Instructor: Dr. Chris Lee Trexler 270D clee@roanoke.edu

Office Hours: I am available for various office hours Monday through Thursday. All office hours are by appointment. To make an appointment, please use the link: **https://drchrislee.youcanbook.me**

Overarching Philosophy: Your ability to do Mathematics is not measured by a number stamped on your forehead at birth. Ability is a direct result of effort, and everything in this course is designed to encourage and reward maximum effort. No matter what your ability or grade is at any given moment, it can be changed through focused effort.

Intended Learning Outcomes: 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 non-linear systems and phenomena. At the end of the course 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 – most importantly determining 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.

Required Text: *Elementary Differential Equations and Boundary Value Problems.* Boyce and DiPrima, 11th Ed.

Community: Please feel free to become an active member of our department's community. Each of the three disciplines in our department has a student club and you should join! The Roanoke College Student Chapter of the Mathematical Association of America (or "Math Club" for short) meetings every other week, plays and learns about games and hosts evening events and the annual Pi-Day celebration! In addition, our department offers MCSP Tea every week on Thursdays from 2:15-3:15pm; come by Trexler 271 to talk to and meet other students as well as chat with the MCSP faculty members in a casual setting!

Attendance: Attendance is critical to the understanding of the material in the course; it is both required and expected. Absence from class has no effect on due dates and missed work may not be made up.

Late Work: Unless specific permission is given in advance, no late work will be accepted.

Academic Integrity: Students are expected to follow the integrity policy detailed in the handbook *Academic Integrity at Roanoke College*. All work that a student submits for a grade must be ***solely*** the work of that student unless the instructor has given explicit permission for students to work together.

Grading Components

Testing: As described in more detail on the next page, we will be making use of mastery-based testing.

Problems of the Day: At the end of each class period during which content is discussed, practice problems will be assigned. It is expected that students work all these problems. To keep you from procrastinating and to measure understanding, an overwhelming majority of class days will begin with a "problem of the day". When you enter the classroom there will be a problem displayed for you to work and turn in. This problem will be due at 1:16pm regardless of when you enter the classroom.

Grading: Components of a student's grade will be weighted as follows:

Mastery: 85% Problem of the Day: 10% Projects: 5%

Grading Scale: A grade scale will be determined after final averages are computed but will be no lower than the scale given below.

0	*60*	*63*	*67*	*70*	*73*	*77*	*80*	*83*	*87*	*90*	*93*
F	*D-*	*D*	*D+*	*C-*	*C*	*C+*	*B-*	*B*	*B+*	*A-*	*A*

Co-Curricular Engagement: The MCSP Department offers a series of talks (MCSP Conversation Series) that appeal to a broad range of interests related to your fields of study. You are invited to be involved with all these meetings. After attending, submit a one-page paper reflecting on the discussion through Inquire. These reflection papers earn **extra credit**, with .5% add to your course average for each attended, up to 2% total. In addition, individually you may request that other appropriate events can count.

Time Commitment: This course expects you to spend at least 12 hours of work each week inside and outside of class.

We will be making use of **mastery-based testing** rather than a points-based system. Mastery-based testing is very different from what you are used to – do not hesitate to ask me questions.

Description: You only receive credit for answers that demonstrate you completely understand (have mastered) a topic. But, you get many chances to display mastery throughout the semester with no penalty whatsoever for earlier attempts.

- The course has been boiled down to 18 essential types of questions, or "topics".
- Your mastery of questions on these topics is assessed through the working of problem each Friday and during the scheduled final exam period.
- Each problem submitted is graded as either "Mastery" or "Not Mastered". A grade of Mastery indicates that you have demonstrated full understanding of the concept being tested and further work on the topic is not necessary.
- Once you have mastered a problem you need not ever attempt it again.
- There is no penalty whatsoever for multiple attempts taken to achieve mastery.
- Mastery does not mean perfect, it means you understand and can demonstrate all fundamentals of the topic and are proficient at the level desired for the course – you do not need to study the topic further.

Your overall test grade is then determined by the number of topics you have mastered.

#Mastered	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Exam Grade	100	96	92	88	84	80	76	72	68	64	60	56	52	48	44	40	36	32

Notes on Master-Based Testing (in no specific order)

- Clear content objectives, students continually know exactly what they need to work on to improve.
- Credit only for eventual mastery. No partial credit. Multiple attempts with complete forgiveness.
- A points-based system sets arbitrary deadlines by which time perfection must be attained.
- Perseverance: Points – try a problem once, maybe twice, hope for the best.
  Mastery – Keep trying until you succeed (and I know you can)
- Use of feedback: Points – do I agree with the instructors grading
  Mastery – what can I do to demonstrate that I understand the concept
- Reduced Test Anxiety: Points – every test has the potential to damage your GPA.
  Mastery – no one test can harm your grade.
- Intelligent Test Preparation: You may choose to skip problems on a test. Better to achieve mastery on some than to demonstrate mediocrity on all.
- A "broad and superficial" strategy may earn a C or D in a points-based system, in mastery you will fail.

Course Schedule

Tue	Jan 14	Intro	1.1, 1.2, 1.3	Models, Direction Fields, and Solutions
Thu		Topic 1	2.1	Linear Equations: Method of Integrating Factors
Tue	Jan 21	Topic 2	2.2	Separable Equations
Thu		Topic 2	2.3	Modeling
Tue	Jan 28	Topic 3	2.5	Population Dynamics
Thu		Topic 4	2.6	Exact Equations
Tue	Feb 4	**Mastery Day**		
Thu		Topic 5	3.1	Homogeneous Equations with Constant Coefficients
Tue	Feb 11	Topic 6	3.2	Solution of Linear Homogeneous Equations
Thu		Topic 7	3.3, 3.4	Characteristic Equation – Complex and Repeated Roots
Tue	Feb 18	Topic 8	3.5	Undetermined Coefficients
Thu		**Mastery Day**		
Tue	Feb 25	Topic 9	7.1, 7.2, 7.3	System of Equations, Linear Algebra Review
Thu		Topic 10	7.4	Theory of Systems
Spring Break				
Tue	Mar 10	Topic 10	7.4	Theory of Systems
Thu		Topic 11	7.5, 7.6	Homogeneous Systems / Complex Eigenvalues
Tue	Mar 17	**Mastery Day**		
Thu		Topic 12	7.8	Repeated Eigenvalues
Tue	Mar 24	Topic 13	9.1, 9.2	Stability and the Phase Plane
Thu		Topic 14	9.3	Locally Linear Systems
Tue	Mar 31	**Mastery Day**		
Thu		Topic 14	9.3	Locally Linear Systems
Tue	Apr 7	Topic 15	9.4, 9.5	Competing Species & Predator-Prey Models
Thu		Topic 16	9.6	Liapunov's Second Method
Tue	Apr 14	**Mastery Day**		
Thu		Wrap Up		
Thu	Apr 23	**Mastery Day** (Final Exam Period 8:30-11:30am)		