**Instructor:** Dr. Chris Lee Trexler 270D clee@roanoke.edu (540) 375-2347

**Office Hours:** I am available for office hours: Mon/Wed: 3:30 – 4:30pm Tue/Thu: 3:00-4:30pm
All office hours are by appointment. To make an appointment, please use the link:
**https://drchrislee.youcanbook.me/**

**Course Objectives**: *Continue to learn how to do mathematics!* Mathematics is a problem-solving discipline, and we all have room to improve. To develop as problem-solvers, we must focus on technique and not on memorization. In this course, we develop an understanding of the theory and elementary applications of functions of several variables, multiple integration, line integrals, and integral theorems of vector calculus. Living in a 3-spatial-dimensional world, it is clearly necessary to use such functions if we are to realistically model the world. Unfortunately, the graphical cues that are so helpful for functions of one variable are not as easy to visualize in 3 or more dimensions. The calculations are sometimes more difficult, requiring us to extend our notion of integration. The different types of integrals are beautifully connected at the end of the course in a series of fundamental theorems.

**Intended Learning Outcomes:** At the end of the course, successful students will be able to

- Apply techniques of differentiation and integration to solve problems involving functions of two or more variables and vector functions
- Understand the role of vector calculus in modern mathematics
- Determine when different coordinate systems are appropriate
- Distinguish among various types of integrals, and determine when to use each type

**Required Text:** ***Calculus***, Smith & Minton 4th edition, Chapters 12-14

**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. I will assume that if you accumulate 3 unexcused absences you are not interested in completing the course and will drop you from the class with a grade of DF (dropped-failing) recorded, regardless of your current average in the course. You, your advisor, and the registrar will receive a warning email at your second unexcused absence. When absent, excused or unexcused, you are responsible for all material covered in class. Work missed due to either an unexcused or excused absence can only be made up when arrangements are made in advance of the absence.

**Homework**: Homework problems will be assigned almost every class period and are due at the start of the next class period on Mondays and Wednesdays. Each HW assignment is graded satisfactory/unsatisfactory. Your HW average is calculated at the end of the term by the percentage of assignments that are satisfactory. The following criterion must be met on an individual assignment for it to be considered satisfactory: Every problem must be attempted with work shown. At least two-thirds of the problems must be worked to completion (errors are allowed, we're learning here)

**Grading:** Components of a student's grade will be weighted as follows: Tests: 90% Homework: 10%
A scale will for final grades will be not be 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* |

**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 17 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** | 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.

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

**Cell Phones:** This is very simple - no cells 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.

**Reading and Participation:** The key to learning a topic in mathematics is participation. We will strive to have an active, rather than passive, classroom environment. The last page of the syllabus is a day-by-day outline of the sections that will be discussed in class. You are fully expected to have read the upcoming section before the class meeting! This does not mean you need to understand everything, but rather you should be familiar with the definitions and concepts from the sections; having read the section will allow you to ask better questions and follow along better in class.

**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**: As you already know from spending a few years here, 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% for each paper not submitted.

**Accessible Education Services (AES)** is located in the Goode-Pasfield Center for Learning and Teaching in **Fintel Library**. AES provides reasonable accommodations to students with documented disabilities. To register for services, students must self-identify to AES, complete the registration process, and provide current documentation of a disability along with recommendations from the qualified specialist. Please contact Dr. Sue Brown, Director of Academic Services and Acting Coordinator of Accessible Education Services, at 540-375-2247 or by e-mail at sbrown@roanoke.edu to schedule an appointment. If you have registered with AES in the past and would like to receive academic accommodations for this semester, please contact Dr. Brown at your earliest convenience to schedule an appointment.

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

| | | |
|---|---|---|
| Mon | Jan 15 | Intro |
| Wed | | Topic 1 – Section 10.6 – Surfaces in Space |
| Fri | | Topic 1 – Section 11.6 – Parametric Surfaces |
| Mon | Jan 22 | Topic 2 – Section 12.6 – Gradient and Directional Derivatives |
| Wed | | Topic 2 – Section 12.6 – Gradient and Directional Derivatives |
| Fri | | Topic 3 – Section 12.7 – Extrema of Functions |
| Mon | Jan 29 | Topic 3 – Section 12.7 – Extrema of Functions |
| Wed | | Topic 4 – Section 12.8 – Lagrange Multipliers |
| Fri | | Topic 4 – Section 12.8 – Lagrange Multipliers |
| Mon | Feb 5 | Topic 5 – Section 13.1 – Double Integrals |
| Wed | | Topic 5 – Section 13.1 – Double Integrals |
| Fri | | Topic 6 – Section 13.2 – Area, Volume, Center of Mass |
| Mon | Feb 12 | Topic 6 – Section 13.2 – Area, Volume, Center of Mass |
| Wed | | Topic 7 – Section 13.3 – Double Integrals in Polar |
| Fri | | Topic 7 – Section 13.3 – Double Integrals in Polar |
| Mon | Feb 19 | Topic 8 – Section 13.5 – Triple Integrals |
| Wed | | Topic 8 – Section 13.5 – Triple Integrals |
| Fri | | Topic 9 – Section 13.6 – Cylindrical Coordinates |
| Mon | Feb 26 | Topic 9 – Section 13.7 – Spherical Coordinates |
| Wed | | Topic 10 – Section 14.1 – Vector Fields |
| Fri | | Topic 10 – Section 14.1 – Vector Fields |
| **Spring Break** | | |
| Mon | Mar 12 | Topic 11 – Section 14.2 – Line Integrals |
| Wed | | Topic 11 – Section 14.2 – Line Integrals |
| Fri | | Topic 12 – Section 14.3 – Independence of Paths |
| Mon | Mar 19 | Topic 12 – Section 14.3 – Independence of Paths |
| Wed | | Topic 13 – Section 14.4 – Green's Theorem |
| Fri | | Topic 13 – Section 14.4 – Green's Theorem |
| Mon | Mar 26 | Topic 14 – Section 14.5 – Curl and Divergence |
| Wed | | Topic 14 – Section 14.5 – Curl and Divergence |
| **Good Friday** | | |
| Mon | Apr 2 | Topic 15 – Section 14.6 – Surface Integrals |
| Wed | | Topic 15 – Section 14.6 – Surface Integrals |
| Fri | | Work Topics |
| Mon | Apr 9 | Topic 16 – 14.7 – Divergence Theorm |
| Wed | | Topic 16 – 14.7 – Divergence Theorm |
| Fri | | Work Topics |

**Homework**

- Collected at the start of class every Monday and Wednesday

**Mastery Attempts**

- Every Friday throughout the term and during the final exam block.
- On any given opportunity you can work any topics which have been covered.

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|---|---|---|---|
| Mon | Apr 16 | Topic 16 – 14.8 – Stokes Theorm | |
| Wed | | Wrapup | |
| Fri | | Work Topics | |
| Mon | Apr 23 | Wrapup | |
| Tue | May 1 | **Final Exam** 2:00-5:00pm | |