

MATH 338

Partial Differential Equations

Professor:

Dr. Joanna Bieri
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Class:

Fall 2024
T, Th 10:50am - 12:05pm

Office Hours:

[Click here for my schedule](#)

About This Course

This course is an introduction to Partial Differential Equations, or the study of solving differential equations in more than one variable. We will focus on solution methods for the Heat Equation and Laplace Equation, with a few days spent on solutions to the Wave Equation and some special topics based on class interest.

You must have completed MATH 235 - Differential Equations - before taking this course.

Course Learning Objectives

By the end of the semester your work must reflect your ability to:

1. Classify a partial differential equation as parabolic, hyperbolic or elliptic.
2. Identify if the problem is homogeneous or if it has homogeneous boundary conditions.
3. Select and use the appropriate solution method based on your classification.
4. Solve parabolic, hyperbolic and elliptic partial differential equations using methods from class.
5. Discuss physically what the equations and boundary conditions mean.
6. Interpret your solutions in terms of real world applications.
7. Use the vocabulary of partial differential equation to explain concepts to your classmates.

Required Texts

- Stanley J. Farlow *Partial Differential Equations for Scientists and Engineers*. (ISBN: 0-486-67620-X)
- Good Reference: *Differential Equations and Boundary Value Problems* – Edwards and Penney (not required but good to have as a reference)
- Other texts and articles made available via our course website and Moodle.

Technology

- a. You will need access to a laptop, computer, or tablet capable of interacting with the Internet and it is helpful if you can bring these to class occasionally when we interact with programs. All course materials will be posted on the course website and can be accessed during class. However, cell phone ringers should be turned off during class and you should not be texting or accessing websites that are not productive to your learning.
- b. You will use Canvas to access your grades and hand in all work for the class.
- c. All class materials, daily homework, lecture notes, etc are posted on our class website:

<https://joannabieri.com/PDE.html>

Classwork

Consistent attendance and participation are crucial to your success in the class. Please read the following carefully:

• Homework:

Homework is assigned daily, posted on the class website, and graded as PASS or FAIL. It is very important that you keep up with the homework and that it is done well. **Homework will be handed in each Sunday by 11:59 pm and submitted on Canvas.** Each assignment will consist of two parts:

- Handwritten work showing complete and correct solutions to each problem assigned. These should be neatly written and clearly communicated.
- Your choice of ONE PROBLEM, that you will type up using $\LaTeX$. Choose the problem that you are most proud of figuring out. You should use complete sentences and write this solution as if you are writing a chapter in a book.

NOTE: There is a starter example of $\LaTeX$ on our class website if you have never used this before. I suggest getting an account on Overleaf

- **Quizzes:** We will have three short in class quizzes toward the end of each main topic (see the class schedule). These will consist of a single problem, handed out at the end of class. You will have full access to your book, but notes, calculators, and other materials are not allowed.

- **Reading, and Class Preparation:** You will be asked to read ahead of the class and create a chapter outline - leave space that can be filled in during class and try the example problems in the book. The goal is for each student to prepare for class so we can have a mathematically mature discussion. You will see me do many of the lesson examples you

read about in class, but my goal is to add mathematical depth to your foundation of understanding. You should first read the chapter without taking notes. Then go back through and write down all new vocabulary or definitions and try the examples. It's ok if you have questions they can be answered in class. Then in class you can append your notes with any improved understanding you gain. These will be submitted before each class on Canvas.

• **Participation:**

You are expected to come to class ready to participate fully. Please arrive to class ready to learn and ready to help your classmates learn. Do not distract yourself or your classmates with non-mathematical talk during class work time. Be willing to work together and collaborate to make this class the best possible learning experience for yourself and others. Be willing to shout out answers, ask questions, and have fun learning math.

• **Final Exam:**

The final exam will be a take home final exam due date will be **Tuesday December 10th at 11:59pm**. You will hand in the final online.

Evaluation Procedures

There are three elements of the course which contribute to your overall grade, as follows:

Homework	35%
Quizzes	15%
Reading, and Preparation	10%
In Class Participation and Attendance	10%
Final Exam	30%

Grading Criteria

All work for the course will be graded according following criteria.

4.0 **Exceptional:** diligently completes assignments, and participates fully during lecture. The student explains ideas fully, connects a broad range of mathematics to

experiences, expands ideas fully, and exhibits a commitment to improving understanding. The student offers valuable critical advice and support to his/her fellow classmates.

3.0 **Very Good:** completes work on time, and usually participates during lecture and discussion. The student presents an understanding of ideas (but it may be unfocused or unclear occasionally), is able to connect some mathematics to experiences, expands some ideas, and exhibits a want to improve understanding. The student offers critical, if occasionally unclear, advice to his/her fellow classmates.

2.0 **Acceptable:** completes work on time, and sometimes participates during lecture and discussion. The student presents unclear ideas or ideas taken directly from texts, connects a limited range of mathematics to experiences, rarely expands ideas, and exhibits an apathetic attitude to engaging in understanding concepts. The student offers inconsistent advice to his/her fellow classmates.

1.0 **Unacceptable:** does not complete work on time, and rarely participates during lecture and discussion. The student presents very few ideas, cannot connect the mathematics to experiences, does not expand ideas, and exhibits no improvement of understanding. The student offers no advice, or unhelpful advice.

Grading Scales:

4.0	95-100%
3.7	90-94%
3.3	87-89%
3.0	83-86%
2.7	80-82%
2.3	77-79%
2.0	73-76%
1.7	70-72%
1.3	67-69%
1.0	63-66%
0.7	60-62%

Please note: According to the University Course Catalog (p. 13) 3.7 and 4.0 are reserved for “outstanding” work; 3.3 and 3.0 are both defined as “excellent,” not mediocre.

Communication

- The most reliable way to reach me is by email. Please note that my normal working hours are 9 a.m. to 5 p.m., Monday to Friday. I do not respond to emails after 5 p.m. or on weekends, except in an emergency.
- You can make appointments with me via email. Appointments can happen in Duke 209 or on Teams.
- It is important that you communicate throughout the semester. Let me know if there are ways I can improve your learning in the class. If you are going to miss class or need an extension on the homework, the earlier you tell me the better!

Health Protocols

- In an effort to keep the classroom community safe and healthy, please follow the guidelines outlined here:
 - Wearing a mask is voluntary.
 - Do not come to class if you feel ill or have been exposed to someone who is ill.
- In any case of the above, e-mail me directly to reconcile any class work and/or attendance issues. Please contact me if you have any concerns as to your health needs and goals for the semester.

Academic Honesty

The University of Redlands enforces strict standards as regards academic honesty, and students may be dismissed for breaches of these standards.

In light of this, please note that:

- intentional plagiarism—i.e. piecemeal or wholesale appropriation of text from one or more printed or internet source—will result in a fail grade for the course.
- plagiarism by default—i.e. uncredited adoption of ideas from source texts due to carelessness in citation—will result in a fail grade for the project.

Artificial Intelligence: There is no tolerance for the use of generative artificial intelligence in place of individual work and thinking in this course. All work is to be considered a student's own. Any violation of that will result in a failing grade for the work.

If you are still in any doubt about what constitutes plagiarism, please ask me before you hand in your work!

Office of Equity and Title IX

In order to provide a safe and equitable learning environment for all students, faculty, and staff, discrimination, harassment, retaliation, sexual misconduct, and sexual harassment (including sexual assault, dating or domestic violence, and stalking) are not tolerated at the University of Redlands. The University prohibits unlawful discrimination or harassment (as defined in the Policy Prohibiting Discrimination, Harassment, Sexual Misconduct, and Retaliation) on the basis of age, color, race, ethnicity, national origin, ancestry, sex, marital status, pregnancy, status as a complaining party of domestic violence, sexual orientation, gender, gender identity or expression, physical or mental disability, genetic information, religion/creed, citizenship status (except to comply with legal requirements for employment), military/veteran status, or any other characteristic protected by law. If you or someone you know has experienced or experiences any of these behaviors, know that you are not alone. You can contact the Office of Equity and Title IX for reporting options, supportive measures, and resources to support you.

Many faculty and staff at the University of Redlands are considered "Responsible Employees," which means that if you tell me about a situation involving any of the above, I must report the matter to the Office of Equity and Title IX. Although I make that report, you are in control of how you would

like to proceed, including whether or not you wish to pursue a formal complaint. Our goal is to make sure you are aware of the range of reporting options available to you and have access to the support and resources you need.

To report an incident directly, you can:

- Contact the Interim Director of Equity & Title IX, Christopher Jones, at 909-748-8289 or titleix@redlands.edu
- Report online at: www.redlands.edu/titleixandequity

You can also report to local law enforcement at 909-798-7681, ext. 1. If you are ever in immediate danger, please call 911 or email/text 911@redlandspolice.org if you cannot call. To reach Public Safety on campus, call 909-748-8888 or use the Rave Gaudian App

If you wish to speak to someone confidentially (meaning not connecting with the Office of Equity and Title IX Office), you can contact the following resources:

- Campus:
 - Counseling Center: 909-748-8108 or 24-Hour Crisis Line: 909-748-8960
 - TimelyCare, 24/7 emotional support; 12 free telehealth counseling sessions
- Community:
 - Partners Against Violence, 24-hour sexual assault crisis line: 909-885-8884
 - Option House, 24-hour dating/domestic violence crisis line: 909-381-3471 Online: <https://www.rainn.org/> (sexual assault); <https://www.loveisrespect.org/>

You can also report to local law enforcement at (909) 798-7681, ext. 1. If you are ever in immediate

danger, please call 911 or email/text 911@redlandspolice.org if you cannot call.

If you wish to speak to someone confidentially (meaning not connecting with the Office of Equity and Title IX Office), you can contact the following resources:

- Campus: Counseling Service: 909-748-8108 or 24-Hour Crisis Line: 909-748-8960 or Chaplain's Office: 909-748-8368
- Community: Partners Against Violence, 24-hour sexual assault crisis line: 909-885-8884
- Option House. 24-hour dating/domestic violence crisis line: 909-381-3471
- Online chat: <https://www.loveisrespect.org/>

For more information, visit www.redlands.edu/titleixandequity

Accommodations

If you are a student with a disability requesting reasonable academic accommodations in this course, please contact Academic Support and Accessibility (ASA). ASA is located in the Student Success Center on the ground floor of the Armacost Library. You can reach the office at 909-748-8069 or asa@redlands.edu. All requests for reasonable accommodations require registration with ASA in advance of need. Faculty, students, and ASA will work together regarding classroom accommodations. You are encouraged to discuss approved accommodations with your faculty. More information is available on the ASA webpage.

If there are ways that simple changes to the class could improve your learning please feel free to reach out to me directly.

Counseling Center

The Counseling Center provides free and confidential mental health services, including short-term

individual therapy, group therapy, single-session therapy, consultations, and urgent appointments to all students with in-person or virtual options. Our Counseling Center is committed to inclusivity and to providing a supportive space for everyone. Please call 909-748-8108 to schedule an appointment or email counseling_center@redlands.edu. If a student is in crisis, please call 909-748-8960 for the 24/7 mental health crisis line. For more information on our resources, go [here](#). Another option for individual therapy for all students is TimelyCare, which provides virtual therapy immediately (Talk Now) or up to 12 scheduled virtual therapy sessions per year. Students can choose their therapist from a list of providers for the scheduled therapy option.

Conflict Resolution Center

Experiencing a conflict? Whether it's with a friend, roommate, another member of a student organization, or faculty or staff member, conflicts happen. Learning to navigate conflicts is important to success in virtually any field, and a vital step in being a part of a community and having healthy, meaningful relationships with others. See <https://sites.redlands.edu/conflict-resolution-center/student-resources/> for more information.

The Care Team

The University CARE Team exists to help provide support and resources to students that are overwhelmed, experiencing significant distress, or possibly present some risk to themselves or others. As a faculty member, I may reach out to students about whom I am concerned to talk individually, and/or refer them to the CARE Team. If you have concerns about a fellow student, consider sharing your concern with the CARE Team via their online form. This is part of who we are as a caring,

proactive community where we all look out for one another. Additionally, if you feel that you or someone else needs immediate mental health support, the University has a 24/7 mental health crisis line at 909-748-8960, and the Timely Care app, which offers on-demand emotional care. Both services connect to a live, licensed counselor.

Additional Resources

If you are in need of additional resources, please refer to the available programs below.

Book Lending Program

The Book Lending Program is an initiative to ensure the academic success of First-Generation students (students who are the first to go to college in their families who meet a particular estimated family contribution [EFC] level). Funded through alumni donations, this program provides books and other classroom materials, when needed, for First-Generation students who could not otherwise afford to purchase them. Books are returned at the end of the course, to be used by other First-Generation students the next semester. The program works alongside the Library and faculty members to ensure the availability of books and classroom materials. For more information, click the link above or contact blp@redlands.edu.

Emergency Student Loans

Student Financial Services (SFS) administers a short-term, no-interest loan fund to assist students experiencing an emergency or cash-flow problem. Except in unusual circumstances, these loans do not exceed \$200 and are billed to the student's account. Evidence of repayment ability is a prerequisite for all short-term loans made to students. Students are not eligible for more than one emergency student loan

per term. Contact: SFS@redlands.edu or x8047

Student Lounges

Lounges for all students to sit, work, and eat can be found [here](#) on the University website.

Student Affairs Discretionary Fund

These endowed funds in Student Affairs can be used to support student success and remove impediments that otherwise may cause the student to stop or leave school. To utilize this fund, divisional leadership should be made aware of the student in dire need of financial support. This support can be anything from personal expenses, such as utility bills, gas money, emergency trips home due to family tragedy, off-campus counseling, and other medical costs, and occasionally mental health assessment expenses. Students receive grants based on their financial need. Contact: student_affairs@redlands.edu.

Student Food Support Pantry

The Student Food Support Pantry is a resource available to all established full and part-time University of Redlands students facing food insecurities. The Pantry is located on the north side of North Hall. This space is an open, no-questions-asked space with dried and canned goods, and non-perishable items, as well as seasonal fresh produce from our sustainable farm and limited refrigerated goods. Food for this distribution is provided in partnership with Feeding America Riverside and San Bernardino. It is also funded through private donations, ASUR, and the Office of Community Service Learning. For more information, please contact SURF@redlands.edu.

Course Schedule

Schedule is subject to change as we progress through the semester. You will be notified of any changes in class.

PDEs - CLASS SCHEDULE

DATE	DAY	TOPIC	ASSIGNED	DUE
09/03/24	Tuesday	Introduction to PDEs	READ F 1-3 REVIEW E&P Ch 3 HW - Lesson 1 + ODEs Review	
09/05/24	Thursday	The Heat Equation	READ F 5 HW - Lesson 2,3 + Additional	HW 1 (due Sunday 11:59pm)
09/10/24	Tuesday	Eigenvalues Problems and Separation of Variables	READ F 6 HW - Lesson 5 + Additional	
09/12/24	Thursday	Transforming Non-Homogeneous Boundary Conditions	READ F 7 HW - Lesson 6 + Additional	HW 2 (due Sunday 11:59pm)
09/17/24		No Class	No HW	
09/19/24		No Class	No HW	
09/24/24	Tuesday	Separation of Variables more Complicated examples	READ F 8 HW - Lesson 7	
09/26/24	Thursday	Transforming Harder Problems into Easier Ones	HW - Lesson 8	HW 3 (due Sunday 11:59pm)
10/01/24	Tuesday	Separation of Variables more examples	REVIEW F 5-8 READ Online material Laplace's Equation HW - Additional	
10/03/24	Thursday	Laplace's Equation	READ F 9 Get Caught up on Past HW!	Quiz1 - in class
10/08/24	Tuesday	FALL BREAK	FALL BREAK	FALL BREAK
10/10/24	Thursday	Eigenfunction Expansions	HW - Lesson 9	HW 4 (due Sunday 11:59pm)
10/15/24	Tuesday	More Practice with Eigenfunction Expansions	READ F 10 HW - Additional	
10/17/24	Thursday	Sine and Cosine Transforms	READ F 11-12 HW - Lesson 10 + Additional	HW 5 (due Sunday 11:59pm)
10/22/24	Tuesday	Fourier Transform	READ F 13 HW - Lesson 11 (1-3) + Lesson 12	

10/24/24	Thursday	Laplace Transform	READ F 14 HW - Lesson 13 (2-4) + Additional	HW 6 (due Sunday 11:59pm)
10/29/24	Tuesday	Convection Terms change of coordinates	READ F 16-17 HW - Lesson 15	
10/31/24	Thursday	Review of Transforms	HW - Additional Practice	HW 7 (due Sunday 11:59pm)
11/05/24	Tuesday	Extra - Duhamels Principle (if time)	Get Caught up on Past HW!	Quiz 2 - in class
11/07/24	Thursday	The Wave Equation and D'Alembert Solution	READ F 19-20 HW - Lesson 17 (1,3,4)	HW 8 (due Sunday 11:59pm)
11/12/24	Tuesday	Boundary Conditions for the Wave Equation	READ F 21 HW - Lesson 19 (1,2) + Lesson 20 (1,2,6,7)	
11/14/24	Thursday	Dimensionless problems and Canonical Forms	HW - Lesson 22 (1,2,5) + Lesson 23 (1-3)	HW 9 (due Sunday 11:59pm)
11/19/24	Tuesday	More Practice Change of Variables and Canonical Forms	READ TBA HW Lesson 23 (4-6)	
11/21/24	Thursday	FREE DAY - Material TBD		HW 10 - (due Sunday 11:59pm)
11/26/24	Tuesday	THANKSGIVING	THANKSGIVING	THANKSGIVING
11/28/24	Thursday	THANKSGIVING	THANKSGIVING	THANKSGIVING
12/03/24	Tuesday	FREE DAY - Material TBD	HAND OUT FINAL EXAMS Get Caught up on Past HW!	Quiz 3 - in class
12/05/24	Thursday	In Class Final Exam Time		
12/10/24	Tuesday	FINAL EXAM DUE	FINAL EXAM DUE	FINAL EXAM DUE