

Math 331: Differential Equations

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Student Help Hours (Formerly known as Office Hours) Tuesday 10 am - noon and Wednesday 10:50 - 11:50 am, or by appointment. Come by my office or join me on Zoom, whichever is easier for you.

Course Description This course will provide the student with an introduction to differential equations, with the focus being on real-world applications. Topics include: First order differential equations, population and other physical models, linear equations of higher order, systems of differential equations, and nonlinear systems and phenomena. The course will also use technology (in particular Mathematica) to help us model and visualize problems.

Learning Outcomes By the end of the course, successful students will be able to:

- Apply their knowledge of differential equations to real-world phenomena.
- Compare the many different techniques available for solving ordinary differential equations and most importantly determine which is appropriate for a given problem.
- Utilize technology to both find and visualize solutions to differential equation problems.
- Successfully employ techniques to analyze solutions of first and second order linear differential equations, systems of equations, and almost linear systems.
- Draw conclusions about the solutions to a variety of differential equations, without finding the solutions.
- Understand the role of modeling with differential equations in problem solving.

Course Materials

Textbook: *Elementary Differential Equations and Boundary Value Problems*. Boyce and DiPrima, 11th Ed.
Devices: Graphing calculator, access to a computer with Mathematica

Important Dates

We will have six in-class tests and a final exam. Each test will focus on the material learned since the last test, but will (necessarily) contain previous material. The final will be comprehensive.

If you have a conflict with one of these dates please email me ASAP.

Test 1	Friday 2/3, in class
Test 2	Friday 2/17, in class
Test 3	Friday 3/3, in class
Test 4	Monday 3/27, in class
Test 5	Monday 4/10, in class
Test 6	Monday 4/24, in class
Final Exam	Saturday 4/29, 8:30 - 11:30 am

The final course grade is determined in the following way:

Homework & Activity Responses	40%
Projects (3% each)	6%
Tests (7% each)	42%
Final Exam	12%

A grade scale will be determined after final grades are computed, but will be no worse than the scale given below. Attendance and class participation will be considered when determining marginal grades.

		B+	87-89	C+	77-79	D+	67-69		
A	93-100	B	83-86	C	73-76	D	63-66	F	0-59
A-	90-92	B-	80-82	C-	70-72	D-	60-62		

Attendance Policy Class attendance is expected because doing well in this class is hard if you aren't here to work on the material with us. However, life happens and sometimes you have to miss. If you know in advance you're going to miss class, make sure you turn in any work due that day (Inquire makes this easy!). Let me know if you need help learning the material we're going to cover, whether that means getting connected with someone who will share their notes or coming to office hours with questions. If you are going to miss a quiz, let me know as soon as you can so we can figure out how to handle that. If you don't know in advance (because sometimes life happens unexpectedly), talk with me as soon as you can about what you can make up and how to get caught up. I will be as generous as I can while still keeping the class fair for all students.

Homework I will assign a graded homework problem each day. Submit your homework in class OR via Inquire as a PDF or Word file. (Picture files may not allow me to give you comments, so copy/paste pictures into Word or get a PDF scanner app on your phone.) These problems are due at the beginning of the next class so you can ask questions about them before we start new material. **Since I can't accept homework turned in after we've done it in class, late homework will usually not be accepted.** If you are unable to complete the homework on time for some reason, please contact me about that as soon as you can so we figure out how to handle the situation. I am happy to help with these problems, but **you may not work on them with anyone but me.**

Co-Curricular Activities The MCSP department and Roanoke College offer many opportunities to engage with mathematical ideas outside of classes. Members of this class are encouraged to attend many of these activities, however attending at least three are mandatory. Examples include MCSP Conversation Series talks and student research showcases - if you're unsure if a given activity makes sense for this purpose, please email me to ask. After you attend (preferably within one week), submit a brief response to the activity. Your responses will count as part of your homework grade.

Projects We will have two projects, each on an application of differential equations. They will be extended problems written up as a paper, with emphasis placed not only on mathematical correctness but on the quality of the explanation.

Daily Problems After each section I will assign some problems from the book for practice. These will not be collected - the answers are in the back and they are your chance to make sure you understand the material and to get help whenever you realize you need it. Feel free to work with other students on these problems.

Covid Policy If you have a temperature of 100.4 or higher or other coronavirus symptoms, don't come to class. Call Health Services IMMEDIATELY. Do not come to class or go to any public area on campus. If you give Health Services permission they can notify me that you have consulted them about coronavirus symptoms so I know what's going on and we can talk about how to get you excused from any work you miss. If Health Services informs you that you should isolate and not attend class for multiple days or weeks, please let me as soon as you can so we can make a plan to keep you caught up in the course. All absences caused by isolation ordered by Health Services will be excused.

Mask Policy Unless the college changes its policy, face coverings/masks are no longer required. However, anyone is welcome to wear a mask for some or all of the semester. If you feel sick and plan to come to class, please wear a mask over your nose and mouth! (The rest of the class thanks you in advance.)

Expected Work Policy This course expects you to spend at least 12 hours of work each week inside and outside of class.

Special Needs If you get any academic accommodations in this course, please let me know and provide your documentation as soon as you can - preferably within the first 2 weeks of the semester. (Check with the Center for Teaching and Learning for their scheduling guidelines.)

Academic Integrity I expect all of you to follow the Academic Integrity policies of Roanoke College. All graded work should be your own work! If you ever have questions about how these policies apply to our class please contact me. Any violations of these policies will automatically be turned over to the Academic Integrity Council.

Pandemic Planning If college policies change due to the pandemic, I will distribute an updated syllabus. I will email you our new plan and post details on Inquire. You should email me with any questions or challenges that arise.

Course Schedule The following schedule is approximate and subject to change except for the test dates. It should give you an idea of the timing of the topics covered and assignments.

Day	Date	Section / Topic	Projects
W	J 18	Intro / 1.1: direction fields	
F	J 20	1.2: solutions / 1.3: classification	
M	J 23	2.1: linear equations via integrating factors	
W	J 25	2.2: separable equations	
F	J 27	2.3: modeling w/ first order equ's	
M	J 30	2.4: linear vs non-linear / 2.5	
W	F 1	2.5: autonomous equ's & population dynamics	
F	F 3	Test 1	
M	F 6	2.6: exact equations	
W	F 8	2.6	
F	F 10	3.1: homogeneous equ's w/ constant coef's	
M	F 13	3.1 / 3.2	
W	F 15	3.2: solutions to linear homogeneous equ's	
F	F 17	Test 2	
M	F 20	3.3: complex roots	
W	F 22	3.4: repeated roots	
F	F 24	3.5: nonhomogeneous equ's - undetermined coef's	
M	F 27	3.6: nonhomogeneous equ's - parameter variation	
W	M 1	7.1: linear systems of DE's / 7.2: matrix review	
F	M 3	Test 3	
Spring Break			
M	M 13	7.3: linear algebra review	
W	M 15	7.4: theory of linear systems of first order DE's	
F	M 17	7.5: homogeneous linear systems w/ constant coef's	
M	M 20	7.6: complex e-values	Project 1 Assigned
W	M 22	7.8: repeated e-values	
F	M 24	7.8	
M	M 27	Test 4	
W	M 29	9.1: phase plane	

F	M 31	9.2: autonomous systems & stability	
M	A 3	9.3: locally linear systems	Project 1 Due
W	A 5	9.3	
F	A 7	No Class	
M	A 10	Test 5	
W	A 12	9.4: competing species	
F	A 14	9.5: predator-prey equ's	Project 2 Assigned
M	A 17	9.6: Liapunov's second method	
W	A 19	9.6	
F	A 21	Project work day	
M	A 24	Test 6	
Tu	A 25	Project work day	Project 2 Due
Sa	A 29	Final Exam 8:30 – 11:30 am	