Course Information
Math 4603: Advanced Calculus I; Fall 2025
9:05 A.M. - 11:00 A.M. ; T-Th ; Vincent 311

Instructor Markus Keel Email: keel@umn.edu

Instructor's office hours (tentative): T 11:00, Th 11:00 + by appointment

Course Description and Course Objectives:

From the novel *My Ántonia* by Willa Cather:

"That is happiness;
to be dissolved into something complete and great."

In this class we start by understanding what it means to say that $\mathbb{R}$, the set of real numbers, is ***complete***. It's an amazing property which puts this system of numbers in a very unique position and ultimately bestows upon $\mathbb{R}$ a whole host of incredible properties. We will spend the rest of the year understanding these incredible properties which follow from the completeness of $\mathbb{R}$, and ***great*** mathematical tools which harness these properties to provide understanding of important theoretical and applied models throughout the physical, biological, and social sciences. The Spring semester of the course continues the work of the Fall semester and discusses particularly important tools for many application areas.

Text: *Introduction to Real Analysis (Fourth Edition)* by Bartle and Sherbert. Published by Wiley. (The text is currently for sale at Amazon at 70 percent off the usual price!)

Homework: Homework will be assigned approximately every week. **Late homework will not be accepted.**

You are encouraged to work together on the homework, but all solutions must be written in your own words - and you are expected to understand any argument you present in your solutions. Our courses do not qualify for the 'writing intensive' designation in your degree program. Nevertheless the way you write up your homework solutions is important for your understanding of the material and for your ability to internalize and use the material for later work (in these courses and in other avenues of investigation you will undertake)!

We will drop your lowest homework score before computing your grades. (For example, if you miss one homework you will receive a "0" that week, but it will not affect your final grade as one score gets dropped.)

Active Participation: Students are expected and encouraged to actively participate in the course. It is very important that students learn to generate questions and interesting examples, and share these with classmates and the instructors in the lectures and discussion sections. There are a lot of ways to do this- and students will choose whatever way fits their individual learning style the best. Examples of active participation include: asking and answering (correctly

or incorrectly!) questions during scheduled class meetings or office hours; asking and answering (correctly or incorrectly!) questions in the discussion threads or by email. Active class participation contributes strong support of all types of learning. Please talk with us if you have any questions or wish to develop strategies for increasing your own active learning this semester.

Exams and Grading: There will be two midterm exams and a final exam, all of which will be closed book and closed notes. The (tentative) dates for the midterms will be announced during the first week of the semester. The final exam is definitely on Tuesday, December 16th from 1:30 to 3:30 pm. The room for the final exam will be announced in class later this semester.

Course grades will, to first approximation, be computed as follows: We will compute 2 different scores according to the following 2 different procedures:

Procedure 1: the midterms will in total contribute 38% of the final grade (19% each), the final exam contributes 32% of the final grade, and the homework contributes 30% of the final grade.

Procedure 2: we will drop your lowest midterm score and have the final exam contribute 42%, the higher midterm exam contribute 28%, and the homework contribute 30% of the final grade.

Your final numerical score will be the higher of the two numbers obtained from Procedures 1 and 2 above. Gradelines can be described very roughly as follows: any score of 90% and above is an A; lower scores higher than 80% of total points are at least B, B+, or A-. Lower scores higher than 70% are at least C, C+, or B-. The words 'at least' in these last two sentences indicate that gradelines will shift if exams or homeworks turn out particularly difficult and if the class scores fall significantly lower than these percentages.

Classroom Expectations: We promote a classroom environment that encourages participation and concentration from everyone - students and instructor! It almost surely goes without saying, but we'll say here anyways that while we certainly respect students who during class time wish to read newspapers (online or paper copies), novels, or material (paper or online) related to topics other than those we are covering in this course, at the same time such activities likely distract students from our class discussion. Students who produce such distractions will be asked to kindly stop, or to leave the classroom for that period. **In particular, laptop use or any consultation with the internet is not allowed in class. For similar reasons, classroom participants (students and lecturer) will be asked to leave any cell phones that they own silenced and in a compartment off their person, or outside the classroom. In particular: students and the instructor are expected to not have their cell phones visible or in one of their pockets. STUDENTS WHO NEED AN EXCEPTION TO THIS POLICY AND NEED TO USE THEIR CELL PHONE OR LAPTOP TO MONITOR FOR IMPORTANT MESSAGES OR EMAILS SHOULD LET THE INSTRUCTOR KNOW BEFORE THE START OF THE DAY'S CLASS THAT THIS WILL BE DONE.**

Readers of this syllabus interested in an example of a study that links cell phone availability to decreased cognitive capability can read:
`https://www.journals.uchicago.edu/doi/full/10.1086/691462`

Readers of this syllabus interested in an example of a study that links cell phone use in a classroom to decreased learning by students not using cell phones but in the same classroom can read:
https://www.rutgers.edu/news/cellphone-distraction-classroom-can-lead-lower-grades-rutgers-study-finds

Readers of this syllabus interested in an example of a study that links laptop use with decreased learning by the laptop user can read:
https://www.timeshighereducation.com/news/using-laptops-in-class-harms-academic-performance-study-warns

A discussion that puts forward the idea that laptop use decreases the learning of those around the laptop user (and not just the user themself) in the classroom can be found at:

https://medium.com/@cshirky/why-i-just-asked-my-students-to-put-their-laptops-away-7f5f7c50f368

See also the following paper, cited in the above discussion:

https://www.sciencedirect.com/science/article/pii/S0360131512002254?np=y

Academic Honesty: Academic dishonesty in any portion of the academic work for this course shall be grounds for awarding a grade of F for the entire course. Information on the student code of conduct at the University of Minnesota can be found in many places, including the following two websites:

https://regents.umn.edu/sites/regents.umn.edu/files/policies/Student_Conduct_Code.pdf

https://isss.umn.edu/Academics/academic-integrity.html

University Policy on Credits and Workload Expectations (I am placing this information here after seeing it on a syllabus of a course taught by Professor Stanton, since I believe it's an important thing for students to keep in mind): For undergraduate courses, one credit is defined as equivalent to an average of three hours of learning effort per week (over a full semester) necessary for an average student to achieve an average grade in the course. For example, a student taking a 4 credit course such as Math 4603 that meets for four hours a week should expect to spend an additional 8 hours a week on coursework outside the classroom to obtain the level of expertise described in the preceding sentence. (Please read that carefully. The sentence uses the phrase "to obtain the level of expertise described in preceding sentence" as a stand-in for "to achieve the grade of C, for an average student".) See https://policy.umn.edu/education/studentwork for the official University of Minnesota policy on credits and workload expectation. IMPORTANT: We do not mean to say the 8 hours need to be stressful! A main goal of the course will be to learn how to engage with advanced material in a careful, deliberate, mindful, attentive, present manner which is actually sometimes not only free of stress, it's downright blissful. The full quotation from Willa Cather's text which is quoted in part above actually reads:

"That is happiness;
to be dissolved into something complete and great.
When it comes to one, it comes as naturally as sleep."