Differential Equations

About This Course

My goal is to help each and every student achieve their personal learning goals for differential equations. I value a diversity of opinions, learning approaches, cultural backgrounds, abilities, and ideas in my class. Classes, lectures, and group interactions should be a safe learning space where each member of the community feels valued, listened to, and respected. It is the responsibility of each of us to ensure that we are lifting up our peers, breaking free from old biases, reaching across cultural or socioeconomic boundaries, and supporting each other. If at any time in the class you feel that there is something that could be done to improve your learning or your experience please let me know. I am here to lift you up and help you learn!

Differential equations are a powerful and fun extension of what we have learned in calculus. They are the language in which many of the laws of nature are expressed. They are used in physics, engineering, environmental science, biology, chemistry, and many other disciplines.

Course Learning Objectives

By the end of this course you should have the ability to:

1. Classify a differential equation and identify a solution method.
2. Understand mathematical models using first and second order differential equations.
3. Solve first order differential equations.
4. Solve higher order homogeneous and non-homogeneous differential equations.
5. Solve systems of differential equations.
6. Use computers and basic numerical methods to solve differential equations.
7. Analyze the stability of systems of differential equations.
8. Use Laplace Transform methods to solve differential equations.
9. Have some fun with differential equations.

Texts

We will follow content and problems will be assigned from:

- Edwards & Penney, Differential Equations and Boundary Value Problems

This is a great online reference:

- Elementary Differential Equations with Boundary Value Problems, William F. Trench, Trinity University

Our course website can be found at:

DifferentialEquations.JoannaBieri.com

Homework will be handed in online and grades will be posted on Canvas:

Canvas - Differential Equations

Classwork

My goal in this class is to support your learning experience, but it is your responsibility to be actively engaged in the course to get the most out of the experience. I do expect to see you in class every day with a positive attitude and a willingness to learn.

i. **Class Preparation and Practice Problems**:

Before you arrive to class you are expected to participate in the preparatory materials. Each day content videos will be posted on the class website covering the basic content for the day's class. You should watch the videos and take notes. In addition practice problems will be posted that you can try to test your understanding. You should come to class having tried most of these problems. Your solutions should be hand written and you should bring your notes and solutions to class.

Practice problems are due before each class and solutions will be provided when you submit your work. These are graded as submitted or not submitted and worth one point. It is okay if you got some or all of them wrong. Your goal is to get as far as you can before looking at solutions and coming to class for help. There will be a total of 36 practice problem sets in this class, you must submit 32.

During class we will work in groups with our peers to make sure we understand all the material. You will have a chance to ask lots of questions, present your work, and see your peers present their work.

ii. **Quizzes**:

Each Friday we will have an in-class quiz (worth 2 points). The content for the quiz will be taken directly from the practice problems problems. It is your responsibility to understand the practice problems well enough to succeed on the quiz. Please come to office hours if you need help. The quiz is open notes - so any notes you take watching lecture videos or any practice problems you have completed can be used during the quizzes. These must be your handwritten or typed notes! Quizzes are graded as pass/fail (no partial credit). You are allowed to retake each quiz once. If you need an additional retake, you are required to come to office hours. There will be 12 quizzes available in the class.

There will be no exams in the class - the quizzes act as our exams.

iii. **Presentations, Attendance and Advanced Problems**:

Each week you will have the opportunity to participate in advanced problem sets. These will be more complicated, theoretical, or applied problems. They are graded as pass/fail. These should be carefully written up so that they meet all of the following criteria:

[ ] Clearly restate the problem.
[ ] Explain solutions steps and mathematical reasoning.
[ ] Completely solve all parts of the problem.
[ ] Discuss the solution: does it make sense? what does it mean? etc.
[ ] Reach a correct solution/conclusion.

Class attendance and participation is expected. If you are going to miss class you must let me know ahead of time. Every day of class you have the opportunity to present some of the in class challenge problems to the class, or to your smaller group. Your group will prepare the presentation and then take turns presenting parts of the problem. You will be writing on the whiteboard while to talk or one person can write while another talks. Credit will only be given for presentations that:

[ ] Clearly restate the problem.
[ ] Explain solutions steps and mathematical reasoning behind the solution
[ ] Correctly solve all parts of the problem.

Unexcused absences will result in a reduction of your grade. Let me know before class if you will be missing class and your absence can be excused.

Grading Criteria

To **pass this class earning a grade of 2.0** you must meet the basic course learning objectives. This can be shown by

- passing 10 out of the 12 quizzes
- submitting 32 out of the 36 practice problem sets
- missing fewer than 8 classes.

Students have the opportunity to show advanced understanding or mastery of the course concepts by participating in more of the class content, passing more quizzes, and submitting advanced problem sets. See the table below for how to earn each grade. You must check each box in the row to earn the grade listed. For example, to earn a 40 you must hand in all the homework, pass all the quizzes, do 12 advanced problem sets and miss fewer than 2 days of class (unexcused).

Grade	Practice Problems	Quizzes	Advanced Problems	Attendance	Total Points
4.0	36	24	12	missed 2 or less = 10	82
3.7	36	22	8	missed 2 or less = 10	76
3.3	34	22	6	missed 4 or less = 8	70
3.0	34	22	4	missed 4 or less = 8	68
2.7	32	20	2	missed 6 or less = 4	58
2.3	32	20	0	missed 6 or less = 4	56
2.0	32	20	0	missed 8 or less = 2	54
1.7 and below	less than 32	less than 20	0	missed more than 8 = 0	less than 54

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.

Aditional 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.

WEEK	DAY	DATE	TOPIC	HW Practice	ADV PPROB
Week 1	M	Jan 05			
	W	Jan 07	Integration Review	HW 1	
	F	Jan 09	Integration as a Solution	HW 2	
Week 2	M	Jan 12	Separable Equations	HW 3	
	W	Jan 14	Linear First Order	HW 4	
	F	Jan 16	Substitution	HW 5	ADV 1
Week 3	M	Jan 19	**NO CLASS – MLK DAY**		
	W	Jan 21	Exact Equations	HW 6	
	F	Jan 23	Population Models	HW 7	ADV 2
Week 4	M	Jan 26	Pause for Understanding	HW 8	
	W	Jan 28	Higher Order Linear Eqns	HW 9	
	F	Jan 30	Linear Constant Coef.	HW 10	ADV 3
Week 5	M	Feb 02	Linear Constant Coef.	HW 11	
	W	Feb 04	Non-Homogeneous	HW 12	
	F	Feb 06	Variation of Parameters	HW 13	ADV 4
Week 6	M	Feb 09	More Examples	HW 14	
	W	Feb 11	Boundary Value Problems	HW 15	
	F	Feb 13	Applications	HW 16	ADV 5
Week 7	M	Feb 16	Laplace Transform	HW 17	
	W	Feb 18	Laplace Transform	HW 18	
	F	Feb 20	Laplace Transform Tricks – convolutions	HW 19	ADV 6

	M	Feb 23	**SPRING BREAK**		
Week 8	W	Feb 25	**SPRING BREAK**		
	F	Feb 27	**SPRING BREAK**		
	M	Mar 02	Review of Power Series	HW 19	
Week 9	W	Mar 04	Series Solutions	HW 20	
	F	Mar 06	More Practice with Series	HW 21	ADV 7
	M	Mar 09	Regular Singular Points	HW 22	
Week 10	W	Mar 11	Method of Frobenius	HW 23	
	F	Mar 13	Bessel's Equation	HW 24	ADV 8
	M	Mar 16	First Order Systems and Review of Matrices	HW 25	
Week 11	W	Mar 18	Homogeneous Systems	HW 26	
	F	Mar 20	Defective Cases	HW 27	ADV 9
	M	Mar 23	Non-Homogeneous Systems	HW 28	
Week 12	W	Mar 25	Applications of Systems	HW 29	
	F	Mar 27	Intro to Nonlinear Systems	HW 30	ADV 10
	M	Mar 30	Fixed Points and Stability and Bifurcations	HW 31	
Week 13	W	Apr 01	Applications of Nonlinear Systems	HW 32	
	F	Apr 03	Python Basics		ADV 11
	M	Apr 06	Numerical Solutions	HW 33	
Week 14	W	Apr 08	Euler's Method	HW 34	
	F	Apr 10	Programming Euler's Method	HW 35	ADV 12
Week 15	M	Apr 13	Make up Quizzes!		
	W	Apr 15	Last Day to Make up Quizzes!		