Instructor:
Dr. Chris Lee Trexler 270D
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Office Hours:
Tue/Thu: 1:00 - 3:00pm, Wed: 2:30 - 3:30pm
Any time by appointment.

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

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!

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. 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:

- Each and every problem must be attempted.
- Work must be shown on each problem!
- 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 / Final Exam: 80% Homework: 10% Quizzes: 10%

A grade scale will be determined after final averages are computed, but will be no worse 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*

Exams:

We will be making use of "Mastery-Based Examinations". This system is very different from what you are used to – do not hesitate to ask me questions in class or my office at any time. In the mathematics community many are working with and researching this technique, one of the best starting sources for understanding can be found at https://mbtmath.wordpress.com. Much of what you'll find on the next two pages is taken from this resource.

Short 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 at all for earlier attempts.

Long Description:
The course has been boiled down to 16 essential types of questions, or "topics", your mastery of questions on these topics is assessed through four tests and the final exam. Each problem submitted is graded as either "Master" or "Apprentice". A grade of Master 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 on a future test, including the final exam. There is no penalty whatsoever for multiple attempts taken to achieve mastery.

Test 1: Topics 1-4
Test 2: Topics 1-8.
Test 3: Topics 1-12.
Test 4: Topics 1-16.
Final Exam: Topics 1-16.

Your overall exam grade (tests and final) is then determined by the number of questions/topics you have mastered.

#Mastered	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	50	40	30	20	10
w/ 100% HW/Quiz	100	96.8	93.6	90.4	87.2	84	80.8	77.6	74.4	71.2	68	60	52	44	36	28
w/ 50% HW/Quiz	90	86.8	83.6	80.4	77.2	74	70.8	67.6	64.4	61.2	58	50	42	34	26	18

Quizzes: Quizzes will be given frequently and also assessed as either Master, Apprentice, or Novice. Your quiz grade will be the percentage of quizzes for which you score Apprentice **or** Master, a softer threshold than testing to allow you to learn and get familiar with expectations.

Notes on Master-Based Testing (in no specific order, credit to Austin Mohr)

- 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 or else penalties a
- 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 on exams
  Points – do I agree with the instructors grading
  Mastery – what can I do to fully 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 actually choose to skip problems on a test. Better to achieve mastery on some than to demonstrate mediocrity on all. Given time constraints of the latter tests, most students will only be able to focus on 5-8 problems in 60 minutes.
- Formative Assessment
  Points: How many points is this error worth?
  Mastery: Will the student benefit from studying the concept again?
- No longer will any of us have to wonder just what exactly a 7/10 means on a problem compared to an 8/10…
- In most points-based systems, a blank exam question is a heavy blow to a student's grade. On the other hand, a student who provides a couple relevant formulas and something resembling the beginning of a solution may receive half credit or more. In the presence of constrained study time, a good strategy is to learn some basics about every test item. Such a student may earn half credit on most items together with a few lucky shots on easier items, which amounts to a passing grade overall. Take a moment to consider whether this experience has adequately prepared the student to apply mathematical thinking to nontrivial problems in the future.

  The "broad and superficial" strategy employed above earns no credit under a mastery-based system. Instead, a student who wishes to earn a passing exam grade must *fully* understand an appreciable subset of the main ideas of the course, and a student wishing to earn an A grade must *fully* understand most or all of the main ideas of the course. Even if students spend no time studying a particular item, I contend that the experience of pursuing deep understanding on the other items leaves them in a stronger position to engage deeply with the troublesome topic when it is needed in the future. Moreover, depth of understanding is critical to one's ability to apply existing mathematical knowledge in novel domains.

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 will be asked to leave the classroom and the day will be counted as an unexcused absence.

Academic Integrity: Students are expected to adhere to the Academic Integrity policies of Roanoke College. All work submitted for a grade is to be your own work! No electronic devices other than calculators can be taken out during any class or testing period.

MCSP Conversations: The Math, Computer Science and Physics department offers a series of discussions that appeal to a broad range of interests related to these fields of study. These co-curricular sessions will engage the community to think about ongoing research, novel applications and other issues that face our discipline.

Sessions are currently being scheduled, and all will be announced in advance.

Members of this class are invited be involved with all of these meetings; however participation in **at least three** of these sessions is mandatory. After attending, students will submit within one week of the presentation a one-page+ paper reflecting on the discussion. This should *not* simply be a regurgitation of the content, but rather a personal contemplation of the experience.

The Office of Disability Support Services (DSS), is located in the Goode-Pasfield Center for Learning and Teaching in **Fintel Library**. DSS provides reasonable accommodations to students with documented disabilities. To register for Disability Support Services, students must self-identify to the Office of Disability Support Services, complete the registration process, and provide current documentation of a disability along with recommendations from the qualified specialist. Please contact JoAnn Stephens-Forrest, MSW, Coordinator of Disability Support Services, at 540-375-2247 or e-mail her at: stephens@roanoke.edu to schedule an appointment. If you have registered with DSS in the past, and would like to receive academic accommodations for this semester, please contact Ms. Stephens-Forrest 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.

Date		**Section**
Wed	Aug 31	10.6 Surfaces in Space
Fri		11.6 Parametric Surfaces
Mon	Sept 5	12.6 Gradient and Directional Der. 1
Wed		12.6 Gradient and Directional Der. 2
Fri		12.7 Extrema of Functions 1
Mon	Sept 12	12.7 Extrema of Functions 2
Wed		12.8 Lagrange Multipliers 1
Fri		12.8 Lagrange Multipliers 2
Mon	Sept 19	*Review*
Wed		**TEST #1**
Fri		13.1Double Integrals 1
Mon	Sept 26	13.1Double Integrals 2
Wed		13.2 Area, Volume, Center of Mass
Fri		13.3 Double Integrals in Polar 1
Mon	Oct 3	13.3 Double Integrals in Polar 2
Wed		13.5 Triple Integrals 1
Fri		13.5 Triple Integrals 2
Mon	Oct 10	*Review*
Wed		**TEST #2**
Fri		13.6 Cylindrical Coordinates 1
Fall Break		
Mon	Oct 24	13.6 / 13.7 Spherical Coordinates
Wed		14.1Vector Fields 1
Fri		14.1Vector Fields 2
Mon	Oct 31	14.2 Line Integrals 1
Wed		14.2 Line Integrals 2
Fri		14.3 Independence of Paths 1
Mon	Nov 7	14.3 Independence of Paths 2
Wed		*Review*
Fri		**TEST #3**
Mon	Nov 14	14.4 Green's Theorem
Wed		14.5 Curl and Divergence
Fri		14.6 Surface Integrals 1
Mon	Nov 21	14.6 Surface Integrals 2
Thanksgiving Break		
Mon	Nov 28	14.7 Divergence Theorem 1
Wed		14.7 Divergence Theorem 2
Fri		14.8 Stokes Theorem
Mon	Dec 5	*Review*
Wed		**TEST #4**
Fri		*Wrapup*
Wed	Dec 14	**Final Exam** 2:00-5:00pm

Content Areas

1. Surfaces in Space / Parametric Surfaces
2. Gradients
3. Extrema of Functions
4. Lagrange Multipliers

5. Double Integrals
6. Area, Volume, Center of Mass
7. Double Integrals in Polar
8. Triple Integrals

9. Cylindrical Coordinates
10. Vector Fields
11. Line Integrals
12. Independence of Path

13. Green's Theorem
14. Curl & Divergence
15. Surface Integrals
16. Surface Integral Theorems: Divergence and Stokes