula.

Textbook: *"Partial Differential Equations: An Introduction"* (2nd Edition) by Walter A. Strauss.

Structure of the course: The material of this course will roughly follow chapters 1,2,3,4,5,6,7,9 of the textbook by Strauss. The lectures will include some of the material from these chapters, as well as some additional material and examples.

In addition to the lectures, there will be twelve weekly problem sets. These will be listed on the tentative schedule at the end of this syllabus and should be uploaded on Gradescope in Canvas by the Saturday of the following week by 3pm (unless otherwise specified in the syllabus). Late homeworks will not be accepted.

It is very important to do all of the problem sets to the best of your ability, as this is the most effective way to absorb the material. While you are welcome to collaborate with your peers, you must attempt all problems on your own and your submitted solutions must be written out individually. Submissions which are copied or suspiciously similar may be rejected. A substantiated violation of the code of academic integrity may result to serious academic disciplinary action.

There will be one midterm exam and one final exam. The midterm will be a seventy-five minute exam which is scheduled on Tuesday March 7th during normal class hours. The final exam will be a 2 hours and 50 minutes exam which is scheduled by the university registrar, and the projected schedule is Tuesday May 9th from 1:10pm to 4pm.

The exams will generally follow the material from the problem sets but may include some additional conceptual problems to test your understanding. The midterm will cover roughly half of the course material, while the final exam will cover all the material from the course, with slightly more emphasis on the content covered after the midterm.

Grading scheme: The course grades will be computed as follows: 20% Homework, 30% Midterm exam, 50% Final exam. We will drop the lowest homework grade.

Office Hours

- The instructor will hold weekly office hours, 11:30am-12:30pm on Tuesdays and Thursday, in her office, room 606 Mathematics.
- Each of the TAs will hold weekly hours in the Math Help Room in room 406 Mathematics (see the schedule here for their office hours) and you are encouraged to come to their hours with any questions or confusions you may have.

Tentative Schedule of Lectures: See table below.

Schedule of Lectures

This schedule is tentative and may be modified as the course progresses. The numbers refer to the chapters in Strauss' book.

Week	Read	Homework
Jan. 17–19	**§1.1**, **§1.2**	**HW 1 due Jan. 28**
Jan. 24 – 26	**§1.5**, **§1.6**, **§2.1**	**HW 2 due Feb. 4**
Jan. 31 – Feb. 2	**§2.2**, **§3.2**	**HW 3 due Feb. 11**
Feb. 7 – Feb. 9	**§3.4**, **§2.3**	**HW 4 due Feb. 18**
Feb. 14 – Feb. 16	**§2.4**, **§3.1**	**HW 5 due Feb. 25**
Feb. 21 – Feb. 23	**§3.5**, **§4.1**	**HW 6 due March 4**
Feb. 28 – Mar. 2nd	**§4.2**, **Review**	No Homework this week
Mar. 7 – Mar. 9	**Midterm Exam** , **§5.1**	
Mar. 21 – Mar. 23	**§5.4**, **§5.5**	**HW 7 due March 25**
Mar. 28 – Mar. 30	**§6.1**, **§6.2**	**HW 8 due April 1**
Apr. 4 – Apr. 6	**§6.3**, **§6.4**	**HW 9 due April 8**
Apr. 11 – Apr. 13	**§7.1**, **§7.2**, **§7.3**	**HW 10 due April 15**
Apr. 18 – Apr. 20	**§9.1**, **§9.2**	**HW 11 due April 22**
Apr. 25 – Apr. 27	**Review**	**HW 12 due April 29**
May 9	**Final Exam 1:10pm - 4pm**	