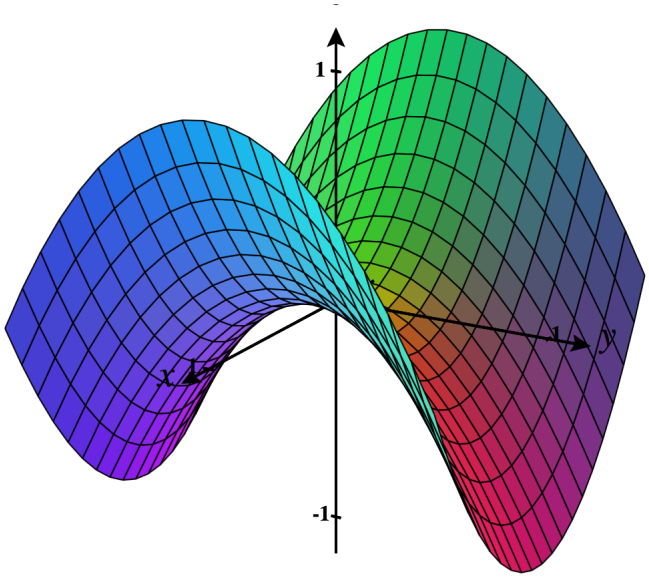
MAT 237: Multivariable Calculus with Proofs

Summer 2024



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LAND ACKNOWLEDGEMENT: We wish to acknowledge this land on which the University of Toronto operates. For thousands of years it has been the traditional land of the Huron-Wendat, the Seneca, and the Mississaugas of the Credit. Today, this meeting place is still the home to many Indigenous people from across Turtle Island and we are grateful to have the opportunity to work on this land.

EQUITY, DIVERSITY, AND INCLUSION: At the University of Toronto, we embrace diversity of age, background, culture, ethnicity, gender expression, religious affiliation, sexual orientation, and other visible and non-visible aspects of one's identity. All members of the learning environment in this course should strive to create an atmosphere of mutual respect where all members of our community can express themselves, engage with each other, and respect one another's differences. It is everyone's responsibility to contribute to an inclusive, welcoming, and equitable environment for all.

You have a right to be addressed however you prefer. Please feel free let us know your pronoun(s) and/or preferred name at any time.

If you experience anything other than an inclusive, welcome, and equitable environment please reach out to your TA or instructor, or contact the Institutional Equity Office (https://people.utoronto.ca/inclusion/resources/).

INTRODUCTION: Welcome to Math 237! In this course we will continue the study of calculus initiated in Math 137 by extending many of the concepts introduced there to the world of functions which take in and output *vectors* instead of single variables. As in 137 there is a focus on mathematical rigour, reading and understanding mathematical statements and precise definitions, and reading, critiquing, and writing rigorous proofs.

Mathematics is not usually easy. You have the right to be confused, make mistakes, ask questions, and have fun. We will get through it together.

When emailing anyone from the teaching team, the subject line should include "MAT237".

COURSE PAGE: https://q.utoronto.ca/courses/345805

LECTURES:
Tuesday 10:10 - 12:00 EST
Wednesday 10:10 - 12:00 EST
Friday 10:10 - 12:00 EST
Zoom information:
https://utoronto.zoom.us/j/84004208464
Meeting ID: 840 0420 8464
Passcode: stokes

TUTORIALS: Tutorials will begin the week of May 13th. In most tutorials you will see one or two examples from your TA then spend some time on a worksheet in small groups. These will be handed in via Crowdmark, once per group, and as long as effort is apparent you will receive full marks. To leave some wiggle room, we expect you to participate in at least 15 of these worksheet sessions.

Section 0101:
Monday 9:10 - 10:00 EST
Thursday 9:10-10:00 EST
Zoom information:
https://utoronto.zoom.us/j/85155687859
Meeting ID: 851 5568 7859
Passcode: implicit

Section 0201:
Wednesday 2:10 - 3:00 EST
Friday 2:10 - 3:00 EST
Zoom information:
https://utoronto.zoom.us/j/86027620786
Meeting ID: 860 2762 0786
Passcode: inverse

OFFICE HOURS:
Instructor Office Hours:
Thursday 12:10 - 1:00 EST
Friday 12:10 - 1:00 EST
Zoom information:
https://utoronto.zoom.us/j/81615286616
Meeting ID: 816 1528 6616
Passcode: fireplace

TA Office Hours:
Monday 1:10-2:00

Zoom information:
https://utoronto.zoom.us/j/81369575570
Meeting ID: 813 6957 5570
Passcode: 338366

PIAZZA: This term we will be using Piazza for class discussion. The system is catered to getting you help fast and efficiently from classmates, TAs, and your course instructor. Rather than emailing questions to the teaching staff, you are encouraged to post your questions on Piazza. If you have any problems or feedback for the developers, email team@piazza.com.

Find our class signup link at: https://piazza.com/utoronto.ca/summer2024/mat237y1ylec0101 or on Quercus.

PREREQUISITES: The prerequisites for this course are a strong background in single-variable calculus (MAT157, MAT137, or a strong performance in MAT135/6), linear algebra (MAT240 or MAT223), along with the prerequisites of all those courses - you must retain a knowledge of precalculus.

LEARNING GOALS: The goals of the course are, as stated in the course description, to explore the following topics: Elementary topology in Euclidean space. Differential calculus of vector valued functions of a vector variable. Implicit and inverse function theorems, regular surfaces. Optimization, Lagrange multipliers, multivariable Taylor polynomials. Integral calculus with the Jordan measure. Fubini's theorem, change of variables. Line and surface integrals. Vector calculus in two- and three-dimensions. Green's theorem, Divergence theorem, Stokes' theorem. Fourier series.

REFERENCES: We will be roughly following a combination of Tyler Holden's 237 notes from a few years ago:

- Tyler Holden, 237 Lecture Notes, 2015-16.

and Asif Zaman's textbook from the regular term, which can be found on our Quercus page. For different versions of the same material, you can have a look at these other resources:

- Gerald B. Folland, *Advanced Calculus*, Pearson, 2001.
- Robert Jerrard, Online notes for MAT237: Multivariable Calculus, 2018-9.

ASSESSMENT: There will be a total of 11 assignments, due 11:59 PM on Crowdmark each Monday except the first Monday (May 13). These are meant to get to you think deeply about the material and are the most important part of the course, since *the only way to learn mathematics is to do it.* The assignments will consist of a mix of computational and theoretic problems. We will drop the worst 2 of the 11 from your final grade.

You are encouraged to discuss the assignments with each other and you may submit in pairs if you desire. You will find yourself more successful if you take this as an opportunity to discuss the problems in depth with a peer, and not as an excuse to only do half the problems. If you choose to submit alone, good way to do this is to work together with other classmates when first thinking about the problems, but not to work together when you are writing your solutions, never share your solutions with your peers, and never have the solution written by a friend in front of you.

In addition, after each lecture a post-lecture quiz will become available on Quercus for the rest of that day. These are meant to help you sum up what you learned that day and will be short and not too difficult. Since these are each only available for a limited time and life can get in the way, your grade will take into account 24 of the 36 total post-lecture quizzes, although you are encouraged to do them all.

The term test will take place in class, on a date to be determined. It will be open book (unlike the final exam) and handed in via Crowdmark.

The final exam will take place in person at a date yet to be determined.

GRADING & REGRADING: Your final grade is broken down as follows:

Surveys	1%
Post-Lecture Quizzes (best 24 of 36)	4%
Tutorial Worksheet (at least 11 of roughly 20)	10%
Term Test	10%
Assignments (best 9 of 11)	35%
Final Exam	40%

Before you ask for a regrade:

- Read the comments the TAs made on your paper and think about them.
- Read the sample solutions posted on Quercus.
- Wait 24 hours, and do it all again. It will make more sense.

We mark in good faith. We are not out to get you. We are not trying to keep the average down. If you truly believe a mistake has been made, email evan.sundbo@mail,utoronto.ca.

Include:

- Your full name, as it appears on Quercus
- Your student number
- Your UTOR ID
- The URL of your graded paper on Crowdmark. (You can find this by viewing your grade on Crowdmark, then clicking "Get sharable link". The URL should be of the form https://app.crowdmark.com/score/...)
- The question or questions you would like to discuss
- A detailed explanation of what you think the error is.

Requests will be considered only up to two weeks after the grades have been returned.

POLICY ON LATE OR MISSED WORK: Late assignments will not be accepted for any reason, and a missed assignment will count as one of the ones dropped from your final grade as outlined above.

Students who are absent from class for prolonged periods and who require consideration for missed academic work should contact the instructor and verify their absence(s) through either the Absence Declaration tool, Verification of Illness or Injury (VOI) form, College Registrar Letter, or Letter of Academic Accommodation from Accessibility Services, as appropriate to their situation.
https://www.artsci.utoronto.ca/current/academics/student-absences

IMPORTANT DATES:

Classes begin	May 6, 2024
Last day to enroll	May 12, 2024
Term Test	TBA
Classes pause	June 17, 2024
Classes resume	July 2, 2024
Last day to drop	July 22, 2024
Classes end	August 12, 2024
Final Exam	TBA

There is a Course Calendar pdf on our Quercus page which you may find useful.

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.viceprovoststudents.utoronto.ca/student-policies-guidelines/tech-requirements-online-learning/)

Other recommended items include headphones, microphone, webcam, and a tablet or printer. If you are facing financial hardship, you are encouraged to contact your college or divisional registrar to apply for an emergency bursary (https://future.utoronto.ca/current-students/registrars/).

ACADEMIC INTEGRITY: The University of Toronto maintains high standards of academic integrity. You are expected to read and abide by The University's Code of Behaviour on Academic Matters found at https://governingcouncil.utoronto.ca/secretariat/policies/code-behaviour-academic-matters-july-1-2019.

Taking credit for someone else's work is an academic offence. Students are responsible for citing their sources and explaining their work in their own words. All suspected cases of academic dishonesty will be investigated following procedures outlined in the Code of Behaviour on Academic Matters. If you have questions or concerns about what constitutes appropriate academic behaviour or appropriate research and citation methods, please reach out to your instructor.

The use of generative artificial intelligence (AI) tools is strictly prohibited in all course assess- ments unless explicitly stated otherwise by the course instructor. This includes, but is not limited to, ChatGPT, GitHub Copilot, and open-source models that you have trained and/or deployed yourself. You may not interact with, nor copy, paraphrase, or adapt any content from any gener- ative AI for the purpose of completing assignments in this course. Use of generative AI will be considered use of an unauthorized aid, which is a form of academic misconduct under the Code of Behaviour on Academic Matters. This course policy is designed to promote your learning and intellectual development and to en- sure that our evaluations are a fair and accurate assessment of your learning. Though it may be tempting to use generative AI to assist you when completing your assignments, this will inhibit your learning.

ACCESSIBILITY SERVICES: We are committed to accessibility at UofT. Accessibility Services supports students who experience difficulties affecting their learning, by providing academic accommodations and services. Such difficulties could take many different forms, and they may be temporary (e.g. a broken wrist or concussion) or longer-lasting (e.g. a learning disability). Accommodations will be made to suit each individual student and their learning needs. If you think you might require accommodations, please contact Accessibility Services, by visiting their website (https://studentlife.utoronto.ca/department/accessibility-services/), emailing accessibility.services@utoronto.ca or calling 416-978-8060. It is important that you get in touch with them right away because the process for obtaining your accommodations letter may take up to several weeks. If you have general questions or concerns about the accessibility of this course, you are encouraged to reach out to your instructor or Accessibility Services.

OTHER ACADEMIC AND PERSONAL SUPPORTS:

- Writing Centre: https://writing.utoronto.ca/writing-centres/arts-and-science/
- U of T Libraries: https://onesearch.library.utoronto.ca/
- Student Code of Conduct: https://governingcouncil.utoronto.ca/secretariat/policies/code-studentconduct-december-13-2019
- Feeling Distressed? https://studentlife.utoronto.ca/task/support-when-you-feel-distressed/
- Academic Success Centre: https://studentlife.utoronto.ca/department/academic-success/
- College/Faculty Registrars: https://future.utoronto.ca/current-students/registrars/