

Course Syllabus

 Edit

Section 101: MWF 11:00-11:50. Credit value: 3 credits.

Instructor: Professor I. Laba

- **Bio:** Ph.D. 1994 (University of Toronto). At UBC since 2000. Full Professor since 2005.
- **If you're not sure what you should call me**, please use "Professor".
- **Online office hours:** Tuesdays 10:30-11:30 starting Sept. 10. See the Zoom link on the course sidebar. I will also be available for questions after each scheduled class.
- **TA office hours:** schedule will be posted soon.
- **Contact information:** For **general questions** about course material and homework, please use Piazza or Discussions on Canvas. For **individual and confidential matters** such as academic concession, please use Inbox -> Conversations on Canvas. Inquiries submitted on evenings and weekends will be answered on the next business day.

Prerequisites: Either (a) a score of 68% or higher in MATH 121 or (b) a score of 80% or higher in one of MATH 101, MATH 103, MATH 105, SCIE 001.

Corequisites: One of MATH 152, MATH 221, MATH 223.

Course-level learning objectives:

- Learn the basic concepts of multivariable calculus, including analytic geometry in 3 dimensions, continuity, differentiation and integration of multivariate functions.
- Understand the differences between the multivariate calculus concepts and their analogues for functions of one variable.
- Use multivariate calculus to solve mathematical questions with several variables, such as optimization problems, questions from geometry and statistics.
- Learn clear and correct mathematical reasoning and writing, including formal mathematical proofs. Please note that this course is not a substitute for taking both Math 200 and Math 220. We will provide instruction in rigorous proofs as they apply to the material in this course, but if you need dedicated classes on the basics of mathematical reasoning and proof writing, you should take Math 220.

Course topics and tentative schedule:

- **Vectors in 3-space:** vectors, dot and cross product, planes and lines, quadric surfaces, cylindrical and spherical coordinates (approx. 2 weeks)
- **Functions of several variables:** graphs, limits, continuity, derivatives and differentiability,

gradients and directional derivatives, implicit functions (approx. 5 weeks)

- **Applications of partial derivatives:** extreme values of functions, minimization and maximization problems (approx. 2-3 weeks)
- **Multiple integration:** double and triple integrals, changing variables, applications (approx. 3 weeks)

A detailed schedule of class topics covered each week [is posted here \(https://canvas.ubc.ca/courses/148382/pages/tentative-course-schedule\)](https://canvas.ubc.ca/courses/148382/pages/tentative-course-schedule) and will be updated as needed.

Course structure and learning activities:

- **Lectures, MWF 11-11:50:** Introduction to the material, examples, discussion of problem-solving techniques. I will also talk about issues related to good mathematical writing and, specifically, writing of formal mathematical proofs. Questions are welcome in class, and I will try to have a dedicated Q&A period on a regular basis.
- **Course notes and textbook:** see below.
- **Discussion boards:** If you have questions about the course material or homework, your best option is to make a post on Piazza. The TA and/or I will check Piazza at least once every business day, and many questions are answered quickly by other students before we even see them. Discussions on Canvas are also available.
- **Homework (WebWork and Longform):** **WebWork** will be assigned weekly. These are usually short questions, graded automatically, where you only have to provide the correct answer and (sometimes) selected intermediate steps. **Longform assignments** will focus on proofs. They will have only 2-3 questions each, but you will have to include complete, correct, and clearly written explanations and justifications for your work. You will be graded both on the correctness of your mathematics and on the quality of your mathematical writing. The correct answer alone will **not** be sufficient.
- **Midterms and final exam:** see below.
- **Additional practice:** see the [recommended textbook problems \(https://canvas.ubc.ca/courses/148382/pages/recommended-practice-problems\)](https://canvas.ubc.ca/courses/148382/pages/recommended-practice-problems) or the practice problems from course notes.
- **Engagement:** Your course participation can include class attendance, reading course notes, posting and answering questions on discussion boards, textbook reading, doing homework (individually or as group work), doing additional practice problems, researching and consulting additional materials, and so on. It is not mandatory to do *all* of this, so that you can participate in class in flexible ways depending on your circumstances. However, *sufficient* engagement is essential.

Required learning materials:

- **Course Notes:** [the notes linked here \(https://canvas.ubc.ca/courses/148382/pages/course-notes\)](https://canvas.ubc.ca/courses/148382/pages/course-notes) were developed specifically for this course and we will follow them closely in class. The notes are

based on my lectures and problem sets from the last several years, and were typeset by one of our TAs (Caleb Marshall) and me.

- **Textbook:** Robert A. Adams and Christopher Essex, *Calculus: A Complete Course*, 10th edition, Pearson, ISBN-13: 9780135766781. The e-text costs \$64.99 (12 months access) and can be purchased here directly from Pearson: <https://www.pearson.com/en-ca/subject-catalog/p/calculus-a-complete-course/P200000002479/9780135766781> ↗ (<https://www.pearson.com/en-ca/subject-catalog/p/calculus-a-complete-course/P200000002479/9780135766781>). If you are also planning to take Math 227, the same textbook will be used there, so I strongly recommend getting either this e-text or the paper book (see below). Other e-text options are also available, for example some Pearson packages include MyLab coursework. These features could be useful to you as additional practice, but will not be required for credit. **Print textbooks**, including used copies and older editions, are acceptable alternatives and may be less expensive.
- **Alternative textbooks:** Most multivariable calculus textbooks cover a large part of our course material. Some are available freely online, for example the [CLP-3 Multivariable Calculus \(https://personal.math.ubc.ca/~CLP/CLP3/\)](https://personal.math.ubc.ca/~CLP/CLP3/) textbook developed at UBC. Please be mindful that this is a proof-based course, and that some textbooks omit proofs and/or more advanced topics that we will cover (the epsilon-delta definition of the limit, the rigorous definition of differentiability of multivariable functions, the implicit function theorem). You may have to pay more attention in class and/or have to look up other materials if you are using such textbooks. If you plan to take Math 227, that course ends with differential forms (Adams-Essex, Chapter 18), which most other calculus books do not cover.
- **Homework assignments** (will be posted on Canvas)
- **WebWork** (must be accessed through Canvas)

Your **course grade** will be based on homework (30%) and exams (70%). Your **homework grade (out of 30%)** will be based on WebWork (20%) and Longform assignments (10%). Your **exam grade (out of 70%)** will be calculated in two ways: (A) 5% lower midterm score + 15% higher midterm score + 50% final exam, (B) 20% each midterm + 30% final exam. Your exam grade will be the **higher** of (A) and (B). Course grades may be **slightly** scaled at the end of the term.

- **WebWork:** problem sets will be assigned weekly. In order for your grades to be recorded properly, you have to access problem sets through Canvas. To allow for minor issues (such as illnesses, technical difficulties with WebWork, etc.), the WebWork part of your grade will be 110% of your total WebWork score^{*}, so that you can miss up to 10% of WebWork and still get full credit. (*If this is more than 20 points, your WebWork score will be 20.)
- **Additional WebWork practice:** WebWork will also be used for prerequisite review questions, additional practice problems, etc. These are for your own practice and will not be graded. To distinguish them from the assignments that are required for credit, the additional practice sets will be labelled AP1, AP2, ... , and the required homework sets will be labelled HW1, HW2, The first additional practice set (AP1, not graded) will be an introduction to WebWork, for those who

have not used it previously.

- **Longform homework assignments** will be due tentatively on Sept. 27, Oct. 23, and Nov. 26. Each assignment will be posted at least a week in advance. Your solutions are to be submitted online (details to be posted) and will be graded online. Late assignments will not be accepted. To allow for minor illnesses and other emergencies, the lowest Longform score will be dropped with no questions asked.
- **The midterms** will be held on **Monday, October 7, 11-11:50 AM**, and **Wednesday, November 6, 11-11:50 AM**. (This is same time as our usual class, but we will move to larger classrooms). Please be aware that the UBC exam hardship policy applies only to final exams (not midterms), and that it is not always possible to avoid situations such as having multiple midterms on the same day.
- **The final examination** will be held in December, The date and location of the final examination will be announced by the Registrar later in the term. The current plan is for the final exam to be written in person, as a closed-book exam with no books, notes, or electronic devices allowed. Attendance is mandatory, so you should not make any travel plans before the exam date is announced.

Academic concession: The rules and procedures for obtaining academic concession are governed by [UBC Policy on Academic Concession \(https://vancouver.calendar.ubc.ca/campus-wide-policies-and-regulations/academic-concession\)](https://vancouver.calendar.ubc.ca/campus-wide-policies-and-regulations/academic-concession). The details in this course are as follows.

- **Late or missed homework:** Late assignments will not be accepted, in order to discourage pile-ups of overdue workload, respect the TA's work schedule, and allow the timely posting of solution sets for everyone. To account for minor illnesses and emergencies, the homework grading scheme (see above) allows for one Longform assignment and about 10% of WebWork to be missed with no penalty.
- Academic concession requests involving **a missed midterm, two or more missed Longform assignments, or more than 10% of WebWork**, should be submitted as soon as reasonably possible using the [Department of Mathematics Academic Concession self-declaration form \(https://canvas.ubc.ca/courses/148382/files/34323414?wrap=1\)](https://canvas.ubc.ca/courses/148382/files/34323414?wrap=1). [↓ \(https://canvas.ubc.ca/courses/148382/files/34323414/download?download_frd=1\)](https://canvas.ubc.ca/courses/148382/files/34323414/download?download_frd=1). The usual remedy will be to have your course grade based on your remaining work.
- Please note that academic concession for certain reasons, such as valid schedule conflicts that can be foreseen, must be requested in advance and may require additional documentation. Personal travel plans and conflicts with work schedule are not valid reasons for academic concession.
- Normally, the self-declaration form can be used only once in a course. Repeated requests for academic concession should be accompanied by supporting documentation and may require a referral to the appropriate advising office.
- **Missing the final exam:** If you miss the final exam for a valid reason such as a medical

emergency, you will need to present your situation to the Dean's Office of your Faculty to be considered for a deferred exam. [See the Academic Calendar for detailed regulations. \(http://www.calendar.ubc.ca/vancouver/index.cfm?tree=3,41,94,0\)](http://www.calendar.ubc.ca/vancouver/index.cfm?tree=3,41,94,0) Your performance in a course up to the exam is taken into consideration in granting a deferred exam status (e.g. failing badly generally means you will not be granted a deferred exam). In Mathematics, students usually sit the next available exam for the course they are taking, which could be several months after the original exam was scheduled.

Academic misconduct: UBC takes cheating incidents very seriously. After due investigation, students found guilty of cheating on tests and examinations are usually given a final grade of 0 in the course and suspended from UBC for one year. [See here for more information. \(https://vancouver.calendar.ubc.ca/campus-wide-policies-and-regulations/student-conduct-and-discipline/discipline-non-academic-misconduct-student-code-conduct\)](https://vancouver.calendar.ubc.ca/campus-wide-policies-and-regulations/student-conduct-and-discipline/discipline-non-academic-misconduct-student-code-conduct)


- While students are encouraged to study together, you should be aware that blatant copying of another student's work is a serious breach of academic integrity. You may use AI tools to improve your writing, but please be aware that such tools do not usually generate correct mathematical content. Your final write-up should be your own and you are responsible for the work you submit.
- Academic misconduct includes misrepresenting a medical excuse or other personal situation for the purposes of postponing an examination or quiz or otherwise obtaining an academic concession.

Sharing course materials: We are working hard to provide all the materials you need to succeed in this course. In return, please respect our work. All class notes, assignment instructions, midterm questions and answers, and any other materials provided here are for the students currently enrolled in this course. It is unacceptable to share any of these materials beyond our course, including by posting on file-sharing websites (e.g., CourseHero, Google Docs). Respect our intellectual property and follow [copyright law. \(https://copyright.ubc.ca/students/?login\)](https://copyright.ubc.ca/students/?login)

Additional help:

- **Piazza and Discussions on Canvas:** see above. [_\(http://www.math.ubc.ca/~ilaba/teaching/email.html\)](http://www.math.ubc.ca/~ilaba/teaching/email.html)
- **I will be available for questions** (a) after each scheduled class, (b) online (Zoom) on Tuesdays 10:30-11:30. There will also be **TA office hours** (schedule to be posted).
- Occasionally, a student may need to make an individual appointment with me or the TA outside of these hours. If this is the case, please make your request at least one day in advance. Our schedules can fill up, so that drop-ins and same-day requests for appointments can be difficult or impossible to accommodate. Please also let me know in advance what you would like to discuss so that we can use the meeting time efficiently.
- **Additional resources for proof writing:**
 - [PLP: An Introduction to Mathematical Proof, \(https://personal.math.ubc.ca/~PLP/\)](https://personal.math.ubc.ca/~PLP/) by Seckin

Demirbas and Andrew Rechnitzer, is a free online textbook that has been used in Math 220 at UBC.

- [Francis Su's handouts on mathematical writing \(https://math.hmc.edu/su/writing-math-well/\)](https://math.hmc.edu/su/writing-math-well/) include good examples and recommendations. Please don't treat these as strict rules that you have to follow 100% of the time. (Some level of informality is OK in homework assignments, for example you don't have to end every calculation with a punctuation sign. My posted lecture notes are a little bit informal. But this should give you a good idea of how you can make your mathematical writing clear and easy to understand.)
- **The Mathematics Learning Centre** is a space for undergraduate students to study math together, with friendly support from tutors who are graduate students in the math department. [Past final exam database \(http://www.math.ubc.ca/Ugrad/pastExams/index.shtml\)](http://www.math.ubc.ca/Ugrad/pastExams/index.shtml), maintained by the Mathematics department. More information will be posted when available.
- **UBC Math Club**  [_ \(https://www.facebook.com/ubcmathclub\)](https://www.facebook.com/ubcmathclub) sells math exam packages (old exams together with solution sets) for a nominal price before each final exam session.

Weather Contingency Plan for Class Sessions, Quizzes, and Exams: Please check [ubc.ca \(http://ubc.ca\)](http://ubc.ca) often during bad weather or snow. If a class session is cancelled, the default contingency plan will be to have an online class on Zoom. For those who cannot attend an online class at short notice, a recording will be posted on Canvas. Please check Canvas for information. If a cancellation impacts a midterm exam or quiz, we will reschedule to another class time. If the final exam is impacted, it will be rescheduled by student services. If you are registered to write exams at the Centre for Accessibility, I encourage you to contact your CFA advisor to discuss the weather contingency plan for this course.

Statement about the University's values and policies, mandated by [UBC Policy V-130 \(http://www.calendar.ubc.ca/vancouver/index.cfm?tree=3,328,0,0\)](http://www.calendar.ubc.ca/vancouver/index.cfm?tree=3,328,0,0): UBC provides resources to support student learning and to maintain healthy lifestyles but recognizes that sometimes crises arise and so there are additional resources to access including those for survivors of sexual violence. UBC values respect for the person and ideas of all members of the academic community. Harassment and discrimination are not tolerated nor is suppression of academic freedom. UBC provides appropriate accommodation for students with disabilities and for religious, spiritual and cultural observances. UBC values academic honesty and students are expected to acknowledge the ideas generated by others and to uphold the highest academic standards in all of their actions. Details of the policies and how to access support are available [here \(http://senate.ubc.ca/policies-resources-support-student-success\)](http://senate.ubc.ca/policies-resources-support-student-success).