

# MAT367H1Y - Differential Geometry

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<b>Office Hours</b>	Wednesday 11AM - 12PM and Friday 2-4 PM	
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<b>Office Hours</b>	Tuesday 2-3 PM and 5-6 PM	Thursday 2-3 PM and 5:30-6:30 OM

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## Course Description

Manifolds, partitions of unity, submersions and immersions, vector fields, vector bundles, tangent and cotangent bundles, foliations and Frobenius' theorem, multilinear algebra, differential forms, Stokes' theorem.

**Lecture times.** Tuesday 3-4 PM, Thursday 3-5 PM. Lectures will be live-streamed on Zoom. The link will be provided later in an announcement on Quercus.

Technical Requirements:

In order to participate in this course, students will be required to have:

- Reliable internet access. It is recommended that students have a high speed broadband connection (LAN, Cable, or DSL) with a minimum download speed of 5 Mbps.
- A computer satisfying the minimum technical requirements  
( <https://www.vicprovoststudents.utoronto.ca/covid-19/tech-requirements-online-learning/>)

If you are facing financial hardship and are unable to meet these requirements, you are encouraged to contact your college or divisional registrar (<https://future.utoronto.ca/current-students/registrars/>) to apply for an emergency bursary so that you can obtain the required items.

**Course Website.** The website for the course is

<https://www.math.toronto.edu/laithy/367-2021/index.html>

All course material will be posted on this website. Quercus will be used for announcements.

**Textbook.** Notes written in lecture and the book "An Introduction to Manifolds" by Loring Tu will form the basis of the material in the course. This book is available online from the U of T Library website (make sure you download the **second edition**). However, several topics will be discussed during the lectures but are not covered in the book; conversely, several sections in the book will not be covered in lectures. Nonetheless, you are only responsible for the material covered in the lectures and tutorials (unless otherwise stated), and you may use the book as a reference. There will be several occasions in which the lectures will deviate from the book; you are encouraged to use the book as an alternative approach to deepen your understanding of the material. I will upload the lecture notes to the course website after each lecture along with the corresponding covered sections in the book.

**Office hours:** I will be holding 3 office hours per week, which will be on Zoom. (The link will be sent via an announcement on Quercus later). The exact times for the office hours are pending discussion with the class about what times are convenient. If you can't make the chosen time, let me know and we can set up a special appointment at a time that works for you. I am willing to have appointments as late as 1 AM for the ones living in a different time zone.

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## Homework Assignments

There will be 7 homework assignments that will be due on Fridays at 11:59 PM. Refer to the course outline below for their tentative due dates. Important dates will also be posted on the course website. These assignments will be given throughout the course, and will cover the recent material discussed in lectures. They also serve as good practice for the midterm and the final assessment.

The solutions are to be submitted electronically using Crowdmark or Quercus. You need a way to produce an electronic copy of your answers. It can be a jpeg file (e.g., take picture with your cellphone) or pdf file (e.g., scan your handwritten file, or use latex to create the file).

**You have to write up the solutions yourself, in your own words.** If your solution is aided by information in textbooks or online sources, you must properly quote these references (and *still* write it up in your own words!) If you are stuck in a problem, or if the problem is unclear, you are encouraged to ask your instructor/TA for help.

## Late Policy for Assignments

20% will be deducted from the mark of the assignment for each day late. So if the assignment is due at 11:59 PM on Friday, and you submit your solutions on Saturday at 12:00 AM, you will lose 20%.

## Midterm Test

There will be one midterm test which will be held during the June examination period. The exact time will later be announced. The test is 2 hours long, but you will be given an extra 30 minutes to upload your solutions to Quercus or Crowdmark (more details will come closer to the date of the test).

### Late Policy for the Midterm

No late submissions for the midterm will be accepted.

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## Final Assessment

The final assessment will take place during the examination period in August. It will cover all the material presented in lectures and tutorials.

### Late Policy for the Final Assessment

No late submissions for the final assessment will be accepted.

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## Authorized Aids for Midterm Test and Final Assessment

You can only use the book ("An introduction to Manifolds" by Loring Tu), anything from the MAT367 course website (link is given above), and the course page on Piazza to aid you solve the problems. **No other aid is permitted.** Please refer to the Academic Integrity section below for more details and for examples of unauthorized aids.

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## Marking Scheme

Your final grade is determined in the following way:

Homework	(best 6 of 7)	60 %
Midterm Test		20 %
Final Assessment		20 %
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		100 %

## Missing Term Work

If you are unable to complete course work due to illness (e.g. cold, flu, etc.), self-isolation relating to COVID-19, or any reason beyond your control, then please inform the instructor (but no later than one week after your situation returns to normal), and use the Absence Declaration Tool on ACORN. The Absence Declaration Tool on ACORN can be used in place of standard documentation at this time. The University is temporarily suspending the need for doctor's note or medical certificates for any absence from academic participation in the University.

If you miss the midterm or an assignment in such cases, the marking scheme will be adjusted appropriately. There will be NO make-up test or final assessment. If you would like feedback on your progress in the course, you may contact the instructor to request permission to take the midterm test informally for feedback only. The midterm test will then be written and marked as usual, but the result is solely for feedback purposes and will not under any circumstances be counted towards your mark in the course.

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## Academic Integrity

All students at the University of Toronto are expected and required to be familiar with this institution's policies on academic integrity. Students should become familiar with and are expected to adhere to the Code of Behaviour on Academic Matters which can be found at:

<https://governingcouncil.utoronto.ca/secretariat/policies/code-behaviour-academic-matters-july-1-2019>

Cheating is a direct insult to your instructor, your TAs and your fellow students. Your instructors and TAs work hard to design, prepare, and deliver course material, provide feedback and guidance, and assess course performance. Your fellow students, who do not cheat, are doing their best to earn the grade they desire by actually putting in the required effort to learn the material. Cheating denigrates all of this and is totally unacceptable. In addition to this, cheating does more harm than good; you will miss out on learning the material as well as the personal growth and refined mathematical maturity that comes with the genuine struggle to learn.

Cheating in the context of this course includes, but is not limited to, any of the following activities:

- Working with any other individual, inside or outside of the class, on the midterm test or the final assessment.

- Posting course material to the internet without the **explicit** permission of your instructor.
- Accessing any online resources of any form (other than the ones listed earlier) while writing the midterm test or the final assessment.
- Allowing someone else to write the test or the final assessment for you, or doing the same for someone else.
- Submitting any work which is not entirely your own independent work.

All cases of cheating will be taken very seriously and referred to the University for potential disciplinary action. **Disciplinary action for academic misconduct, which includes cheating, can be severe, up to and including expulsion from the University.**

We want to emphasize that our main interest in this class is to help you actually learn the material, not to be police officers. If at any point in the term you are becoming concerned about your performance in the course, please talk to your TA or instructor. We will do what we can to help you learn the course material and get the best mark you can. If you feel that your performance is less than you wanted, the solution is to work harder and ask for help, not to cheat.

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## Copyright

This course, including your participation, will be recorded on video and will be available to students in the course for viewing remotely and after each session.

Course videos and materials belong to your instructor, the University, and/or other sources depending on the specific facts of each situation and are protected by copyright. Do not download, copy, or share any course or student materials or videos without the explicit permission of the instructor.

For questions about the recording and use of videos in which you appear, please contact your instructor.

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## Accessibility

The University provides academic accommodations for students with disabilities in accordance with the terms of the Ontario Human Rights Code. This occurs through a collaborative process that acknowledges a collective obligation to develop an accessible learning environment that both meets the needs of students and preserves the essential academic requirements of the University's courses and programs.

Students with diverse learning styles and needs are welcome in this course. If you have a disability that may require accommodations, please feel free to approach your Course Instructor and/or the

Accessibility Services office as soon as possible. The sooner you let us know your needs the quicker we can assist you in achieving your learning goals in this course.

Link to Accessibility Services website:

<https://studentlife.utoronto.ca/department/accessibility-services/>

## Course Outline

The following is a tentative outline of the material which will be covered.

(Recall that Assignments are due on Fridays at 11:59 PM).

Week #	Date of week	Topics	Due Dates
1	May 3	Informal introduction, Def of Manifolds	—
2	May 10	Examples of Manifolds	Assignment 1 due
3	May 17	Smooth maps, tangent vectors	—
4	May 24	Immersion and submersion theorem, submanifolds	Assignment 2 due
5	May 31	Tangent bundle, vector bundles, sections	—
6	June 7	Vector fields and flows, Lie brackets	Assignment 3 due
–	June 17-28	–	Midterm Test
7	July 5	Frobenius theorems and foliations	Assignment 4 due
8	July 12	Differential 1-forms, cotangent bundle	—
8	July 19	Differential forms, exterior derivation	Assignment 5 due
9	July 26	Cartan's Calculus	—
10	Aug 2	Orientations, integration on manifolds	Assignment 6 due
12	Aug 9	Stokes theorem, Riemannian metrics	Assignment 7 due
–	Aug 18-30	–	Final Assessment