Math 3150-3, Fall 2019
Partial Differential Equations for Engineers

Instructor: Jingyi Zhu, LCB 335, 581-3236, zhu@math.utah.edu.

Course URL: `http://www.math.utah.edu/~zhu/3150_19f.html`

Time and Place: TuTh 6:00 - 7:20 pm, WEB L103

Office Hours: TuTh 4:00 - 5:30 pm, or by appointment.

Prerequisites: Math 2250 and either Math 1260 or Math 2210.

Text: Edwards, Penney, and Haberman, *Linear Algebra and Differential Equations: with Introductory Partial Differential Equations*, (ISBN-13: 9781269425579). The text is a University of Utah custom edition specially designed for the engineering math sequence. If you would just like to purchase a text for 3150, either a 4th edition or 5th edition of Haberman's text (Applied Partial Differential Equations with Fourier Series Boundary Value Problems, Chapters 1-4 and 10) should suffice.

Course Objectives: The subject of partial differential equations (PDE) has been the most relevant to many scientists and engineers working with mathematical models, and it continues to be one of the most active mathematics research fields, as old problems are being solved, or remain to be solved, and more challenging and exciting equations keep emerging. In this course, we will discuss the subject starting from the modeling of physical problems and the derivations of the equations, and introducing the approaches that lead to Fourier series or Fourier transform representations of the solutions, and use the classic ideas as stepping stones to explore practical solutions for problems encountered in the real world. Specifically, we will learn about the following:

- Become knowledgable about PDEs arising from classic physical problems and their classifications, be able to derive heat and wave equations based on the idea of flux balancing;
- Distinguish the roles played by time and spatial variables, and initial vs. boundary conditions for the PDE problem;
- Appreciate the importance of boundary conditions, and use separation of variables technique for PDEs in finite rectangular regions to reduce the problem to several ODE problems;
- Understand the ideas of equilibrium and steady solutions, and make a connection between the heat equation and the Laplace's equation;
- Learn about representing functions by Fourier series, as candidates for PDE solutions, and furthermore understand the principle behind the formulas for the coefficients;

- Understand the concept of series convergence and its relevance to PDE solutions;
- Solve the one-dimensional initial/boundary value problems for the wave equation and heat equation in bounded regions;
- Understand the idea of Fourier transform in conversion of a PDE problem involving unbounded regions;
- Be familiar with the technique of Fourier transform and use it to solve PDEs in **unbounded** regions .

Grading: The course grade will be based on weekly homework (20%), weekly quizzes (20%), two midterm exams (30%), and a final comprehensive exam (30%).

- Homework: Weekly assignments will be posted on Canvas each Tuesday, and collected on the following Tuesday. No late homework will be accepted, unless it has been requested and approved in advance for extreme circumstances.
- Weekly Quizzes: On each Tuesday except the midterm weeks, there will be a 15-minute quiz. The problems are more conceptual for the emphasis on ideas rather than final answers. Those quizzes are closed book and closed notes.
- Midterms: There will be two 50-minute midterm exams on **Thursdays, Sept. 19, and Oct. 31**. These midterm exams are **not** comprehensive. Under special circumstances, arrangements can be made to take the exam at an earlier time, but no makeup exam will be arranged.
- Final Exam: **Tuesday, Dec 10, 2019**, 6:00 - 8:00 pm, in our regular classroom. The final exam is a comprehensive exam, covering all materials discussed in the semester.
- Exam Policies: All the midterm and final exams will be closed book exams. You are allowed to bring a 5×7 index card with your own handwritten notes. Laptops, tablets, and other wireless devices are **not** allowed in exams.

Table 1: Grading Scales

%-age	90-100	85-89	80-84	75-79	70-74	65-69	60-64	55-59	45-54	0-44
Grade	A	A-	B+	B	B-	C+	C	C-	D	E

Withdrawals: Last day to register without a permission code is Aug. 23. Last day to drop class is Aug. 30. Until October 18 you can withdraw from class with no approval at all. After that date you must petition to your dean's office to be allowed to withdraw.

Tutoring Center: Free tutoring is available in Room 155 of the T. Benny Rushing Mathematics Center, located between JWB and LCB. It opens M-Th 8:00 am - 8:00 pm, Fri 8:00 am - 6:00 pm. Please check

`https://www.math.utah.edu/undergrad/mathcenter.php`

for more information about the tutoring service available.

ADA Statement: The American with Disabilities Act requires that reasonable accommodations be provided for students with physical, sensory, cognitive, systemic, learning, and psychiatric disabilities. Please contact me at the beginning of the semester to discuss any such accommodations for the course.

Campus Safety: The University of Utah values the safety of all campus community members. To report suspicious activity or to request a courtesy escort, call campus police at 801-585-COPS (801-585-2677). You will receive important emergency alerts and safety messages regarding campus safety via text message. For more information regarding safety and to view available training resources, including helpful videos, visit `safeu.utah.edu`.

Tentative Schedule

Date	**Section**	**Topic**
Aug 20 and 22	12.1-2	Introduction to PDEs, Derivation of Heat Equation
Aug 27 and 29	12.3-4	Boundary Conditions, Equilibrium Distribution
Sept 3 and 5	12.5, 13.1	Heat Equation in 2 or 3 Dimensions
Sept 10 and 12	13.2-3	Method of Separation of Variables, Temperature in a Rod
Sept 17 and 19	13.4	Other Boundary Conditions, **Midterm 1**
Sept 24 and 26	13.5, 14.1-2	Laplace's Equation, Fourier Series, Convergence
Oct 1 and 3	14.3-4	Cosine and Sine Series, Term-by-Term Differentiation
Oct 8 and 10		**Fall Break**
Oct 15 and 17	14.5, 15.1	Term-by-Term Integration, Inner Product Spaces, Introduction to Wave Equation
Oct 22 and 24	15.2-4	Wave Equation, Vibrating String
Oct 29 and 31	15.5	Vibrating Membrane, **Midterm 2**
Nov 5 and 7	15.5-6	Wave Equation in 2-Dimensions
Nov 12 and 14	16.1-2	Heat Equation on an Infinite Domain
Nov 19 and 21	16.3-4	Fourier Transform Pair
Nov 26	16.5	Fourier Transform and the Heat Equation
Dec 3 and 5		Course Review
Dec 10		**Final Exam**