Topology (MAT4121A/9021) - Course Outline - Fall 2023

1. Course Information

Course Information

Course Name:	Topology - MAT4121A/9021
Academic Term:	Fall
Lecture Hours:	MWF 11:30am-12:30pm
Lecture Location:	MC-107

List of Prerequisites

Mathematics 3122A/B, Mathematics 2122A/B. In particular, an understanding of logic, proofs, sets and functions is required.

Unless you have either the requisites for this course or written special permission from your Dean's Designate (Department/Program Counsellors and Science Academic Counselling) to enroll in it, you may be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.

2. Instructor Information

Instructor Name:	Dr. Yvon Verberne
Instructor Email:	yverber@uwo.ca
Instructor Office:	MC-280
Instructor Phone:	519-661-2111 x86966
Office Hours (Tentative):	M 12:30am-11:30pm (In Person), W 10:30am-11:30am (Zoom)

Students must use their Western (`@uwo.ca` or `@ivey.uwo.ca`) email addresses when contacting their instructors. Please wait at least two business days for a reply.

3. Course Syllabus, Schedule, and Delivery Mode

Course Goals

Topology is the field of mathematics which studies which properties are preserved through deformations, twistings, and stretchings of objects. Point-set topology lays down the groundwork for the field of topology. Point-set topology allows us to evaluate the structure a mathematical object has, and studies the general abstract nature of continuity, or the "closeness" of two different spaces. Topology is used in many branches of mathematics, such as differentiable equations, complex dynamics, and Riemann surfaces in complex analysis. Additionally, topology has applications in physics, for instance in string theory and fluid dynamics, and has recently been applied in statistics to analyze data sets.

The main goal of this course is to provide an introduction to point-set topology. In addition to understand-

ing the main content presented in the course, I expect students to become more comfortable approaching a theoretical math topic. In particular, students will learn to understand and manipulate mathematical definitions and other familiar objects, and be able to write a clear, correct mathematical proof. Writing clear mathematical proofs is key since they are one of the important ways we communicate mathematical results to other mathematicians and scientists.

This is a course where we will cover some deep concepts in topology. The course is likely to be challenging for many students, and will likely become more difficult for you as the semester goes on. Due to this, please engage with the course material and to talk to your instructor regularly. By doing so, we can help you develop a deeper understanding of the course material.

Topics

This is a tentative list of topics we will cover in this course. The list of topics is quite ambitious, and the list is subject to change depending on time constraints. These topics are covered in Chapters 2-9 of the course textbook, "Topology through inquiry" by Su and Starbird.

- Open sets and topological spaces
- Limit points and closed sets
- Interior and boundary
- Bases and subases
- Order topology
- Product spaces
- Hausdorff, regular, and normal spaces
- Separation properties
- Heredity
- Separable spaces
- First and second countability
- Compactness
- Heine-Borel Theorem
- Continuous functions and homeomorphisms
- Urysohn's Lemma
- Connectedness
- Metric spaces and Metrizability

Course Learning Outcomes

Upon successful completion of the course, students will:

- Be able to define terms and restate theorems related to topology;
- Be able to apply terms and theorems to a range of examples of topological structures;
- Be able to draw figures to illustrate the meaning of the definitions and theorems;
- Be able to apply the theory from the course to solve problems and prove theorems in point-set topology;
- Be able to write a thorough, carefully written proof; and
- Be able to converse with peers on the course topics.

Key Sessional Dates

Classes begin:	September 7, 2023
Last day to add:	September 15, 2023
No classes:	September 29, 2023
Holiday:	October 9, 2023
Reading Week:	October 30 to November 5, 2023
Last day to drop:	November 13, 2023
Classes end:	December 8, 2023
Exam period:	December 10 to 22, 2023

Although the intent is for this course to be delivered in person, should any university-declared emergency require some or all of the course to be delivered online, either synchronously or asynchronously, the course will adapt accordingly. The grading scheme will not change. Any assessments affected will be conducted online as determined by the course instructor.

Course Materials

Required Textbook We will be following textbook will be our guide for the course:

- *Topology through inquiry* by Michael Starbird and Francis Su. This is available in print at the bookstore, and an e-book version is available at the following link: https://bookstore.ams.org/text-58/

Recommended Textbooks

- *Topology (Second Edition)*, by James Munkres. This book is easy to read and excellent for self study. It is recommended that you not immediately look up the answers for the worksheets in this textbook, but this is a useful resource for the course. A downside of this book is that its quite expensive (around $125).

- *Counterexamples in Topology*, by Steen and Seebach. Think of this as a dictionary for topological spaces. It includes the almost all the definitions we will use in the course, and many more. It is *not* suitable for learning the material from scratch, and should be thought of as a supplementary resource.

Learning Management System (OWL)

Students are responsible for checking the course OWL site (http://owl.uwo.ca) on a regular basis for news and updates. This is the primary method by which information will be disseminated to all students in the class.

If students need assistance with the course OWL site, they can seek support on the OWL Help page. Alternatively, they can contact the Western Technology Services Helpdesk. They can be contacted by phone at 519-661-3800 or ext. 83800.

Technical Requirements

The students are required to have access to a device on which they can run any LaTeXeditor, as well as a device on which they can send emails. Should we be required to move online, the student would need access to a stable internet connection, a working microphone, and webcam.

4. Course Activities

Lectures

There are three 50 minute lectures every weekly. During the lectures, I hope to motivate the course material, clarify difficult concepts, and help you assess your understanding of the course material. Come prepared to class, and be ready to think and engage with the lecture material. The classes consist of us collaboratively working on a worksheet which will focus on introducing the days topic, proof writing, and problem solving. In this course, you are allowed to use technology during our class, but the technology must be utilized for an in-course purpose as to not distract your other classmates.

Worksheets We will not be able to complete all the questions on the worksheet during class. The remainder of each worksheet will be assigned as homework, unless otherwise specified at the end of class. On each Friday, you will hand in the worksheets from the week prior (for example, on Friday, September 22, you will hand in the worksheets from the week of September 11-September 15), giving you at least one week to finish each worksheet. You may either hand in the worksheets via email, or hand in a hardcopy at the start of class. The worksheets will be graded on completion only, and not on correctness. Each worksheet will be graded separately. You are expected to collaborate on the worksheets, but you must write your answers in your own words to ensure you understand the solution to each question.

Written Solutions and Common Class Solutions

In class, we will write a common solutions document together. Each student will be assigned 1-3 questions per week which they will type up using LaTeX. Each student will be emailed their assigned worksheet problems from the week no later than Friday morning at 11:30am (the start of Friday's class). They will

be due the next week at the start of class, where the solutions are to be sent via email. I will give written feedback to the typed up solutions, and you may choose to implement this feedback on your write up. This goal of this exercise is to improve your proof writing skills. You may collaborate to solve each of the problems assigned to you, but you must write up each solution entirely on your own.

Office Hours

Before Monday and Wednesday classes, I will hold one hour of office hours in my office or over Zoom. If you are unable to attend these office hours, please email me to set up an individual appointment. While you are not required to attend office hours, it is an excellent opportunity to ask questions or ask for clarifications of the course work. Students who attend office hours tend to do the best, and it is important to clarify any difficulties you're having as they come up. In addition, this helps to give me the opportunity to get to know you! Even if you don't have questions on the course materials, feel free to come so I can get to know you.

Midterms

The midterm tests will be during class time and will be 50 minutes in length. These will be closed book midterms, and while cumulative, will be heavily focused on the material leading up to the midterm. No unauthorized aids, including any electronic devices, will be permitted during either of the midterms. A student who misses the midterm test due to an illness or other verified reason must follow the instructions under "Missing a Course Assessment" in this syllabus. If a student does not have valid documentation or does not follow the instructions under "Missing a Course Assessment" within a week of the midterm, then the student will receive a grade of 0 on the midterm test. If a student does have valid documentation, a makeup test will be administered, where the date of this makeup midterm test is to be determined. If the student misses both the midterm and makeup midterm with valid documentation, the weight of the midterm will be shifted onto the final exam.

Final Exam

The final exam will be during the final exam period. The exact date and time will be made available later on in the semester. This will be a closed book final exam, and no unauthorized aids, including any electronic devices, will be permitted during either of the midterms. The final exam will be cumulative, and more information regarding the final exam will be made available closer to the final exam date. A student who misses the final exam due to an illness or other verified reason must follow the instructions under "Missing a Course Assessment" in this syllabus.

5. Methods of Evaluation

Course Grade

The final course grade will be determined by student performance on

Participation [10%]: Every student will receive a participation grade. This includes (but is not limited to) attendance, asking questions, and making mistakes. This grade will be based on in-class participation throughout the semester.

Worksheet Completion [15%]: To be handed in every Friday at the start of class, starting September 15. Grade of each worksheet is based on the percentage of the worksheets completed.

Written Solutions [15%]: Written solutions are due every Friday at the start of class, starting September 15. Written feedback will be provided, and students may edit their solutions based on this feedback. The grade is based on the final solution the student provides.

Two Midterms [15% each; Total 30%]: Midterms will take place during our regular class time on October 13, and on November 17.

Final Exam [30%]: The final exam will be scheduled by the Registrar during the Exam Period.

Make-up Dates

The first makeup midterm will be from 12:30pm–1:20pm on October 13, and the second makeup midterm will be on November 27 from 12:30pm–1:20pm. The makeup date for the Final Exam will occur in January.

6. Student Absences

If you are unable to meet a course requirement due to illness or other serious circumstances, please follow the procedures below.

Assessments Worth Less Than 10% of Course Grade

Late worksheets or written solution without discussion with the instructor will be penalized with a 20% deduction per day. The lowest 6 worksheets and lowest two written solutions will be dropped at the end of term. Each student can miss 6 lectures without it having any affect on their participation grade.

Assessments Worth At Least 10% of Course Grade

For work totalling 10% or more of the final course grade, you must provide valid medical or supporting documentation to the Academic Counselling Office of your Faculty of Registration as soon as possible. For further information, please consult the University's medical illness policy (click here) and review the Student Medical Certificate (click here). In the event that the links do not work, type either

- https://www.uwo.ca/univsec/pdf/academic_policies/appeals/academic_consideration.pdf (for policy)
- https://www.uwo.ca/univsec/pdf/academic_policies/appeals/medicalform.pdf (for certificate)

into your browser.

Absences From Final Examinations

If you miss the Final Exam, please contact the Academic Counselling office of your Faculty of Registration as soon as you are able to do so. They will assess your eligibility to write the Special Examination (the name given by the University to a makeup Final Exam).

You may also be eligible to write the Special Exam if you are in a "Multiple Exam Situation" (e.g., 3 or more exams in 23-hour period, 4 or more exams in a 47-hour period).

If a student fails to write a scheduled Special Examination, the date of the next Special Examination (if granted) normally will be the scheduled date for the final exam the next time this course is offered. The maximum course load for that term will be reduced by the credit of the course(s) for which the final examination has been deferred. See the Academic Calendar for details (under Special Examinations).

Accommodation and Accessibility

Religious Accommodation

When a course requirement conflicts with a religious holiday that requires an absence from the University or prohibits certain activities, students should request accommodation for their absence in writing at least two weeks prior to the holiday to the course instructor and/or the Academic Counselling office of their Faculty of Registration. Please consult the University's list of recognized religious holidays (click here), which is updated annually. Alternatively, you may wish to enter

- https://multiculturalcalendar.com/ecal/index.php?s=c-univwo

directly into your browser.

Accommodation Policies

Students with disabilities are encouraged to contact Accessible Education, which provides recommendations for accommodation based on medical documentation or psychological and cognitive testing. Students can consult the policy on Academic Accommodation for Students with Disabilities (click here). Alternatively, type

- www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic Accommodation_disabilities.pdf

into a browser.

7. Academic Policies

The website for Registrarial Services is http://www.registrar.uwo.ca (click here).

In accordance with policy (click here), the centrally administered e-mail account provided to students will be considered the individual's official university e-mail address. It is the responsibility of the account holder to ensure that e-mail received from the University at their official university address is attended to in a timely manner. The policy referenced above can also be accessed by typing

- https://www.uwo.ca/univsec/pdf/policies_procedures/section1/mapp113.pdf

into your browser.

No electronic devices will be permitted on tests and exams.

Scholastic offences are taken seriously and students are directed to read the appropriate policy (click here), specifically, the definition of what constitutes a Scholastic Offence. This policy can also be accessed by typing

- http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf

into your browser.

In the event of a health lock-down, tests and examinations in this course will be conducted using a remote proctoring service. By taking this course, you are consenting to the use of this software and acknowledge that you will be required to provide personal information (including some biometric data) and the session will be recorded. Completion of this course will require you to have a reliable internet connection and a device that meets the technical requirements for this service. More information about this remote proctoring service, including technical requirements, is available on Western's Remote Proctoring website at https://remoteproctoring.uwo.ca (click here).

8. Support Services

Please visit the Science & Basic Medical Sciences Academic Counselling webpage for information on adding/dropping courses, academic considerations for absences, appeals, exam conflicts, and many other academic related matters: https://www.uwo.ca/sci/counselling/ (click here).

Students who are in emotional/mental distress should refer to Mental Health@Western by visiting their website https://uwo.ca/health/ (click here) for a complete list of options about how to obtain help.

Western is committed to reducing incidents of gender-based and sexual violence and providing compassionate support to anyone who has gone through these traumatic events. If you have experienced sexual or gender-based violence (either recently or in the past), you will information about support services for survivors, including emergency contacts is available (click here). If you cannot access the link you can type

- https://www.uwo.ca/health/student_support/survivor_support/get-help.html

into your browser. To connect with a case manager or set up an appointment, please email support@uwo.ca.

Please contact the course instructor if you require lecture or printed material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Accessible Education (click here) if you have any questions regarding accommodations. If the link provided does nto work, type

- http://academicsupport.uwo.ca/accessible_education/index.html

into your browser.

Learning-skills counsellors at the Student Development Centre (click here) are ready to help you improve your learning skills (alternatively, type https://learning.uwo.ca into your browser). They offer presentations on strategies for improving time management, multiple-choice exam preparation/writing, textbook reading, and more. Individual support is offered throughout the Fall/Winter terms in the drop-in Learning Help Centre, and year-round through individual counselling.

Additional student-run support services are offered by the USC, https://westernusc.ca/services/ (click here).