MATH 131P: Partial Differential Equations
SYLLABUS

Official Course Description: An introduction to PDE; particular suitable for non-Math majors. Topics include physical examples of PDEs, method of characteristics, D'Alembert's formulation, maximum principles, heat kernels, Duhamel's principle, separation of variables, Fourier series, Harmonic functions, Bessel functions, spherical harmonics.

Teaching Staff:

Instructor: Dr. Laura Fredrickson
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Office Hours: Mondays 4-5:30pm

Course Assistant: Andrea Ottolini
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Office Hours: Mondays 2-4, Tuesdays 3-4:30 Fridays 3:30-5:30pm

Lecture: MWF 10:30-11:20am | 380-380F

Exams: There will be one midterm exam, taken in class. The final is comprehensive.

Midterm: Friday, February 7 (in class)
Final: Monday, March 16 from 3:30-6:30pm (Building 260, Room 113)

Prerequisites: Math 53 or equivalent

Textbook: (Required) *Partial Differential Equations for Scientists and Engineers* by Stanley J. Farlow (ISBN: 0-486-67620-X) (An online version of the textbook is available for free through the Stanford Libary.)

Course website: Course announcements, homework, solutions will be posted on Canvas. Additionally, the syllabus will be posted on my website http://web.stanford.edu/~ljfred4/.

Grading Policy: On all work, your grade will be computed as a percentage: the number of points you earned divided by the number of points possible. The weekly homework and exams are weighted as follows:

- Homework: 25% (lowest score dropped)
- Midterm: 30%
- Final: 45%

Your letter grade will be given based on your numerical average earned in the class, on a scale not stricter than the following: you are guaranteed a D for 60.0 or above, C- for 70.0 or above, C for 73.0 or above, C+ for 77.0 or above, B- for 80.0 or above, B for 83.0 or above, B+ for 87.0 or above, A- for 90.0 or above, and an A for 93.0 or above.

Homework: The only way to learn mathematics is to do mathematics! I encourage you to form study groups and work together. A good strategy is to try each problem yourself first, then get together with others to discuss your solutions and questions, and finally *write up the solutions*

yourself. Please work out problems neatly—don't hand in your scratch work. One course goal is to sharpen your mathematical writing skills, and homework is a place to practice.

Weekly homework assignments are to be submitted via Gradescope by the beginning of class on Wednesdays. The assignments will be posted on Canvas by the previous Wednesday.

The lowest score will be dropped to accommodate exceptional situations such as a serious illness. Because the lowest score is dropped, you can miss one assignment without penalty. No late homework will be accepted, and no make-up homework will be given.

Alternate Sitting for the Midterm Exam: In exceptional circumstances, and by *prearrangement only*, you may take the midterm exam at a fixed alternate time. The alternate sitting will always occur *before* the standard sitting for the exam. To arrange an alternate sitting you must e-mail me at least two weeks before the midterm.

Final Exam Policy: (See registrar.stanford.edu/students/final-exams.)

- Students must not register for classes with conflicting end-quarter exams.
- Alternative arrangements for the final may only be made for the following unforeseen circumstances: illness, personal emergency, or the student's required participation in special events (for example, athletic championships) approved as exceptions by the Committee on Undergraduate Standards and Policy (C-USP).

Schedule: This course is structured with the expectation that you will attend every lecture. Of course, sometimes an absence is necessary. In such a situation, you should contact a classmate to get notes and other information for the class you missed.

We will have 28 lectures in total. Here is a tentative schedule, which may be adjusted as the quarter goes on.

- **Week 1** [Jan 6, 8, 10] (Introduction to PDE (§1); Diffusion-Type Problems (§2, 3, 4)
- **Week 2** [Jan 13, 15, 17] Separation of Variables (§5, 7); Transforming hard equations into easier ones (§8); Solving nonhomogenous PDEs (§9)
- **Week 3** [Jan 22, 24] Integral transforms (§10); The Fourier Transform (§11, 12); The Laplace transform (§13); Duhamel's Principle (§14)
- **Week 4** [Jan 27, 29, 31] The one dimensional wave equation (§16); D'Alembert's solution of the wave equation (§17) More on the D'Alembert's solution (§18); Standing waves (§20)
- **Week 5** [Feburary 3, 5] Classification of PDEs (§23); [February 7] **Midterm**
- **Week 6** [Feburary 10, 12, 14] The wave equation in two and three dimensions (§24); The vibrating drumhead (§30); Method of characteristics (§27)
- **Week 7** [Feburary 19, 21] The Laplacian (§31, 32, 33); The Dirichlet problem in an annulus (§34); Bessel functions
- **Week 8** [Feburary 24, 26, 28] Spherical harmonics (§35); Green's functions (§36); The maximum principle
- **Week 9** [March 2, 4, 6] Calculus of variations (Euler-Lagrange Equations) (§44); Perturbation method for solving PDEs (§46)
- **Week 10** [March 9, 11, 13] **Review**

Students with Documented Disabilities: Students who may need an academic accommodation based on the impact of a disability must initiate the request with the Office of Accessible Education (OAE). Professional staff will evaluate the request with required documentation, recommend reasonable accommodations, and prepare an Accommodation Letter for faculty dated in the current quarter in which the request is made. Students should contact the OAE *by the end of the first week of the quarter*, since timely notice is needed to coordinate accommodations. The OAE is located at 563 Salvatierra Walk (723-1066, studentaffairs.stanford.edu).

Textbook and other Resources: The primary textbook is *Partial Differential Equations for Scientists and Engineers* by Farlow. The textbook is of high quality, and you should read it. This does not mean that it is "easy" to read. Math books are quite demanding on the reader, owing to the intrinsic difficulty of the material, so do not be surprised if you have to go slowly.

You are encouraged to attend the office hours provided by the instructor and course assistant.

Another resource which may be of use is Counseling and Psychological Services. See vaden.stanford.edu/caps-and-wellness.

Computers: If you wish to use a computer in class, you must speak with me first.

Academic Integrity: The Honor Code articulates Stanford University's expectations of students and faculty in establishing and maintaining the highest standards in academic work. Examples of conduct that have been regarded as being in violation of the Honor Code (and are most relevant for this course) include copying from another's examination paper or allowing another to copy from one's own paper; plagiarism; revising and resubmitting an exam for regrading, without the instructor's knowledge and consent; representing as one's own work the work of another; and giving or receiving aid on an academic assignment under circumstances in which a reasonable person should have known that such aid was not permitted. See communitystandards.stanford.edu for more information on the Honor Code.

Important Dates:

First Day of Classes	January 6
Martin Luther King, Jr., Day (no classes)	January 20
Add/Drop Deadline	January 24
Midterm Exam (in class)	February 7
Presidents' Day (no classes)	Feburary 17
Course Withdrawal & Change of Grading Basis Deadlines	March 28
Last Day of Classes, Last Day to Arrange an Incomplete	March 13
Final Exam	March 16 (3:30-6:30pm)