Essential Information

Course Title	Introduction to Real Analysis
Instructor	Ed Bueler elbueler@alaska.edu Chapman 306C
Class meeting	MWF 1:00–2:00 pm, Chapman 104
CRN	73252
Public website	bueler.github.io/real
Canvas website	canvas.alaska.edu/courses/27104
Required text	S. Abbott, *Understanding Analysis*, 2nd. edition, Undergraduate Texts in Mathematics, Springer Press 2015

Catalog summary

Completeness of the real numbers and its consequences: convergence of sequences and series, limits and continuity, differentiation, and the Riemann integral.

Description

By the 19th century, calculus had already been in use for two centuries. It enabled the creation of quantitative sciences and engineering, and all mathematicians thought it was basically correct. Many, however, including Dirichlet, Cauchy, and Riemann, understood that some basic ideas were suspect when examined closely. An influential crisis had arisen around Fourier's new series, which he claimed could approximate any function. This crisis, and broading education about calculus generally, exposed fundamental concerns about the meaning and logic of the real numbers. Calculus needed rigorous underpinning. The creation of real analysis was thus the major milestone in the development of mathematics in the 1800s.

Real analysis is now a core discipline in mathematics, and central to a student's maturing and careful understanding of mathematics. It is a major component of modern—basically this means 20th century—mathematical fields including linear algebra, functional analysis, differential geometry, and stochastic processes.

It is also essential for applied mathematics, including differential equations, approximation theory, numerical analysis, fluid dynamics, quantum physics, and even machine learning. In my own work, for example, real analysis is at the heart of the equations for the flow of glaciers (fluid dynamics), and it is generally essential in how we simulate parts of the actual world on computers (numerical analysis and scientific computing).

Course Goals and Student Learning Outcomes

This course is key preparation for teaching calculus. Many math majors do that job, whether in high schools, community colleges, or universities. Regardless of the level, teaching calculus requires you, as instructor, to have a coherent thread to follow. Much of that thread is the clear understanding of the limit process(es) in calculus. Just being able to work problems in calculus, *which is a skill you should have already for this course*, does not suffice.

On the other hand, if you plan further study in mathematics, whether to understand 20th-century mathematics or to create 21st-century mathematics, you need a rigorous basis in things like the definition of real numbers, convergent sequences and series, and integrals.

Prerequisites

Officially: *WRTG F111X; WRTG F211X, WRTG F212X, WRTG F213X or WRTG F214X; MATH F253X; MATH F265.*

That is: basic writing courses, completion of the calculus sequence, and the introduction to mathematical proofs course. The last prerequisite (MATH F265) is the most important one. Content from calculus III is not essential, but calculus I and II content definitely is!

Schedule and Online Materials

The public course website includes a day-by-day schedule listing the due date of each Homework Assignment, as they are assigned, and the timing of the Midterm Exams and the Final Exam. Please consult this schedule frequently. It is subject to change, but it will be kept up to date.

Most course materials (syllabus, schedule, homework assignments, exam review guides) will be posted on the public website. Some private-access course materials (student grades, homework solutions, exam solutions) will go on the Canvas site.

Office Hours and Communication

My Office Hours are shown online at `bueler.github.io/OffHrs.htm`; I hold office hours in Chapman 306C. Students can also schedule meetings with me outside of regular office hours; please send an email. I will use Canvas to send announcements. If I need to contact you outside of class times, I'll try to email via Canvas. (Please set your email address in Canvas to one that you check regularly!)

Assessments

Homework Assignments	nearly weekly	35%
Midterm Exam 1	in-class Friday 3 October	20%
Midterm Exam 2	in-class Friday 7 November	20%
Final Exam	in-class Tuesday 9 December 1-3 pm	25%
total		100%

Grades

The scores of the assessments will be summed and the final course grade will be assigned as follows:

A	93–100%	B-	79–81%	D+	65–67%
A-	90–92%	C+	76–78%	D	60–64%
B+	87–89%	C	68–75%	D-	57–59%
B	82–86%	C-	not given	F	$\leq 56\%$

These ranges are a guarantee and a lower bound. I reserve the right to increase your grade above these ranges based on the actual difficulty of the work and/or on average class performance. Any such increases will preserve grade ordering by weighted total score.

Homework

Homework is due at the start of class. **Late homework is not accepted.** If you have unavoidable circumstances which do not allow you to turn in an Assignment on time then please contact me (elbueler@alaska.edu) in advance.

Homework Assignments and their due dates will regularly be posted at the public website. The Homework consists of proofs, first of all, but also requests for rigorously-justified examples and counter-examples, and occasionally a visualization or informal explanation. Problems very similar to, or shortened versions of, such Homework problems will make up a large fraction of the in-class, on-paper, and no-technology Exams.

You may talk to other students about the Homework, and you may even use internet and generative AI resources in your solutions. The goal is indeed to be correct in your proofs! However, **actual comprehension of the ideas on the Homework Assignments is required to get even a passing grade in the course**. This is enforced via the in-class, on-paper, and no-technology assessments, that is, the Midterm Exams and the Final Exam. Note that Exams are 65% of the grade. Thus if you get into the habit of using too much help on the Homework, and you are not generating your own carefully thought-through solutions which you fully understand, then this will have a huge impact on Exam performance, and thus on your course grade.

Exams

There will be two in-class, hour-long Midterm Exams covering definitions, concepts, rigorously-justified examples and counter-examples, and many, many proofs. The in-class Final Exam will be similar, but it will have a writing part with an emphasis on summative understanding of the course concepts.

Make-up Midterm Exams will be given only for well-documented extenuating circumstances, and at my discretion. Department policy (below) does not allow me to move the time of the Final Exam.

Department of Mathematics & Statistics Rules and Policies

Incomplete Grade

Incomplete (I) will only be given in DMS courses in cases where the student has completed the majority (normally all but the last three weeks) of a course with a grade of C or better, but for personal reasons beyond his/her control has been unable to complete the course during the regular term. Negligence or indifference are not acceptable reasons for granting an incomplete grade.

Late Withdrawals

A withdrawal after the deadline from a DMS course will normally be granted only in cases where the student is performing satisfactorily (i.e., C or better) in a course, but has exceptional reasons, beyond his/her control, for being unable to complete the course. These exceptional reasons should be detailed in writing to the instructor, Department Chair and the Dean.

No Early Final Examinations

Final examinations for DMS courses shall not be held earlier than the date and time published in the official term schedule. Normally, a student will not be allowed to take a final exam early. Exceptions can be made by individual instructors, but should only be allowed in exceptional circumstances and in a manner which doesn't endanger the security of the exam.

Academic Dishonesty

Academic dishonesty, including cheating and plagiarism, will not be tolerated. It is a violation of the Student Code of Conduct and will be punished according to UAF procedures.

Student protections and service statement

Every qualified student is welcome in my classroom. As needed, I am happy to work with you, Disability Services, Veterans' Services, Rural Student Services, and so on, to find reasonable accommodations. Students at this University are protected against sexual harassment and discrimination (Title IX), and minors have additional protections. For more information on your rights as a student and the resources available to you to resolve problems, please go the following site: www.uaf.edu/handbook.

Official UAF Syllabus Addendum

Student protections statement

The university respects and upholds the principles of due process and a fair and equitable process as specified in the Board of Regents' Policy 09.02 Student Rights and Responsibilities. For more information regarding the rights and responsibilities of students, refer to the Office of Rights, Compliance and Accountability website. You are encouraged to read the Board of Regents' policy carefully to fully understand your responsibilities to our community.

We strive to create a safe and respectful environment for all members of our community. If you have questions about expectations of you as a student or believe your rights are being violated, we

encourage you to reach out to the Office of Rights, Compliance and Accountability for help. UAF reserves the right to suspend, expel or take other necessary and appropriate action in cases where a student is unable or unwilling to uphold community standards and campus safety.

For more information on your rights as a student and the resources available to you to resolve problems, please go to the following site: catalog.uaf.edu/academics-regulations/students-rights-responsibilities

Disability services statement

I will work with the Office of Disability Services to provide reasonable accommodation to students with disabilities.

ASUAF advocacy statement

The Associated Students of the University of Alaska Fairbanks, the student government of UAF, offers advocacy services to students who feel they are facing issues with staff, faculty, and/or other students specifically if these issues are hindering the ability of the student to succeed in their academics or go about their lives at the university. Students who wish to utilize these services can contact the Student Advocacy Director by visiting the ASUAF office or emailing asuaf.office@alaska.edu.

Student Academic Support

- Communication Center (907-474-7007, uaf-commcenter@alaska.edu, Student Success Center, 6th Floor Room 677 Rasmuson Library)
- Writing Center (907-474-5314, uaf-writing-center@alaska.edu, Student Success Center, 6th Floor Room 677 Rasmuson Library)
- UAF Math Services (907-474-7332, uaf-traccloud@alaska.edu)
  - Drop-in tutoring, Student Success Center, 6th Floor Room 672 Rasmuson Library
  - 1:1 tutoring (by appointment only), 6th Floor Room 677 Rasmuson Library
  - Online tutoring (by appointment only), available at the Student Success Center www.uaf.edu/dms/mathlab
- Developmental Math Lab, Gruening 406
- The Debbie Moses Learning Center at CTC (907-455-2860, 604 Barnette St, Room 120, www.ctc.uaf.edu/student-services/student-success-center)
- For more information and resources, please see the Academic Advising Resource List (www.uaf.edu/advising/students/index.php)

Student Resources

- Disability Services (907-474-5655, uaf-disability-services@alaska.edu, 110 Eielson Building)

- Student Health & Counseling, free counseling sessions available (907-474-7043, www.uaf.edu/chc/appointments.php, Whitaker Building, Room 206, Health, Safety & Security Bldg — same building as Fire and Police)
- Office of Rights, Compliance and Accountability (907-474-7300, uaf-orca@alaska.edu, 3rd Floor, Constitution Hall)
- Associated Students of the University of Alaska Fairbanks (ASUAF) or ASUAF Student Government (907-474-7355, asuaf.office@alaska.edu, Wood Center 119)

Nondiscrimination statement

Nondiscrimination statement: The University of Alaska is an equal opportunity/equal access employer, educational institution and provider. The University of Alaska does not discriminate on the basis of race, religion, color, national origin, citizenship, age, sex, physical or mental disability, status as a protected veteran, marital status, changes in marital status, pregnancy, childbirth or related medical conditions, parenthood, sexual orientation, gender identity, political affiliation or belief, genetic information, or other legally protected status. The University's commitment to nondiscrimination, including against sex discrimination, applies to students, employees, and applicants for admission and employment. Contact information, applicable laws, and complaint procedures are included on UA's statement of nondiscrimination available at www.alaska.edu/nondiscrimination.

UAF Office of Rights, Compliance and Accountability
1692 Tok Lane
3rd floor, Constitution Hall, Fairbanks, AK 99775
907-474-7300
uaf-orca@alaska.edu

[syllabus version: August 23, 2025]