

## Course Description

Math F641 is part of the core mathematics graduate curriculum. Our goal is to provide you with the basic background in real analysis required of all mathematicians, regardless of their area of interest. The course will be divided into roughly two portions, one on classical mathematics from the 19th century, and one on the theory of Lebesgue integration developed in the early part of the 20th century. Specific topics include the Weierstrass Theorem, the Arzela-Ascoli Theorem, and Lebesgue's Monotone and Dominated Convergence Theorems.

Successful completion of the class will leave you prepared to write our Real Analysis comprehensive exam.

## Essential Information

Professor	David Maxwell
Office	Chapman 308C
Email	damaxwell@alaska.edu
Phone	474-1196
Web	damaxwell.github.io
Required Text	<b>Real Analysis</b> , <i>N.L. Carothers</i> , Cambridge University Press

## Prerequisites:

MATH F401 **or** permission of instructor.

## Student Learning Outcomes

Students will:

- prove facts about metric spaces, including those based on compactness and completeness
- prove facts about sequences and series of functions
- prove results about Lebesgue measure, and be able to apply the major theorems in this area (Fatou's Lemma, the Dominated and Montone convergence theorems)
- acquire skills needed to pass the master's comprehensive exam.

## Class Time

There will be three hours of class lecture each week. We will also have a one hour problem session on Tuesdays at a time yet to be determined. The problem sessions will be an opportunity for you to discuss with each other (with occasional guidance from me) the homework problems due that week.

Lecture Times

MWF 9:15–10:15 Chapman 107

## Covid 19

The urgency of recent years concerning Covid 19 is waning. Nevertheless:

- We need to be especially kind and patient with one another.
- Unforeseen circumstances are going to occur. I will try to ensure that the class is taught in a way so that if you must miss a class due to illness or other reasons, you will have tools to make up the missed class. Please see the section below on Zoom and recordings.
- If circumstances routinely impact your ability to participate in the course, please get in touch with me so we can determine a best plan of action.

### **Office Hours**

I will schedule 3 hours a week of formal office hours after consultation with my students. Some of these will be held in the Engineering building, but I will be available by Zoom.

### **Discord**

A Discord server has been set up for this class. We will use it as the primary means of group communication.

Communication in Discord will be on-topic, polite and collegial as is suitable for a workplace setting.

### **Homework**

There will be a homework assignment due roughly every week, usually on Wednesdays. Each week's assignment and due date will be announced in class and will be posted on my web page. I will also post solutions after each homework has been handed in (see below for more information concerning solutions).

Regarding late homework, I will accept from each student a single late homework with no questions asked. Simply hand in a note indicating you are using your free late homework in place of your actual assignment. You must notify me no later than the time the homework is due that you intend to take advantage of this opportunity, and you must hand in the homework no later than one week after it was due. Subsequent late homeworks will be accepted only under extenuating circumstances to be determined at my discretion.

The late homework freebie cannot be used for the first two homework sets, nor can it be used for the final assignment.

### **Midterm**

There will be one in-class midterm exam. It is tentatively scheduled to be held on Friday, October 27. Associated with this midterm, there will also be a take-home midterm to be handed out on Friday, October 20.

### **Final Exam**

There will be a two-hour final exam on Wednesday, December 13. There will also be a take-home portion of the final exam to be handed out in the last week of class and due on December 15. Details on the take-home exam will be announced closer to the end of the semester.

### **Evaluation**

Course grades will be determined as follows:

Homework	33%
Midterm	33%
Final	33%

Letter grades will be assigned according to the following scale. This scale is a guarantee; I also reserve the right to lower the thresholds.

A+	97–100%	C+	77–79%	F	$\leq 59$
A	93–96%	C	73–76%		
A-	90–92%	C-	70–72%		
B+	87–89%	D+	67–69%		
B	83–86%	D	63–66%		
B-	80–82%	D-	60–62%		

### Tentative Schedule

The following is a tentative list of the topics to be covered in this class. As we proceed in the course, the course web page will list specific sections to be read for each week.

Week	Topics and Events
8/28 – 9/1	Review of Chapters 1 & 2 (Real Numbers, Countability)
9/4 – 9/8	Start Chapters 3, 4 & 5 (Metric Spaces) Monday: Labor Day
9/11 – 9/15	Metric Spaces continued.
9/18 – 9/22	Chapter 7 (Completeness)
9/25 – 9/29	Chapter 8 (Compactness)
10/2 – 10/6	Chapter 10 (Sequences of Functions)
10/9 – 10/13	Chapter 10 (Sequences of Functions)
10/16 – 10/20	Chapter 11 (Space of Continuous Functions) Friday: Take-home midterm posted
10/23 – 10/27	Review of Riemann Integral (Notes) Friday: Midterm Friday: Last day to withdraw with a 'W'
10/30 – 11/3	Chapter 16 (Lebesgue Measure)
11/6 – 11/10	Lebesgue Measure continued.
11/13 – 11/17	Chapter 17 (Measurable Functions)
11/20 – 11/24	Chapter 18 (Integrable Functions) Thursday: Thanksgiving
11/27 – 12/1	Integrable Functions continued.
12/4 – 12/8	Chapter 19 ( $L_p$ Spaces) Friday: Take-home final posted Friday: Last day of class

## Rules and Policies

### Collaboration

You are encouraged to work together in solving homework problems. But each student must write up his or her own solutions independently. If you receive significant help solving a problem, it is customary to make a note in your homework to give the person who helped you credit.

### Makeup Exams

You can make up an exam if certain extenuating circumstances prevent you from taking it and if you inform me in advance. Contact me as soon as possible if you are going to miss an exam.

### Attendance

Attendance is not included directly as part of your grade.

### Cell Phones

Turn off your cell phone before you come to class.

### Disabilities Services

I will work with the Office of Disabilities Services (203 Whitaker, 474-7043) to provide reasonable accommodation to students with disabilities.

### Incomplete Grade

Incomplete (I) will only be given in Computer Science, Mathematics or Statistics 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 the granting of an incomplete grade. (Note: this is essentially the old University policy.)

### Late Withdrawals

A withdrawal after the university deadline from a Department of Mathematical Sciences 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 head and dean.

### 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.

### Artificial Intelligence (AI)

In this class you are learning skills that lie at the foundation of your graduate education in mathematics. Because you need to acquire and master these skills for yourself, unless otherwise stated explicitly, there are no acceptable uses of AI in this class. Unless specifically authorized, you may not use any form of AI to assist with a proof (either in determining the

argument of the proof, or in writing the text of the proof). This holds both for ordinary homework solutions and for take-home exams.

## Official UAF Syllabus Addendum

**Student protections statement:** UAF embraces and grows a culture of respect, diversity, inclusion, and caring. Students at this university are protected against sexual harassment and discrimination (Title IX). Faculty members are designated as responsible employees which means they are required to report sexual misconduct. Graduate teaching assistants do not share the same reporting obligations. For more information on your rights as a student and the resources available to you to resolve problems, please go to the following site: <https://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.

### Student Academic Support:

- Speaking Center (907-474-5470, [uaf-speakingcenter@alaska.edu](mailto:uaf-speakingcenter@alaska.edu), Gruening 507)
- Writing Center (907-474-5314, [uaf-writing-center@alaska.edu](mailto:uaf-writing-center@alaska.edu), Gruening 8th floor)
- UAF Math Services, [uafmathstatlab@gmail.com](mailto:uafmathstatlab@gmail.com), Chapman Building (for math fee paying students only)
- Developmental Math Lab, Gruening 406
- The Debbie Moses Learning Center at CTC (907-455-2860, 604 Barnette St, Room 120, <https://www.ctc.uaf.edu/student-services/student-success-center/>)
- For more information and resources, please see the Academic Advising Resource List ([https://www.uaf.edu/advising/lr/SKM\\_364e19011717281.pdf](https://www.uaf.edu/advising/lr/SKM_364e19011717281.pdf))

### Student Resources:

- Disability Services (907-474-5655, [uaf-disability-services@alaska.edu](mailto:uaf-disability-services@alaska.edu), Whitaker 208)
- Student Health & Counseling [6 free counseling sessions] (907-474-7043, <https://www.uaf.edu/chc/appointments.php>, Whitaker 203)
- Center for Student Rights and Responsibilities (907-474-7317, [uaf-studentrights@alaska.edu](mailto:uaf-studentrights@alaska.edu), Eielson 110)
- Associated Students of the University of Alaska Fairbanks (ASUAF) or ASUAF Student Government (907-474-7355, [asuaf.office@alaska.edu](mailto:asuaf.office@alaska.edu), Wood Center 119)

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