

## Course Description

Topologies are used to define continuous functions. This notion of continuity is quite general and extends the concept of continuity you have seen before for metric spaces. Although the definition of a topology is very simple, the framework it provides is surprisingly powerful. In particular, a topology describes a set's "shape", both locally and in terms of its global structure.

There are two distinct branches of topology: point-set topology and algebraic topology. This course will contain elements of both branches (with my bias as a differential geometer influencing the material). We will start with basic concepts from point-set topology, and will spend about half of the course studying this foundation-level material. The second half of the class will be devoted to elementary algebraic topology, a fascinating field that studies the relations between topological spaces and natural algebraic objects associated them. In this part of the class we will study homotopy theory, the fundamental group, homology, covering spaces, and the classification of compact surfaces.

## Essential Information

Professor:	David Maxwell
Office:	Chapman 308C
Phone:	474-1196
Email:	damaxwell@alaska.edu
Web:	<a href="http://www.math.uaf.edu/~maxwell">http://www.math.uaf.edu/~maxwell</a>
Required Text:	<b>Introduction to Topological Manifolds</b> , <i>John M. Lee</i> , Springer-Verlag
Recommended Text:	<b>Essential Topology</b> , <i>Martin D. Crossley</i> , Prentice Hall

## Prerequisites

MATH F401 (Advanced Calculus) **or** MATH F404 (Topology) **or** permission of instructor. It will be helpful if you have seen a bit of group theory before, but I will summarize the basic group theoretic concepts and theorems as we go along

## Student Learning Outcomes

Students will:

- prove facts about topological spaces, including those related to compactness, connectedness, product and quotient structures.
- prove facts about topological manifolds, especially those that exhibit the naturalness of the definition of these spaces,
- prove facts about elementary algebraic topology concerning the fundamental group of a topological space,
- 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 a day and 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 seems to be 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.
- Course practices or this syllabus may need to be adjusted as the semester progresses. I will announce any changes as needed; syllabus updates will be posted on the web site.
- University policies related to COVID-19 are found at <https://sites.google.com/alaska.edu/coronavirus/uaf>. These can be expected to be updated.

## **Office Hours**

I will schedule 2 hours a week of formal office hours after consultation with my students. I am also available via Discord for help throughout the week.

## **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.

As a courtesy to everyone you are communicating with, please sign in to the server with a handle that identifies yourself. As much as I am fond of my dog Frog, a handle of RedFrog2016 would not be a great user id.

## **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, March 10. Associated with this midterm, there will also be a take-home midterm to be handed out on Friday, March 3.

### **Final Exam**

There will be a two-hour final exam at 8:00am on Friday, May 5. 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 May 5. 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	40%
Midterm	30%
Final	30%

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
1/16 – 1/20	Review of Metric Spaces, Topologies
1/23 – 1/27	Convergence, Continuity, Hausdorff spaces
1/30 – 2/3	Bases, Manifolds
2/6 – 2/10	Subspace and Product Topologies
2/13 – 2/17	Quotient Topology, Adjunction
2/20 – 2/24	Connectedness, Compactness
2/27 – 3/3	Flavours of Compactness
3/6 – 3/10	Nets, Topological Groups Friday: Midterm
3/13 – 3/17	Spring Break (no classes)
3/20 – 3/24	Homotopy, Fundamental Group, Homotopy Equivalence
3/27 – 3/31	More on Homotopy, Retractions Friday: Last day to withdraw with a 'W'
4/3 – 4/7	Fundamental Group of the Circle
4/10 – 4/14	Fundamental Group
4/17 – 4/21	Free Groups
4/24 – 4/28	Seifert-Van Kampen Theorem
5/1 – 5/5	Exam week Monday: 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.

### **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.

## Official UAF Syllabus Addendum

**COVID-19 statement:** Students should keep up-to-date on the university's policies, practices, and mandates related to COVID-19 by regularly checking this website: <https://sites.google.com/alaska.edu/coronavirus/uaf?authuser=0>

Further, students are expected to adhere to the university's policies, practices, and mandates and are subject to disciplinary actions if they do not comply.

**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)

**Nondiscrimination statement:** The University of Alaska is an affirmative action/equal opportunity employer and educational institution. 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](http://www.alaska.edu/nondiscrimination). For more information, contact:

UAF Department of Equity and Compliance  
1760 Tanana Loop, 355 Duckering Building, Fairbanks, AK 99775  
907-474-7300  
[uaf-deo@alaska.edu](mailto:uaf-deo@alaska.edu)

### **General Education Requirement**

This course is listed as a General Education Math Course. As such this course is expected to meet the 4 general learning outcomes.

- Build knowledge of human institutions, sociocultural processes, and the physical and natural works through the study of mathematics. Competence will be demonstrated for the foundational information in each subject area, its context and significance, and the methods used in advancing each.
- Develop intellectual and practical skills across the curriculum, including inquiry and analysis, critical and creative thinking, problem solving, written and oral communication, information literacy, technological competence, and collaborative learning. Proficiency will be demonstrated across the curriculum through critical analysis of proffered information, well-reasoned solutions to problems or inferences drawn from evidence, effective written and oral communication, and satisfactory outcomes of group projects.
- Acquire tools for effective civic engagement in local through global contexts, including ethical reasoning, intercultural competence, and knowledge of Alaska and Alaska issues. Facility will be demonstrated through analyses of issues including dimensions of ethics, human and cultural diversity, conflicts and interdependencies, globalization, and sustainability.
- Integrate and apply learning, including synthesis and advanced accomplishment across general and specialized studies, adapting them to new settings, questions and responsibilities, and forming a foundation for lifelong learning. Preparation will be demonstrated through production of a creative or scholarly product that requires broad knowledge, appropriate technical proficiency, information collection, synthesis, interpretation, presentation and reflection.