

Instructor:

Dr. Chris Lee
Trexler 270D
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Office Hours:

All office hours are by appointment.
To make an appointment, please use
the link:

<https://drchrislee.youcanbook.me>

| Mon | Tue | Wed | Thu | Fri |
|---------------------------------|-------------------------------|-------------------------------|-------------------------------|-----------------------------|
| Math 121 10:50 – 11:50am | | Math 121 10:50 – 11:50am | | Math 121 10:50 – 11:50am |
| INQ 240 1:10 – 2:10pm | Math 331 1:10 – 2:40pm | INQ 240 1:10 – 2:10pm | Math 331 1:10 – 2:40pm | INQ 240 1:10 – 2:10pm |
| Office Hours 2:15 – 3:45pm | Office Hours 2:45 – 4:15pm | Office Hours 2:15 – 3:45pm | Office Hours 2:45 – 4:15pm | |
| Curriculum Committee 4 – 5pm | | | | |

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.

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 non-linear systems and phenomena.

Ancillary Skill Goals:

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. Any absence that is not discussed with the instructor prior to the missed class is considered unexcused. If you accumulate 3 unexcused absences you will be dropped from the class with a grade of DF recorded. When absent, you are responsible for all material covered in class. Missing class has no effect on assignment due dates.

Cell Phones: This is very simple - no cell phones are allowed to be used or even visible in our classroom. This includes before, during, and after class. If a cell phone is seen, the student may be asked to leave the classroom and the day will be counted as an unexcused absence.

Homework: Homework problems will be assigned almost every class period and are due at the start of the next class. Each homework assignment is graded on a 15-point scale as follows:

- 5 pts – one specific problem for correctness, clarity, and thoroughness.
- 5 pts – approximately 7-10 problems graded for effort and completeness
- 5 pts – organization. The graded for correctness problem MUST be on top, all pages stapled, neat, & READABLE.

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

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

Tests: 85% Projects: 5% Homework: 10%

A scale will for final grades will be not be lower than the scale given below.

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

Academic Integrity: Students are expected to follow the integrity policy detailed in the handbook *Academic Integrity at Roanoke College*. Additionally, if you are ever uncertain as to how the College's policy pertains to any assignment or exam in this course, please ask me for clarification. The bottom line is that 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. You will have the opportunity on some quizzes and our main project to collaborate with another as you work in pairs. It is critical that you understand that collaboration means both parties are contributing equally and meaningfully to the assignment. Adding your name to the work of another, as well as using a divide-and-conquer approach, are both examples of seeking credit for work that is not your own.

MCSP Conversations: The MCSP Department offers a series of discussions that appeal to a broad range of interests related to these fields of study. These are known as the talks and lectures in the MCSP Conversation Series. You are invited to be involved with all of these meetings; however, participation **at least three** of these sessions is mandatory. After attending, submit a one-page paper reflecting on the discussion. This should **not** be a regurgitation of the content, but rather a personal contemplation of the experience. These reaction papers will be submitted through Inquire; your final grade will be reduced by 2% if this is not completed

Testing: 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 16 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.

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| #Mastered | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| Exam Grade | 100 | 95 | 90 | 85 | 80 | 75 | 70 | 65 | 60 | 55 | 50 | 45 | 40 | 35 | 30 | 25 |

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 (improvement!)
- 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.
- No longer will any of us have to wonder just what exactly a 7/10 means on a problem compared to an 8/10...
- A “broad and superficial” strategy may earn a C or D in a points-based system, in mastery you will fail.

Course Schedule This course expects you to spend at least 12 hours of work each week inside and outside of class.

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|---------------------|---------|-----------------------|---------------|--|
| Thu | Aug 30 | Intro | 1.1, 1.2, 1.3 | Models, Direction Fields, and Solutions |
| Tue | Sept 4 | Topic 1 | 2.1 | Linear Equations: Method of Integrating Factors |
| Thu | | Topic 2 | 2.2, 2.3 | Separable Equations and Modeling |
| Tue | Sept 11 | Topic 3 | 2.4, 2.5 | Linear/Nonlinear Equations, Population Dynamics |
| Thu | | Mastery Day | | |
| Tue | Sept 18 | Topic 4 | 2.6 | Exact Equations |
| Thu | | Topic 5 | 3.1 | Homogeneous Equations with Constant Coefficients |
| Tue | Sept 25 | Topic 6 | 3.2 | Solution of Linear Homogeneous Equations |
| Thu | | Mastery Day | | |
| Tue | Oct 3 | Topic 7 | 3.3, 3.4 | Characteristic Equation – Complex and Repeated Roots |
| Thu | | Topic 8 | 3.5, 3.6 | Undetermined Coefficients / Variation of Parameters |
| Tue | Oct 9 | Topic 9 | 7.1, 7.2 | System of Equations, Linear Algebra Review |
| Thu | | Mastery Day | | |
| Fall Break | | | | |
| Tue | Oct 23 | Topic 10 | 7.3, 7.4 | Linear Algebraic Equations / Theory of Systems |
| Thu | | Topic 11 | 7.5, 7.6 | Homogeneous Systems / Complex Eigenvalues |
| Tue | Oct 30 | Topic 12 | 7.8 | Repeated Eigenvalues |
| Thu | | Mastery Day | | |
| Tue | Nov 6 | Topic 13 | 9.1, 9.2 | Stability and the Phase Plane |
| Thu | | Topic 14 | 9.3 | Locally Linear Systems |
| Tue | Nov 13 | Topic 14 | 9.3 | Locally Linear Systems |
| Thu | | Mastery Day | | |
| Tue | Nov 20 | Project Presentations | | |
| Thanksgiving | | | | |
| Tue | Nov 27 | Topic 15 | 9.4, 9.5 | Competing Species & Predator-Prey Models |
| Thu | | Topic 16 | 9.6 | Liapunov's Second Method |
| Tue | Dec 4 | Mastery Day | | |
| Thu | | Wrap Up | | |

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| Thu | Dec 13 | Mastery Day (Final Exam Period 2-5pm) |
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