**Department of Mathematics**

 **Topology (Math4121A/Math9021) - Course Outline – Fall 2024**

**1. Course Information**

**Course Information**

Course Name: Topology – Math4121A/9021

Academic Term – Fall

Lecture Hours:

Lecture Location:

**List of Prerequisites**

Mathematics 3122A/B, Mathematics 2122A/B. 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):

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, 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 introduce point-set topology. In addition to understanding 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;
* Be able to present clear proofs to the class; and
* Be able to converse with peers on the course topics.

**Key Sessional Dates:**

September 5, 2024: Classes begin

September 13, 2024: Last day to add a full-course or a first-term half course or drop a course without showing WDN

September 30, 2024: National Day for Truth and Reconciliation (observed at Western). No classes.

October 12 – 20, 2024: Fall Reading Week

December 2, 2024: Last day to withdraw from a first-term half course or full-year course without academic penalty (extended from Sat. Nov. 30)

December 6, 2024: Last day of classes in Fall term

December 7-8, 2024: Study Days

December 9 – 22, 2024: Exam period

*Contingency Plan:* 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.

**4. Course Materials**

*Recommended textbook:* The following textbook will be our guide for the course

* Topology through inquiry by Michael Starbird and Francis Su. An e-book version is available at the following link: <https://bookstore.ams.org/text58/>

*Supplementary resource:*

* *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)**

All course material will be posted to OWL: https://westernu.brightspace.com/

Students are responsible for checking the course OWL site (https://westernu.brightspace.com/) regularly 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 Brightspace Help](https://brightspacehelp.uwo.ca/) 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.

**5. 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.

Every student will receive a participation grade. This includes (but is not limited to) attendance, asking questions, and making mistakes. Each student can miss 6 lectures without it having any effect on their participation grade.

**Worksheets**

To each lecture, there is an associated worksheet. 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, at 11:30am. 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.

Should extenuating circumstances arise, students do not need to request academic consideration and they are permitted to submit their assignment up to 69.5 hours (9am on Mondays) past the deadline without a late penalty. Worksheets will no longer be accepted past 9am on Mondays. The lowest 6 worksheets will be dropped at the end of term.

**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 a 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, the weight of the midterm will be transferred to 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.

**6. Methods of Evaluation**

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 13. Grade of each worksheet is based on the percentage of the worksheets completed.

*Two Midterms [20% each; Total 40%]:* Midterms will take place during our regular class time on October 11, and on November 15.

*Final Exam [35%]:* The final exam will be scheduled by the Registrar during the Exam Period.

**7. Student Absences**

**General information about missed coursework**

Students must familiarize themselves with the *University Policy on Academic Consideration – Undergraduate Students in First Entry Programs* posted on the Academic Calendar:

<https://www.uwo.ca/univsec/pdf/academic_policies/appeals/academic_consideration_Sep24.pdf>,

This policy does not apply to requests for Academic Consideration submitted for **attempted or completed work**, whether online or in person.

The policy also does not apply to students experiencing longer-term impacts on their academic responsibilities. These students should consult [Accessible Education](http://academicsupport.uwo.ca/accessible_education/).

For procedures on how to submit Academic Consideration requests, please see the information posted on the Office of the Registrar’s webpage:

<https://registrar.uwo.ca/academics/academic_considerations/>

All requests for Academic Consideration must be made within 48 hours after the assessment date or submission deadline.

All Academic Consideration requests must include supporting documentation; however, recognizing that formal documentation may not be available in some extenuating circumstances, the policy allows students to make one Academic Consideration request **without supporting documentation** in this course. However, the following assessments are excluded from this, and therefore always require formal supporting documentation:

* Final exam
* Midterm exam

When a student *mistakenly* submits their one allowed Academic Consideration request **without supporting documentation** for the assessments listed above or those in the **Coursework with Assessment Flexibility** section below, the request cannot be recalled and reapplied. This privilege is forfeited.

**Evaluation Scheme for Missed Assessments**

*Participation:*

Each student can miss 6 lectures without it having any effect on their participation grade.

*Worksheets:*

Should extenuating circumstances arise, students do not need to request academic consideration and they are permitted to submit their assignment up to 69.5 hours (9am on Mondays) past the deadline without a late penalty. Worksheets will no longer be accepted past 9am on Mondays. The lowest 6 worksheets will be dropped at the end of term.

*Midterm Examination*:

A student who misses a midterm test due to an illness or other verified reason must follow the instructions under “General information about missed coursework” in this syllabus. If a student does not have valid documentation or does not follow the instructions under “General information about missed coursework” 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, the weight of the midterm will be transferred to the final exam.

*Final Examination:*

A student who misses the final exam due to an illness or other verified reason must follow the instructions under “General information about missed coursework” in this syllabus.When a student misses the Final Exam and their Academic Consideration has been granted, they will be allowed to write the Special Examination (the name given by the University to a makeup Final Exam). See the Academic Calendar for details (under [Special Examinations](https://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=5&SelectedCalendar=Live&ArchiveID=#SubHeading_70)), especially for those who miss multiple final exams within one examination period.

**Coursework with Assessment Flexibility**

By policy, instructors may deny Academic Consideration requests for the following assessments with built-in flexibility:

**Flexible Completion**

**Worksheets.** Should extenuating circumstances arise, students do not need to request academic consideration and they are permitted to submit their assignment up to 69.5 hours (9am on Mondays) past the deadline without a late penalty. Worksheets will no longer be accepted past 9am on Mondays. The lowest 6 worksheet grades will be dropped at the end of term. Should extenuating circumstances arise, students do not need to request Academic Consideration for the first 6 missed worksheets. Academic consideration requests will be denied for the first 6 missed worksheets. All requests after the first 6 worksheets will be denied.

**Participation.** Each student can miss 6 lectures without it having any effect on their participation grade. Should extenuating circumstances arise, students do not need to request Academic Consideration for the first 6 missed lectures. Academic consideration requests will be denied for the first 6 missed lectures. All requests after the first 6 lectures will be denied.

**8. Additional Statements**

**Religious Accommodation**

When conflicts with a religious holiday that requires an absence from the University or prohibits certain activities, students should request an accommodation for their absence in writing to the course instructor and/or the Academic Advising office of their Faculty of Registration. This notice should be made as early as possible but not later than two weeks prior to the writing or the examination (or one week prior to the writing of the test).

Please visit the Diversity Calendars posted on our university’s EDID website for the recognized religious holidays:

[https://www.edi.uwo.ca](https://www.edi.uwo.ca/).

**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. The policy on Academic Accommodation for Students with Disabilities can be found at:

[https://www.uwo.ca/univsec/pdf/academic\_policies/appeals/Academic Accommodation\_disabilities.pdf](https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic%20Accommodation_disabilities.pdf).

**Academic Policies**

The website for Registrar Services is <https://www.registrar.uwo.ca/>.

In accordance with policy,

<https://www.uwo.ca/univsec/pdf/policies_procedures/section1/mapp113.pdf>,

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.

No electronic devices will be permitted on midterms or exams.

**Scholastic offences** are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following Web site:

<https://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf>.

**Support Services**

Please visit the Science & Basic Medical Sciences Academic Advising 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/>.

Students who are in emotional/mental distress should refer to Mental Health@Western (<https://uwo.ca/health/>) 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 find information about support services for survivors, including emergency contacts at

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

To connect with a case manager or set up an appointment, please contact 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 at

<http://academicsupport.uwo.ca/accessible_education/index.html>

if you have any questions regarding accommodations.

Learning-skills counsellors at Learning Development and Success ([https://learning.uwo.ca](https://learning.uwo.ca/)) are ready to help you improve your learning skills. 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.

Western University is committed to a thriving campus as we deliver our courses in the mixed model of both virtual and face-to-face formats. We encourage you to check out the Digital Student Experience website to manage your academics and well-being: <https://www.uwo.ca/se/digital/>.

Additional student-run support services are offered by the USC,  <https://westernusc.ca/services/>.