

Math 2468 Real Analysis in One Variable

Section A Fall 2023

Course Overview:

MATH 2468 : Real Analysis in One Variable. 3 Credits.

Principles of analysis in one variable. Heine-Borel and Bolzano-Weierstrass theorems; rigorous development of differential and integral calculus; infinite sequences and series of functions. May not be taken concurrently with or after MATH 3468. Prerequisite: MATH 2055 (preferred) or CS 1640. Catamount Core: MA, QR.

Learning Outcomes:

At the end of this course, you will be ready to take and do well in the more theoretical math courses such as Linear Algebra, Geometry, Abstract Algebra, and Real Analysis in Several Variables.

Students will be able to...

1. Write sound logical proofs on various topics with correct terminology, notation, and grammar.
2. Think like a mathematician: analyze how they arrive at conclusions, distinguishing definitions from theorems.
3. Use foundational material in various settings.
4. Make connections between various areas of math.

Expanded Course Description and Textbook:

Topics using the textbook "Analysis with an Introduction to Proof" 5th edition by Steven Lay, published by Pearson, ISBN # ISBN-13: 978-0321747471, ISBN-10: 032174747X

1) Logic and Proofs 2) Sets and Functions 3) The Real Numbers 4) Sequences 5) Limits and Continuity 6) Differentiation 7) Integration 8) Infinite Series

Practically all of the problems on the homework, midterms, and final will be proofs or will have proofs as essential parts of their solutions.

The textbook may not be available at the UVM bookstore. You can rent or purchase e-copies or hardcopies on amazon.com or other on-line book sellers. .

Class time: The class meets 12:00pm to 12:50 pm M W F in Lafayette L210

Please refrain from using cell phones during class.

Attendance: Attendance is required. In accordance with University Policy, I allow students to miss classes due to religious observances, varsity sporting matches or any other activities stated in the UVM attendance policy. You must email me ahead of time telling me that you will be absent. If you will be absent, plan to ask a peer about what was covered in class. In borderline final letter grade situations, your attendance and participation may help your grade.

Notetaking: My Course Notes are available as a pdf on Brightspace in the **Course Materials** area. The course is based almost entirely on these Notes. They cover 95% of what I present in class. You can use these notes instead of copying everything I write on the board so that you can listen and absorb the material better during class. The # 1 thing you can do to succeed in this class is to read the Course Notes outside of class.

Instructor Information:

Name: Dr. Dan Hathaway

Email : Daniel.Hathaway@uvm.edu **Include Math 2468 in the subject line*

Office: Innovation Bldg, Room 311

The best way to contact me is by email.

Office Hours:

Monday, Wednesday, and Friday 10:50 am to 11:50 am

Please feel free to email me to set up an appointment at another time if you have class during these office hours. Students are always welcome to ask me questions before or after class or send me an email for a fast response.

Brightspace:

Brightspace will be used for Announcements, Course Notes, and grades.

Homework:

Weekly homework assignments will be posted on Wednesdays on Brightspace and due the following Wednesday in class on paper. For each assignment that you type in Latex, you will receive 5 bonus points on that assignment. You will not get bonus points for any other software such as Microsoft Word. Four questions at random will be graded on each homework assignment. No late homework assignments will be accepted. Each homework will count the same amount and **the two lowest grades will be dropped.**

Use the 2 dropped homework assignments wisely to cover any absences for university events, illness, family emergencies, funerals, and workload issues. You must put your name on your homework and staple it to receive full credit.

You are encouraged to work with other classmates on your homework, but the write-up you turn in must be your own. Your objective on homework should be to write a clear, concise exposition of each solution. This means all work that is required to arrive at an answer should be included and all proofs must be written explanations in complete, grammatical sentences with correct mathematical terminology and notation. Academic honesty demands that you indicate clearly that you have referred to people, books, or sources of any kind. Responsible work habits and consideration for the grader dictate that late homework cannot be accepted.

Midterm Exams: There will be 2 midterm exams. The dates of the midterms are **September 27 and November 1.** You may bring one 3 x 5 inch card filled front and back to the first midterm exam. You may bring two 3 x 5 inch cards to the second midterm. Each exam is **cumulative** from the beginning of the course. No books, calculators or electronic devices. No make-up exams.

Final Exam: There will be a **cumulative** final exam given at the end of the semester. The final exam will be held **Monday, December 11 at 10:30 AM (until 1:15 pm)** in our usual classroom. You may bring three 3 x 5 inch cards to the final exam. No books, calculators or electronic devices.

On ALL exams and homework, you MUST show all your work to get full credit.

Computation of grade:

Homework: 35%

Midterm1: 21%

Midterm2: 22%

Final Exam: 22%

Point Values for Final Grades:

A+	97–100%
A	93–96%
A-	90–92%
B+	87–89%
B	83–86%
B-	80–82%
C+	77–79%
C	73–76%
C-	70–72%
D+	67–69%
D	63–66%
D-	60–62%
F	< 60%

Tutoring Center:

The Tutoring Center is free to all undergraduate students. To schedule an appointment, go to their website: https://www.uvm.edu/academicsuccess/tutoring_center

IT Technical support for students:

Students should contact the Helpline (802-656-2604) for support with technical issues

Math 2468 Detailed Course Schedule

	Course Schedule Detail	Fall 2023	Note: Subject to Change
Week #	Monday	Wednesday	Friday
1	Start Chapter 1 Logic and Proof	Continue Ch1 /Start Ch2 Sets and Functions	Worksheet #1 /Continue Ch2
2	No School	Finish Ch2	Worksheet #2/Ch3 Natural Numbers and Induction
3	Ch 4 Ordered Fields	Ch 5 The Completeness Axiom and start Ch6 Topology of the Real numbers	Worksheet #3/Continue Ch6
4	Continue Ch6	Finish Ch6	Worksheet #4/Ch7 Continuity Induction and started Ch8 Compact Sets
5	Review for Midterm	Midterm #1	Go Over Exam; Continue Ch8
6	Continue Ch8	Finish Ch8	Ch9 Metric Spaces, Ch10 Sequence Convergence and started Ch11 Limit Theorems
7	Finished Ch11 and Ch 12 Monotone Sequences and Cauchy Sequences	Worksheet #5 /Ch13 Subsequences	No School
8	Ch14 Limits of a Function	Ch15 Continuous Functions	Worksheet #6/ Ch16 Properties of Continuous Functions
9	Ch17 Uniform Continuity	Ch18 Continuity in Metric Spaces	Worksheet #7/Start Ch19 Derivatives
10	Review for Midterm	Exam #2	Go Over Exam
11	Finish Ch19 and start Ch20 Mean Value Theorem	Continue Ch20	Worksheet #8/Finish Ch20
12	Ch21 L'Hospital's Rule	Ch22 Taylor's Theorem	Worksheet #9/Start Ch23 Reimann Integral
	No School	No School	No School
13	Continue Ch23	Finish Ch23	Infinite Series
14	Finish Infinite Series	Review for Final Exam	Review for Final Exam

The following are General Policies from UVM and CEMS:

Additional Information on Attendance and Illness:

If a student will not be able to attend in-person classes for qualifying health reasons, Student Health Services (SHS) will send a notification to the appropriate student services office or designated staff member informing them of this along with the dates the student is unable to attend. The SHS notification will specify whether the request for flexibility is only around in-person class attendance or includes additional flexibility for assignments and tests because the student is too ill to participate. Students are responsible for working with their faculty to make up class content and work they miss due to a documented illness.

Inclusion Statement:

Our intention is for CEMS to be a place where you will be treated with respect and kindness. We welcome individuals of all ages, backgrounds, beliefs, interests, ethnicities, genders, gender identities, gender expressions, national origins, religious affiliations, sexual orientations, ability – and other visible and nonvisible differences. All members of the College are expected to contribute to a respectful, welcoming and inclusive environment for every other member of the community. If you ever feel that you have been unfairly treated or judged by an instructor, a mentor, another student, or another member of the CEMS community, please let someone know. Your instructors and advisors in the [CEMS Office of Student Services](#) are available to discuss any concerns or you can report an incident of bias through the [Campus Bias Response Program](#).

UVM Land Acknowledgement:

The campus of the University of Vermont sits within a place of gathering and exchange, shaped by water and stewarded by ongoing generations of Indigenous peoples, in particular the Western Abenaki.

Acknowledging the relations between water, land, and people is in harmony with the mission of the university. Acknowledging the serious and significant impacts of our histories on Indigenous peoples and their homelands is a part of the university's ongoing work of teaching, research, and engagement and an essential reminder of our past and our interconnected futures for the many of us gathered on this land.

UVM respects the Indigenous knowledge interwoven in this place and commits to uplifting the Indigenous peoples and cultures present on this land and within our community.

Lived Name and Pronoun Information:

The UVM Directory includes fields for indicating your lived name and your pronouns. Lived names (preferred names, names in use) are names that an individual wants to be known by in the University community. Entering your pronouns is strongly encouraged to help create a more inclusive and respectful campus community. To update your information, login to the UVM Directory. A preview box will allow you to see how this information will appear in other systems used on campus such as Microsoft Teams and Brightspace.

More information about how to make changes to your lived name and pronouns is available in the [Knowledge Base](#).

To read more about official UVM policies, events, and initiatives regarding diversity, equity, and inclusion: <https://www.uvm.edu/diversity>

Research and Citation Help:

For help selecting research topics, finding information, citing sources, and more, ask a librarian. The UVM Libraries are eager to help. You may ask questions by phone, e-mail, chat, or text, or make an appointment for an individual consultation with a librarian.

Howe Library: <https://library.uvm.edu/askhowe>

Dana Medical Library: <https://dana.uvm.edu/help/ask>

Silver Special Collections Library: <https://specialcollections.uvm.edu/help/ask>

Career Readiness Skills:

Questions on how to incorporate coursework on your resume? Please visit the [Career Readiness Program's Resume & Cover Letter page](#).

Course Evaluations:

All students are expected to complete a mid-term evaluation and final evaluation of each course they are enrolled in. The evaluations will be anonymous and confidential, and the information gained, including constructive criticisms, will be used to improve the course. Students can access Blue course evaluation via Brightspace institutional homepage or by visiting <https://blue.uvm.edu/uvm>. You can also link to the UVM Knowledge Base page with [student instructions on how to access Blue course evaluations](#).

Intellectual Property Statement/Prohibition on Sharing Academic Materials:

Students are prohibited from publicly sharing or selling academic materials that they did not author (for example: class syllabus, outlines or class presentations authored by the professor, practice questions, text from the textbook or other copyrighted class materials, etc.); and students are prohibited from sharing assessments (for example homework or a take-home examination). Violations will be handled under UVM's Intellectual Property policy and Code of Academic Integrity. Please note that 'sharing assessments' also includes course materials that students share on study sites such as Chegg and Course Hero.

Tips for Success:

Course-specific study/preparation tips

Here are a few resources for students on remote/online learning:

- Checklist for success in <https://learn.uvm.edu/about/support-for-students/checklist-online-credit-courses/>
- Academic support for online courses: <https://www.uvm.edu/academicsuccess/online-learning-student-resources-remote-instruction>
- 30-minute webinar on online learning success (Mar 2020): https://www.youtube.com/watch?v=Xp_MYsqQyvE

Helpful resources other than the professor (e.g., [Undergraduate/Graduate Writing Center](#), [Supplemental Instruction](#), [Learning Co-op tutors](#), supplemental course materials)

Student Learning Accommodations:

In keeping with University policy, any student with a documented disability interested in utilizing ADA accommodations should contact Student Accessibility Services (SAS), the office of Disability Services on campus for students. SAS works with students and faculty in an interactive process to explore reasonable and appropriate accommodations, which are communicated to faculty in an accommodation letter. All students are strongly

recommended to discuss with their faculty the accommodations they plan to use in each course. Faculty who receive Letters of Accommodation with Disability Related Flexible accommodations will need to fill out the Disability Related Flexibility Agreement. Any questions from faculty or students on the agreement should be directed to the SAS specialist who is indicated on the letter.

Contact SAS:

A170 Living/Learning Center;

802-656-7753

access@uvm.edu

www.uvm.edu/access

Academic Integrity:

The policy addresses plagiarism, fabrication, collusion, and cheating.

<https://www.uvm.edu/policies/student/acadintegrity.pdf>

The Center for Student Conduct has created several modules to help students learn about UVM's Academic Integrity Policy, definitions, and process. The modules include brief readings, videos, quizzes to check knowledge, links to resources, survey on students' beliefs about cheating, discussion board topics and an honor pledge. We encourage you to check out these resources and incorporate some of them into your courses. To preview the modules, self-enroll in the Blackboard Organization (CSC 001: Academic Integrity Faculty Resources). [Click here for directions for self-enrolling](#) or reach out to Deanna Garrett-Ostermiller (dgarett@uvm.edu) to request a zip file and instructions for importing into your Blackboard course. Information on the Academic Integrity Process for faculty can be found in the CEMS TEACH MS Team / Resources channel or by request. Contact Courtney Giles (cdgiles@uvm.edu) or Priyantha Wijesinghe (pwijesin@uvm.edu).

Code of Student Conduct:

[UVM's Code of Student Conduct](#) outlines conduct expectations as well as students' rights and responsibilities.

FERPA Rights Disclosure:

The purpose of UVM's [FERPA Rights Disclosure](#) is to communicate the rights of students regarding access to, and privacy of their student educational records as provided for in the Family Educational Rights and Privacy Act (FERPA) of 1974.

Final Exam Policy:

The University [final exam policy](#) outlines expectations during final exams and explains timing and process of examination period.

Grade Appeals:

If you would like to contest a grade, please follow the procedures [outlined in this policy](#).

Grading:

[This link](#) offers information on grading and GPA calculation.

Religious Holidays:

Students have the right to practice the religion of their choice. If you need to miss class to observe a religious holiday, please submit the dates of your absence to me in writing by the

end of the second full week of classes. You will be permitted to make up work within a mutually agreed-upon time. The complete policy is [here](#).

Promoting Health & Safety:

The University of Vermont's number one priority is to support a healthy and safe community:

[Center for Health and Wellbeing](#)

[Counseling & Psychiatry Services \(CAPS\)](#) Direct Phone Line: (802) 656-3340

C.A.R.E. If you are concerned about a UVM community member or are concerned about a specific event, we encourage you to contact the Dean of Students Office (802-656-3380). If you would like to remain anonymous, you can report your concerns online by [visiting the C.A.R.E. Team website](#).

Food Insecurity: The UVM Center for Health & Wellbeing provides several on- and off-campus resources for students struggling with food insecurity: <https://www.uvm.edu/health/food-insecurity-uvm>

General statement regarding potential changes during the semester:

<http://catalogue.uvm.edu/>

The University of Vermont reserves the right to make changes in the course offerings, mode of delivery, degree requirements, charges, regulations, and procedures contained herein as educational, financial, and health, safety, and welfare considerations require, or as necessary to be compliant with governmental, accreditation, or public health directives.

Statement on Alcohol and Cannabis in the Academic Environment:

As a faculty member, I want you to get the most you can out of this course. You play a crucial role in your education and in your readiness to learn and fully engage with the course material. It is important to note that alcohol and cannabis have no place in an academic environment. They can seriously impair your ability to learn and retain information not only in the moment you may be using, but up to 48 hours or more afterwards. In addition, alcohol and cannabis can:

Cause issues with attention, memory and concentration

Negatively impact the quality of how information is processed and ultimately stored

Affect sleep patterns, which interferes with long-term memory formation

It is my expectation that you will do everything you can to optimize your learning and to fully participate in this course.