MAT235Y1 Y: Multivariable Calculus

Fall 2024 – Winter 2025
University of Toronto

1. Contact information

Course administrative email: admin235@math.toronto.edu

LEC0101: Yu Li
Email: liyu@math.toronto.edu

LEC0201: Kevin Chien
Email: ck.chien@utoronto.ca

LEC0301: Xiaoyue Cui
Email: xiaoyue.cui@utoronto.ca

LEC0401: Mikale Reddy
Email: mikale.reddy@mail.utoronto.ca

LEC0501 (first term): Ilia Kirillov
Email: ilia.kirillov@mail.utoronto.ca

LEC0501 (second term): Obinna Kennedy Idu
Email: idu@math.toronto.edu

LEC0601: Marielle Ong
Email: marielle.ong@utoronto.ca

LEC0701: Mehul Gupta
Email: mmgupta@math.utoronto.ca

LEC5101: Maarten Mol
Email: maarten.mol@utoronto.ca

LEC5201: Jamal Kawach
Email: jamal.kawach@utoronto.ca

Office hours will be posted on Quercus.

2. Course overview

2.1. **Official course description.** Parametric equations and polar coordinates. Vectors, vector functions and space curves. Differential and integral calculus of functions of several variables. Line integrals and surface integrals and classic vector calculus theorems. Examples from life sciences and physical science applications.

Prerequisite: MAT133Y1/ MAT133Y5/ (MATA32H3, MATA33H3)/ (MAT135H1, MAT136H1)/ (MAT135H5, MAT136H5)/ MAT134Y5/ MAT135Y5/ (MATA30H3/ MATA31H3, MATA36H3/MATA37H3)/ MAT137Y1/ MAT137Y5/ MAT157Y1/ MAT157Y5

Exclusion: MAT235Y5/ (MAT232H5/ MAT233H5, MAT236H5/ MAT368H5)/ (MATB41H3, MATB42H3)/ MAT237Y1/ MAT291H1/ MAT294H1

Recommended Preparation: MAT223H1/ MAT223H5/ MATA22H3/ MATA23H3/ MAT240H1/ MAT240H5

2.2. **Course topics.** We will cover the following course units in MAT235. The corresponding sections of the textbook are indicated below. Not all material from the indicated sections will be covered, and some material may be covered in an order which is different from that of the textbook. More details about the coverage for each week will be announced in advance on Quercus. An approximate schedule can be found at the end of this syllabus.

Unit 1: Multivariable Functions. §12.1, 12.2, 12.3, 12.4, 12.5, 12.6
Unit 2: Vectors and Linear Algebra. §13.1, 13.2, 13.3, 13.4
Unit 3: Partial Derivatives and the Gradient. §14.1, 14.2, 14.3, 14.4, 14.5, 14.6, 14.7, 14.8
Unit 4: Critical Points and Optimization. §15.1, 15.2, 15.3
Unit 5: Double and Triple Integrals. §16.1, 16.2, 16.3, 16.4, 16.5, 21.2
Unit 6: Line Integrals and the Fundamental Theorem of Calculus. §17.1, 17.2, 17.3, 18.1, 18.2, 18.3, 18.4
Unit 7: Surface Integrals and The Divergence Theorem. §21.1, 19.1, 19.2, 21.3, 19.3, 19.4
Unit 8: The Curl and Stokes' Theorem. §20.1, 20.2, 20.3

For each section, a short list of **learning objectives** will be provided. The purpose of these learning objectives is to help guide and focus your studies. **Not all learning objectives will be addressed in lecture**, and so it is your responsibility to ensure that you have met each goal, whether it be via lecture, tutorial, or textbook readings.

2.3. **Textbook and course materials.** The textbook for the course is **Calculus: Multivariable, 8th edition, with WileyPLUS access** by Hughes-Hallett. You can either purchase a physical or electronic copy from the bookstore; both options will be bundled with WileyPLUS access. **You only need to purchase one of these options.** WileyPLUS access is required to complete all of the pre-class assignments (see below for details) and also gives you access to a large number of practice problems, resources, and videos. The MAT235 team **strongly**

recommends purchasing the textbook bundle from the UofT bookstore, as the bundle is cheaper if you purchase it from the bookstore vs. directly from the publisher.

The chapters from the textbook are **required reading**. Detailed instructions on what to read (or what not to read) will be available on Quercus. Please note that practice problems will be assigned from the textbook, so it is imperative that you have the correct edition.

2.4. **Course website and communication.** All course materials, announcements, and grades will be available on Quercus at `q.utoronto.ca`. All lectures and tutorials are scheduled to take place in person. Office hours will primarily be held in person, but, for the sake of convenience, we may offer a few online office hours at the discretion of the instructors and TAs.

The University has a policy requiring that students have a UofT email address and that you check it regularly. Please use your UofT email address when contacting any member of the MAT235 team. Furthermore, please include "MAT235" in the subject line in order to ensure that your email is not missed. Please refrain from emailing your TA; their availability is limited, and reading/responding to emails is not within their TA duties. Given the difficulty in effectively communicating mathematics over email, the MAT235 team requests that you **do not** send detailed math questions over email. Instead, please make an attempt to attend office hours.

2.5. **Lectures, tutorials, office hours.** This course will consist of **three weekly one-hour lectures** and **one weekly tutorial session**. All lectures and tutorials are scheduled to take place in person. The schedule for lectures is as follows:

Section	Schedule	Instructor(s)
LEC0101	MWF 9-10	Yu Li
LEC0201	MWF 10-11	Kevin Chien
LEC0301	MWF 11-12	Xiaoyue Cui
LEC0401	MWF 12-13	Mikale Reddy
LEC0501	MWF 14-15	Ilia Kirillov, Obinna Kennedy Idu
LEC0601	MWF 15-16	Marielle Ong
LEC0701	MWF 16-17	Mehul Gupta
LEC5101	MWTh 17-18	Maarten Mol
LEC5201	MWTh 18-19	Jamal Kawach

For up-to-date information on lecture and tutorial times and rooms, please refer to the official Faculty of Arts & Science 2024/2025 Timetable. Students must attend the lectures of the section they are officially registered, and are not permitted to attend the lectures of any other section unless approved by the course coordinator. Please note that due to the ongoing COVID-19 pandemic, the course delivery method may change after term has started and this may alter the course organization. Students are expected to check the course site for updates as the contents of this syllabus may change.

Tutorials will start **the week of September 16**. Students must attend the tutorials of the section they are officially registered in, and are not permitted to attend the tutorials of any other section. During tutorials, your TA will assign problems for you to work on with your peers. These tutorials will then conclude with a short **tutorial quiz**, which will be administered by your TA and will take place toward the end of your scheduled tutorial time slot. More details on tutorial quizzes can be found below.

In addition to lectures and tutorials, there will be weekly office hours held by the MAT235 team. This is an opportunity for you to ask questions about the material outside of lectures and tutorials. No appointment is necessary; you are welcome to drop in any time during an office hour. Office hour schedules will be posted on Quercus.

The unauthorized use of any lecture or tutorial materials provided by a MAT235 instructor or TA is covered by the Canadian Copyright Act and is prohibited. Students must obtain prior written consent to any kind of use beyond a MAT235 setting. In this course, you are permitted to download materials for your own academic use, but you should not copy, share, or use them for any other purpose without the explicit permission of the instructor.

3. Evaluation and assessments

3.1. **Marking scheme.** Your final grade for the course will be computed as follows:

- Pre-class assignments: 6%
- Tutorial quizzes: 10%
- Term tests: 54%
- Final exam: 30%

3.2. **Pre-class assignments.** Each week, you will have two types of pre-class assignments (or **PCA**): A required reading assignment from the textbook (not graded), and a graded pre-class assignment administered via WileyPLUS. There will be **8 graded pre-class assignments per term**, for a total of 16 for the academic year. Each graded pre-class assignment will be due on **Tuesdays at 6pm**. Please note that there will be no graded pre-class assignment during weeks in which there is a term test. A detailed schedule is given on the last page of this syllabus. Details about the assigned pre-class readings will be provided on Quercus. You are allowed to use your course notes and the textbook when completing the pre-class assignments, but **you must complete your pre-class assignments individually**. Each pre-class assignment will become available approximately one week prior to the due date.

Your best 12 PCA grades will account for 6% of your final course grade; the lowest four PCA grades will be dropped. In lieu of this flexibility, we will not offer any make-up assignments, and we will not extend the deadline for an assignment under any circumstances.

3.3. **Tutorial quizzes.** There will be **5 tutorial quizzes per term**, for a total of 10 for the academic year. A detailed schedule is given on the last page of this syllabus. The quizzes will be administered **in tutorials**. You are required to attend the tutorial in which you are registered; if you attend another tutorial and write a quiz, it will not be graded and you will receive a 0 for that week's quiz. The quizzes will take place during the second half of your tutorial and will consist of a short written question based on the material covered in the current tutorial and/or the previous week's lectures. You will be given **15 minutes** to work on your quiz. During the first part of tutorial, your TA will assign problems which will be similar to the quiz problem. In some tutorials, your TA may also introduce concepts which are not introduced in lecture. You will be given the opportunity to work in small groups in order to solve the assigned tutorial problems before the quiz takes place. Although you will be working with your peers in the first part of your tutorial, **once the quiz begins you will write your quiz individually**. In order to verify your identity, you **must present your TCard to your TA upon request**.

Important note: Please ensure you write your full name **as it appears on Quercus** prior to submitting your quiz. Otherwise, your TA will be unable to assign you a grade.

Your best 8 quiz grades will account for 10% of your final course grade; the lowest two quiz grades will be dropped. There will be no make-up quizzes. Due to the flexibility built into the marking scheme, we do not allow temporary tutorial switches. More details about the coverage of each quiz will be announced on Quercus at least one week in advance. **You are not permitted to discuss the quiz content until all tutorial sections have finished their quiz for the week.**

3.4. **Term tests.** There will be **three term tests** focused on problem solving. Each term test will be **90 minutes in length**. The tests may consist of a mix of short answer and written portions. Your solutions to the short answer problems will only be graded for correctness; you do not need to show your work for short answer problems. Your solutions to the written problems **will be graded for both correctness and clarity**. For written problems, it will not be enough to simply produce a correct final answer: you will need to show how you arrived at your answer by providing a complete and clear solution. Likewise, you may still receive partial marks even if you do not arrive at a correct final answer but demonstrate an understanding of the key ideas or progress towards the correct answer. Not all questions will be of equal difficulty or be worth the same number of points. More details about the coverage of each term test will be announced on Quercus at least one week in advance.

The term tests will be held in person on **October 18, November 29, and February 14**. Each term test will take place from **6:10pm to 7:40pm**; locations will be announced on Quercus prior to the term tests. The term tests are **closed-book**: no resources are permitted, and you are not permitted to bring a calculator. In order to verify your identity, you **must present your TCard to your invigilator upon request**. Each term test will count toward 18% of your final grade.

If you are not able to attend a term test and you have a legitimate reason for being unable to attend (e.g. scheduling conflicts), you may be permitted to write the term test at an earlier time on the test day. In this case, you will be asked to complete a form containing the following information:

- Your name and UofT email.
- The reason for your absence.
- Documentation containing proof that you will be unable to attend the regular 6:10pm to 7:40pm sitting.

The request form will be made available before each term test; the form must be submitted **at least one week** prior to the main sitting. If you submit a late request, your request will not be accepted. If your request is accepted, you will be authorized to write your term test on the same day at an early sitting; these will be scheduled for 4:10pm to 5:40pm. **No other make-up tests or time slots will be offered.** The number of students who can write the early sitting is limited, and early sittings will be offered on a first-come, first-served basis. Please see the next section for the missed test policy for MAT235.

3.5. **Final exam.** The final exam for the course will take place during the final exam period for April 2025 (between April 9 and April 30, inclusive). The final exam will take place in person and will be **3 hours in length**. The final exam will account for 30% of your final grade. More details will be given closer to the final exam period.

4. Course policies

4.1. **Policy on missed term work.** As flexibility for missed course assignments has been built into the marking scheme, missed term work will not be rescheduled, and no make-up tests, assignments or quizzes will be offered. Please note that effective for the Fall/Winter 2023-24 session, the Absence Declaration Policy has changed and students are only permitted to submit the absence declaration once for an undocumented reason across all courses. If a student needs to submit another absence after their first undocumented one, they may need to provide some form of documentation to an instructor or for a petition. The declaration is available on ACORN under the Profile and Settings menu. Please see `https://registrar.utoronto.ca/policies-and-guidelines/absence-declaration/` and `https://www.artsci.utoronto.ca/current/academics/student-absences` for more information about absence declaration and about acceptable forms of documentation.

4.2. **Missed term test policy.** In case of a missed term test, you will be asked to provide documentation to support your request for academic consideration. If approved, the weighting of any missed term tests will be moved to the final exam. A link to a missed test form will be made available on Quercus. You will be required to submit this form at most one week after the term test has taken place.

4.3. **Missed quiz policy.** No adjustments will be made for missed tutorial quizzes, since the lowest two quiz grades are dropped. The remaining quizzes will contribute to your overall quiz grade for the course.

4.4. **Missed pre-class assignment policy.** No adjustments will be made for missed pre-class assignments. Your best 12 PCA grades will account for 6% of your final course grade; the lowest four PCA grades will be dropped.

4.5. **Email policy.** Should you have a question that is not answered on the syllabus or the course website (please check there first!) please note that all communications with the MAT235 team must be sent from your official utoronto email address, with the course number included in the subject line. If these instructions are not followed, your email may not be responded to. For administrative questions, please write to `admin235@math.toronto.edu`. The administrative email is checked twice a week and should be used for any course-wide requests or concerns. For questions related to your specific lecture section, please contact your instructor directly. For mathematical questions, we strongly prefer that you visit during office hours.

5. Institutional policies and support

5.1. **Academic integrity.** The MAT235 team is strongly committed to assigning grades based on our students' honest efforts to demonstrate learning in this course. Academic dishonesty in any form will thus not be tolerated in this course. All suspected cases of academic dishonesty will be investigated following procedures outlined in the Code of Behaviour on Academic Matters:
`https://governingcouncil.utoronto.ca/secretariat/policies/code-behaviour-academic-matters-july-1-2019`.
If you have questions or concerns about what constitutes appropriate academic behaviour or appropriate research and citation methods, please reach out to the course coordinator. Note that you are expected to seek out additional information on academic integrity from the course coordinator or from other institutional resources (for example, the University of Toronto website on Academic Integrity `http://academicintegrity.utoronto.ca`). **Potential offences** include, but are not limited to:

- Using any sort of aid (notes, textbook, the Internet, etc.) during a term test or quiz.
- Having another student write an assessment for you, or impersonating someone else in writing one of these assessments.
- Posting course materials (including quizzes, tests, announcements, etc.) online.
- Submitting questions to assessments online, or obtaining answers online.
- Communicating with another person during a quiz or test.
- Talking to others about the content of an assessment before it has finished for all sections, including posting the content online.
- Submitting an altered term test or quiz for re-grading.
- Violating term test or quiz procedures.

5.2. **Copyright.** Course materials belong to your instructors, 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 without the explicit permission of the instructors.

5.3. **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 coordinator 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`

5.4. **Equity, diversity and inclusion.** The University of Toronto is committed to equity, human rights and respect for diversity. 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. UofT does not condone discrimination or harassment against any persons or communities.

5.5. **Important academic dates and deadlines.** The academic dates include enrolment dates, drop deadlines, final assessment periods, petition deadlines and more. `https://www.artsci.utoronto.ca/current/dates-deadlines/academic-dates`

5.6. **Other academic and personal supports.**

- Writing Centre: `https://writing.utoronto.ca/writing-centres/arts-and-science`
- UofT Libraries: `https://onesearch.library.utoronto.ca`
- 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`

6. Schedule and important dates

Please see `https://www.artsci.utoronto.ca/current/dates-deadlines/academic-dates` for key dates set by the Faculty of Arts & Science, including add deadlines and holidays. Some important dates for 2024-25 to note include:

- Fall classes begin: September 3
- Last day to switch tutorials: September 16
- First MAT235 tutorials: Week of September 16
- Thanksgiving holiday (no classes): October 14
- Fall reading week (no classes, tutorials, or office hours): October 28 - November 1
- Fall classes end: December 2
- Winter classes begin: January 6
- Last day to drop Y courses: February 14
- Winter reading week (no classes, tutorials, or office hours): February 17 - 21
- Winter classes end: April 4
- Winter final exam period: April 9 - 30

Please see the next page for a detailed course schedule. Please note that the lecture schedule is only an approximation and hence is subject to change.

Fall Schedule

Week	Dates	Sections	Assessments	Pre-class Assignment
1	Sep. 4-6	Course intro, 12.1		
2	Sep. 9-13	12.2, 12.3		PCA 1 due Sep. 10 at 6pm
3	Sep. 16-20	12.4, 12.5	Quiz 1 in tutorial	PCA 2 due Sep. 17 at 6pm
4	Sep. 23-27	12.6, 13.1, 13.2	Quiz 2 in tutorial	PCA 3 due Sep. 24 at 6pm
5	Sep. 30-Oct. 4	13.3, 13.4	Quiz 3 in tutorial	PCA 4 due Oct. 1 at 6pm
6	Oct. 7-11	14.1, 14.2	TT1 prep in tutorial	PCA 5 due Oct. 8 at 6pm
7	Oct. 16-18	TT1 review	TT1: Fri. Oct. 18, 6:10-7:40pm	
8	Oct. 21-25	14.3, 14.4		PCA 6 due Oct. 22 at 6pm
9	Nov. 4-8	14.5, 14.6	Quiz 4 in tutorial	PCA 7 due Nov. 5 at 6pm
10	Nov. 11-15	14.7, 14.8	Quiz 5 in tutorial	
11	Nov. 18-22	15.1, 15.2	TT2 prep in tutorial	PCA 8 due Nov. 19 at 6pm
12	Nov. 25-29 + Dec. 2	15.3, TT2 review	TT2: Fri. Nov. 29, 6:10-7:40pm	

Winter Schedule

Week	Dates	Sections	Assessments	Pre-class Assignment
13	Jan. 6-10	16.1, 16.2		PCA 9 due Jan. 7 at 6pm
14	Jan. 13-17	16.3, 16.4		PCA 10 due Jan. 14 at 6pm
15	Jan. 20-24	16.5, 21.2	Quiz 6 in tutorial	PCA 11 due Jan. 21 at 6pm
16	Jan. 27-31	17.1, 17.2	Quiz 7 in tutorial	PCA 12 due Jan. 28 at 6pm
17	Feb. 3-7	17.3, 18.1	TT3 prep in tutorial	
18	Feb. 10-14	18.2, TT3 review	TT3: Fri. Feb. 14, 6:10-7:40pm	
19	Feb. 24-28	18.3, 18.4		PCA 13 due Feb. 25 at 6pm
20	Mar. 3-8	21.1, 19.1	Quiz 8 in tutorial	PCA 14 due Mar. 4 at 6pm
21	Mar. 10-15	19.2, 21.3	Quiz 9 in tutorial	PCA 15 due Mar. 11 at 6pm
22	Mar. 17-22	19.3, 19.4	Quiz 10 in tutorial	PCA 16 due Mar. 18 at 6pm
23	Mar. 24-28	20.1, 20.2		
24	Mar.31-Apr. 4	20.3, Exam review		