MATH 321 A: Vector Calculus
Fall 2025, MWF 12:00-1:00, Trexler 374

Instructor: Dr. Michael Weselcouch
Office: Trex #270F
Student Hours: MW 9:30-10:30, Th 1:00 - 2:00 or by appointment
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Course Description. 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 vectors, vector-valued functions, multiple integration, line integrals, and the integral theorems of vector calculus. Living in a 3-spatial-dimensional world, it is clearly necessary to use 3-dimensional 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.

Learning Outcomes. By the end of this 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 when different coordinate systems are appropriate
- Distinguish among various types of integrals and determine when to use each type

Course Materials.

(1) *Textbook: Calculus: Early Transcendental Functions;* Smith and Minton, 4th Edition
(2) *Calculator:* Any scientific or graphing calculator.
(3) *Computer:* A laptop computer with Mathematica installed, or access to Mathematica.
(4) *YouTube:* I will be posting supplementary videos to my YouTube channel.
(5) *MathMatize:* Homework will be posted here.

Attendance Policy. Attendance is a very important aspect of a student's success in this course. For that reason it makes up part of your grade. It will be taken at the beginning of every class meeting. If you arrive late, it is your responsibility to make sure you are not marked absent in my grade book. You get three free absences so that I don't have to distinguish between excused and unexcused absences. Please come see me immediately if you are an athlete or if you are involved with other activities on campus that will require you to miss class. If you should have an emergency that requires you to miss a large chunk of the course, please notify me ASAP.

Structure and Grading. 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.

Grading Scale

		93-100	A	90-92.99	A-
87-89.99	B+	83-86.99	B	80-82.99	B-
77-79.99	C+	73-76.99	C	70-72.99	C-
67-69.99	D+	63-66.99	D	60-62.99	D-

The final course grade is determined in the following way:

Mastery Tests	60%	Homework	10%
Problem of the Day	15%	Attendance	3%
Final Exam	12%		

Homework. There will be one homework assignment after nearly every lecture. These assignments are on our class's MathMatize page. All work submitted for a grade must be your own (for instance, you cannot use internet resources aside from my own YouTube videos or other videos linked on Inquire and, if you do work and study with others, the final write-up must be done by yourself). No late homework will be accepted, but at the end of the semester, your lowest three homework grades will be dropped.

Problem of the Day. We will start nearly every class with a Problem of the Day (POD). You will have about 5 minutes to complete the problem and you can use your notes (not computer) for assistance. PODs cannot be made up for unexcused absences. At the end of the semester, your lowest three POD grades will be dropped. These will be graded on a scale of 0 (not turned in) to 3 (perfect).

Tests. Mastery-based testing on the topics on the final page. Test questions are graded on a mastery/no mastery basis. You will have multiple chances to demonstrate mastery of a topic, but you do not have unlimited opportunities. Once you master a topic, you will not be directly tested on that topic (you often need to know a topic for later topics). If you do not achieve mastery of a topic on one test, new problems on that topic will be given on subsequent tests. My judgment of mastery is based on whether you show that you fully understand the question; your arithmetic and algebra do not have to be perfect, but there should be no flaws in your approach to the problem. In most cases, a topic will have multiple parts. If you get part (a) right but not part (b), you will get credit for 1/2 mastery. When you retake the topic, you must work all parts of the topic. Your grade will not be lowered if you do not master as many parts. While Mastery grading has the downside of no partial credit, the upsides include the ability to completely make up for early deficiencies. You always have the possibility of demonstrating mastery on 100% of the topics for the semester. The intent is not to allow you to delay learning topics to the end of the course, but to encourage you to continue studying to fully understand the early topics so that later topics can make sense. The exam is Friday, December 12, 2:00-5:00 and will consist of all 18 content areas.

Test Make-up Policy. Test make-ups are administered in accordance with College policy. Anticipated, excused absences must be reported to the instructor with appropriate certification *well before* the scheduled test date. Legitimate emergency absences must be reported with appropriate documentation within one week of returning to class. No other make-ups will be given.

Corrections to Grading. If you think an error may have been made in the grading of your test, carefully review the answer key posted on Inquire and then contact the instructor **within 1 week of the test's return** with your question. **Do NOT alter the original work**. The entire test may be re-graded and the test grade is *subject to remain the same, increase or decrease* at the discretion of the instructor.

MCSP Conversations. The MCSP department offers a series of talks designed to appeal to a broad audience. Members of this class are encouraged to attend many of these meetings, however attending at least one session is mandatory. The schedule for the talks is posted on Inquire. Within one week of attendance you must submit a response to the talk. This will count towards your Homework grade.

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

Electronic Devices. You can use only your calculator during class unless stated otherwise. (This means no cell phones - please set them on silent and leave them in your bag. You will be kicked out of the classroom if I see you taking cringe SnapChat selfies.)

Inquire Policy. Students are required to be knowledgeable of all postings on Inquire. It is each student's responsibility to consistently monitor Inquire for course information. This means every day! Any assignment that requires an Inquire upload will not be accepted in any other form. Also, to receive credit for uploads, the file must be readable on the instructor's college computer. It is the student's responsibility to make successful submissions. It is the student's responsibility to resolve technology problems through the college's IT department.

Academic Integrity. I expect all of you to follow the Academic Integrity policies of Roanoke College. All work submitted for a grade must be your own (for instance, you cannot use internet resources aside from my own YouTube videos or other videos linked on Inquire and, if you do work and study with others, the final write-up must be done by yourself). If you ever have questions about how these policies apply to our class please contact me. Any violations of our AI policies will automatically be turned over to the Academic Integrity Council.

Artificial Intelligence. There are situations when the use of generative AI may be appropriate and educational. If you believe that your use of generative AI is appropriate for a given assignment, please contact me (via email, or in person at least 3 days before the due date) to explain your rationale for its use. No use is permitted without prior permission.

Subject Tutoring. Subject Tutoring, located on the lower level of Fintel Library (Room 5), is open 4 pm – 9 pm, Sunday – Thursday. We are a Level II Internationally Certified Training Center through the College Reading and Learning Association (CRLA). Subject Tutors are friendly, highly-trained Roanoke College students who offer free, one-on-one tutorials in a variety of general education and major courses such as: Business, Economics, Mathematics, INQ 240, Modern Languages, Lab Sciences, INQ 250, and Social Sciences (see all available subjects at www.roanoke.edu/tutoring). Tutoring sessions are available in 30 or 60-minute appointments. Schedule an appointment at www.roanoke.edu/tutoring, or contact us at (540)375-2590 or subject_tutoring@roanoke.edu. We hope to see you soon!

AES. 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. To schedule an appointment, call (540)375-2247 or e-mail aes@roanoke.edu. If you have registered with AES in the past and would like to receive academic accommodations for this semester, please contact the AES at your earliest convenience to schedule an appointment and/or obtain your accommodation letter for the current semester.

Course Schedule

Date	Section	Topic	Mastery Tests
Wed Aug 27	9.1	Plane Curves and Parametric Equations	
Fri Aug 29	10.1-10.2	Vectors in 2 and 3 Dimensions	
Mon Sep 1	10.3	Dot Product	
Wed Sep 3	10.4	Cross Product	
Fri Sep 5	10.5	Lines and Planes in Space	1-2
Mon Sep 8	10.6	Surfaces in Space	
Wed Sep 10	10.6	Surfaces in Space	
Fri Sep 12	11.1	Vector-Valued Functions	3-4
Mon Sep 15	11.3	Motion in Space	
Wed Sep 17	11.3	Motion in Space	
Fri Sep 19		Mastery	1-6
Mon Sep 22	13.1	Double Integrals	
Wed Sep 24	13.3	Double Integrals in Polar Coordinates	
Fri Sep 26	13.3	Double Integrals in Polar Coordinates	7-8
Mon Sep 29	13.5	Triple Integrals	
Wed Oct 1	13.6	Cylindrical Coordinates	
Fri Oct 3	13.7	Spherical Coordinates	Pick 2
Mon Oct 6	13.7	Spherical Coordinates	
Wed Oct 8			
Fri Oct 10		Mastery	1-10
		Fall Break	
Mon Oct 20	14.1	Vector Fields	
Wed Oct 22	14.1	Vector Fields	
Fri Oct 24	14.2	Line Integrals	Pick 2
Mon Oct 27	14.2	Line Integrals	
Wed Oct 29	14.3	Independence of Path	
Fri Oct 31	14.3	Independence of Path	11-12
Mon Nov 3	14.4	Green's Theorem	
Wed Nov 5	14.4	Green's Theorem	
Fri Nov 7	14.5	Curl and Divergence	13-14
Mon Nov 10	14.6	Surface Integrals	
Wed Nov 12	14.6	Surface Integrals	
Fri Nov 14	14.7	The Divergence Theorem	15-16
Mon Nov 17	14.7	The Divergence Theorem	
Wed Nov 19	14.8	Stokes' Theorem	
Fri Nov 21	14.8	Stokes' Theorem	
Mon Nov 24		Mastery	17-18 + Pick 2
Wed Nov 26		**Thanksgiving Break**	
Fri Nov 28		**Thanksgiving Break**	
Mon Dec 1	14.9	Applications of Vector Calculus	
Wed Dec 3		Mastery	1-18
Fri Dec 5		Review	
Fri Dec 12		Final Exam 2:00 - 5:00	

Mastery Topics

Topic	Section	Description
(1)	§10.1	Dot Product
(2)	§10.2	Cross Product
(3)	§10.5	Lines and Planes
(4)	§10.6	Surfaces in Space
(5)	§11.1	Vector Functions
(6)	§11.3	Motion in Space
(7)	§13.1	Double Integrals
(8)	§13.3	Double Integrals
(9)	§13.5 – 13.6	Triple Integrals
(10)	§13.7	Spherical Coordinates
(11)	§14.1	Vector Fields
(12)	§14.2	Line Integrals
(13)	§14.3	Independence of Path
(14)	§14.4	Green's Theorem
(15)	§14.5	Curl and Divergence
(16)	§14.6	Surface Integrals
(17)	§14.7	Divergence Theorem
(18)	§14.8	Stokes Theorem