**Department of Mathematics**

**Course Outline**

**Mathematics 9055A/4155A**

**Fall 2024**

**1. Course Information**

**Course Information**

Math 9055A/4155A — Calculus on Manifolds

Fall 2024, Western University

Time: TBA

Room: TBA

**List of Prerequisites**

CALC 2503A/B and MATH 3122A/B

Unless you have either the requisites for this course or written special permission from your Dean’s Designate (Department/Program Counsellors and Science Academic Advisors) 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**

Masoud Khalkhali, Professor of Mathematics UWO.

Email: masoud@uwo.ca

Office:

Office hours: TBA

Students must use their Western (@uwo.ca) email addresses when contacting their instructors.

**3. Course Syllabus, Schedule, Delivery Mode**

The first main idea is to understand what a manifold is and how to differentiate and integrate a function on a manifold, including Stoke's formula (the fundamental theorem of calculus for manifolds). We shall learn about differential forms and de Rham cohomology, and then tensor fields on a manifold in general.

The course can be useful for students of pure and applied mathematics as well as physics. Topics will include Manifolds (definition, examples, constructions), orientation, functions on manifolds, partitions of unity, tangent bundle, cotangent bundle, vector fields, integral curves, differential forms, integration, manifolds with boundary, Stokes' theorem, submersions, immersions, embeddings, submanifolds, and time permitting: Sard's theorem, Whitney embedding theorem.

Learning outcome: You will learn what a manifold is, and what are the important classes of manifolds like topological, smooth, or analytic manifolds, and how to construct new manifolds out of old ones like by quotienting. You will learn how to do calculus and analysis on (smooth) manifolds.

Classes are in person: Tuesdays 12:30-2:30 PM, Thursdays 12:30-1:30 PM.

Classes begin: September 5, 2024.

Fall Reading Week: October 12 – 20.

Classes end: December 6, 2024.

Exam period: December 9 – 22, 2024.

**4. Course Materials**

Course Textbook:

An Introduction to Manifolds by Loring Tu (2nd Edition, Springer Verlag).

We shall start from Chapter 2, Manifolds.

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.

**5. Methods of Evaluation**

**Grading Scheme and Assessment Dates**

The overall course grade will be calculated as listed below:

Assignments (4) 45%

Midterm Test 20%

Final Exam (oral) 35%

The midterm test will be given in class (2 hours) in a Tuesday in the last week of October or the week after. If you miss the midterm, you can take a makeup test a week after, or reweight your final exam. The final oral exam questions will be from a list of questions that I will share with class by mid-November.

**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: Examinations scheduled during official examination periods (Defined by policy)

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**

For each missed assessment (assignment, midterm, final) there will be an extension (before solutions are posted-usually will be two weeks after the due date, or make-up. If you miss any of these, its weight will be added to the final exam.

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.

**6. 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.

Your midterm test is closed book and no electronic devices, laptops, or phones will be allowed.

**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>.

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**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/>.