Course Syllabus

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Section 201: MWF 12:00-12:50. Credit value: 3 credits.

Instructor: Professor I. Laba

- **Bio:** Ph.D. 1994 (University of Toronto). At UBC since 2000. Full Professor since 2005.
- **Email**: ilaba@math.ubc.ca
- **Office hours:** 10-15 minutes after each class as needed, and **Wednesdays 2-3 on Zoom, starting 01/12**. This schedule may change after we move to in-person classes.
- If you cannot attend regular office hours due to schedule conflict, you can request an appointment. 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.
- **Contact information:** The best way to contact me is (a) by email, or (b) on Canvas. For questions that would likely be of interest to other students (e.g. homework question clarifications), please use Discussions or Piazza. For individual and confidential matters (your homework grades, academic concession), please use either email or Inbox -> Conversations on Canvas.
- Please note that email received on evenings and weekends will normally be answered on the next business day.
- If you are not sure how to email a professor, **see here for templates and recommendations. (http://www.math.ubc.ca/~ilaba/teaching/email.html)**)

Prerequisites: A score of 68% or higher in MATH 226.

Course-level learning objectives:

- Learn advanced concepts of multivariable calculus, including differential geometry of curves and surfaces, line and surface integrals, the fundamental integral theorems, and the general framework of differential forms.
- Explore the connections between "visible" geometric features of objects and their mathematical expressions.
- Use multivariate calculus to solve mathematical questions related to motion in space, force fields, electromagnetism and fluid dynamics.
- Practice high quality mathematical writing, including constructing and writing formal mathematical proofs.

Course topics and tentative schedule:

- **Vector-valued functions and curves (Chapter 12)**: curves, velocity, acceleration, arc length, curvature, tangent, normal, binormal.
- **Vector fields and line integrals (Sections 16.1-16.4):** vector fields, field lines, conservative fields, line integrals.
- **Surface integrals (Sections 16.5-16.6):** surfaces, surface area, flux integrals.
- **Integral theorems (Chapter 17):** gradient, divergence and curl, vector identities, divergence theorem , Green's theorem, Stokes' theorem, applications.
- **Differential forms (Chapter 18):** differential forms, exterior derivative, generalized Stokes' Theorem.

A more detailed tentative schedule of class topics and textbook sections covered each week **is posted here**. Recommended practice problems for the semester **are posted here.**

Course structure and learning activities:

- **Textbook:** The required textbook has full and complete explanations of all topics covered in class, as well as a broad selection of practice problems for you to work on (specific recommendations will be posted on a regular basis). For more on the textbook and possible alternatives, see below. Lectures and class notes are intended to supplement the textbook. They will not duplicate or replace it.
- **Lectures and Q&A, MWF 12-12:50, Zoom (hopefully, moving to in-person later):** the lectures will provide an introduction to the material (the main points, frequently asked questions about the material, problem-solving techniques, issues related to good mathematical writing). Questions in class are encouraged and I will try to address them as we go. The lecture and Q&A will be recorded and available for asynchronous viewing after class. Prepared class notes will be uploaded to Canvas in advance.
- **Problem-solving classes:** about once a week, we will have a class dedicated to examples and problem-solving. I will start with a presentation of a few worked examples and exercises. We may also use parts of such classes for group work (such as breakout rooms on Zoom). You are welcome to use that time any way you like: work in groups on the problem sets assigned for that session, ask individual questions, etc. **All course-related questions, not necessarily just about the problem set for that day, are welcome**.
- **Discussion boards:** Both Piazza and Discussions on Canvas will be available. I will check both at least once a day, and will also ask the TA to monitor both.
- **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 be due biweekly (except for the winter break), tentatively on 01/28, 02/11, 03/09, 03/23, 04/06. They will have only 2-4 questions, but that will include proofs, and 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.

- **Verification by Videoconferencing:** From time to time, I may ask selected students to explain their homework solutions to me, either live or via a recording, with the webcam on.
- **Final exam:** see below.
- **Additional practice:** Recommended textbook problems and additional suggested WebWork (not for credit) may be posted as needed.
- **Engagement:** Your course participation can include class attendance, participation in the Q&A, watching class recordings, 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 and preferences. However, *sufficient* engagement is essential. Therefore, as part of your course work for credit, I will ask you to describe and reflect on your engagement in this class.

Required learning materials:

- **Textbook:** Robert A. Adams and Christopher Essex, MyLab Mathematics with Pearson eText -- Access Card -- for Calculus: A Complete Course, 10/E, ISBN 9780135732526. This package should be available through the UBC bookstore, and gives you access to the textbook and the additional features* (such as quizzes) for one year. This is the same textbook that was used in Math 226. A cheaper 180-day access card for the same textbook may be available, either through UBC bookstore or through other resellers. (*The additional features should be useful to you as additional practice, but will not be required for credit.)
- **The Pearson course ID is** laba73686. You will need this to register your e-text. Here are **more detailed registration instructions**.
- **The hard copy version of the textbook:** Robert A. Adams and Christopher Essex, Calculus: A Complete Course Plus MyLab Mathematics with Pearson eText -- Access Card Package, 10/E, ISBN 9780135732595. This is the paper version of the required textbook above, with only minor differences. Used copies, editions that only include multivariable calculus (and not single variable), and older editions are acceptable alternatives and may be less expensive.
- **Alternative textbooks:** Most multivariable calculus textbooks cover a large part of the material required in this class. Some are available free of charge, see for example **here. (https://aimath.org/textbooks/approved-textbooks/)** However, please be mindful that this is a proof-based course, and that some textbooks omit proofs and/or more advanced topics (such as the epsilon-delta definition of the limit, the rigorous definition of differentiability of multivariable functions, or the inverse or implicit function theorems) that we will cover. You may have to pay more attention in class and/or have to look up other materials if you are using such textbooks. In

particular, this 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 mark will be based on WebWork (30%), Longform homework assignments (40%), the final exam (25%), and two engagement surveys (5%). The grades may be **slightly** scaled at the end of the course.

- **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 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 30 points, your WebWork score will be 30.)
- **Additional WebWork practice:** From time to time, WebWork may 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 required for credit assignments, the additional practice sets will be labelled AP1, AP2, ... , and the required homework sets will be labelled HW1, HW2, ...
- **Longform homework assignments** will be assigned biweekly (so that there should be 6 such assignments in total). Each assignment will be posted at least a week in advance. Your solutions are to be uploaded to Canvas 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 final examination** will be held in April. The date of the final examination will be announced by the Registar later in the term. Depending on the Covid situation and UBC policies, the final exam will be either in-person or online. Attendance is mandatory, so you should not make any travel plans before the exam date is announced.
- **Engagement surveys:** twice during the semester, tentatively in early February and again in March, I will ask you to describe your engagement in the course. I will use the results to fine-tune the course structure, and will follow up with you as needed. These will be worth 5% of your grade, with 2.5% given for *participation* in each survey (regardless of your answers).

Academic concession: The rules and procedures for obtaining academic concession are governed by **UBC Policy V-135 on Academic Concession (http://www.calendar.ubc.ca/vancouver/index.cfm?tree=3,329,0,0)** . The details in this course are as follows.

- **Late or missed Longform homework**: Late Longform assignments will not be accepted, in order to discourage pile-ups of overdue workload, keep the TA's work schedule consistent, and allow the timely posting of solution sets for everyone. (If you cannot complete an assignment

before the deadline for a valid reason, see below.) The only exception is that students who register late in the course will be allowed extended deadlines on the first Longform assignment. Please contact me if that is your situation.

- **Late WebWork:** All WebWork assignments will have a one-week extension built in. I will post the recommended deadline for each problem set (you should aim to complete the WebWork by that date in order to keep up with the material). However, to allow for Covid-related disruptions, each assignment will close one week after the recommended deadline, so that you have additional time to complete it if needed.

- **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 two or more missed Longform assignments, or more than 10% of WebWork, should be accompanied by the **Department of Mathematics Academic Concession self-declaration form (http://www.math.ubc.ca/Ugrad/ugradForm/Student_Declaration_Academic_Concession_MATH.pdf)** and submitted as soon as reasonably possible. The Academic Concession form can be used for medical issues involving you or your family members, as well as other circumstances such as a "challenging emergency/unanticipated situation". I will be interpreting this liberally, and will only require a general description of the situation without personal detail (for example, it suffices to say that you were sick without providing medical details). 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.

- **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)** 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. (http://www.calendar.ubc.ca/vancouver/?tree=3,54,111,959)**

- 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. Your final write-up should be your own.

- 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.

Additional help:

- **You are welcome to contact me by email or on Canvas,** see above.
- **Individual videoconferencing consultations by appointment** are available, on a limited basis, during normal business hours (M-F 9-5, Vancouver time). Please try to 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 (e.g. the general nature of your inquiry, the homework or textbook question you'd like to talk about) so that I can look it up before the appointment and we can use the videoconferencing time efficiently.
- **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. Details will be posted when they become available.

- **Additional resources for proof writing:**

  - **Richard Hammack, *Book of Proof* (https://www.people.vcu.edu/~rhammack/BookOfProof/)** : This textbook, available for free, is specifically dedicated to mathematical logic, proof techniques, and proof writing. It has been used in MATH 220 (the proof writing course) at UBC.
  - **Francis Su's handouts on mathematical writing (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.)
- **Past final exam database   (http://www.math.ubc.ca/Ugrad/pastExams/index.shtml)** , maintained by the Mathematics department.
- **UBC Math Club (https://www.facebook.com/ubcmathclub)** sells math exam packages (old exams together with solution sets) for a nominal price before each final exam session.

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) : 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)** .

Course Summary:

Date	Details	Due
Mon Jan 31, 2022	📝 **Longform HW1 (https://canvas.ubc.ca/courses/85173/assignments/1126196)**	due by 11:59pm
Mon Feb 14, 2022	📝 **Longform HW2 (https://canvas.ubc.ca/courses/85173/assignments/1126197)**	due by 11:59pm
Sun Feb 20, 2022	📝 **Engagement Survey 1 (https://canvas.ubc.ca/courses/85173/assignments/1126194)**	due by 11:59pm
Mon Mar 7, 2022	📝 **Longform HW3 (https://canvas.ubc.ca/courses/85173/assignments/1126198)**	due by 11:59pm
Mon Mar 21, 2022	📝 **Longform HW4 (https://canvas.ubc.ca/courses/85173/assignments/1126199)**	due by 11:59pm
Mon Apr 4, 2022	📝 **Longform HW5 (https://canvas.ubc.ca/courses/85173/assignments/1126200)**	due by 11:59pm
Sun Apr 17, 2022	📝 **Engagement Survey 2 (https://canvas.ubc.ca/courses/85173/assignments/1126193)**	due by 11:59pm
Mon Apr 18, 2022	📝 **Longform HW6 (https://canvas.ubc.ca/courses/85173/assignments/1126201)**	due by 11:59pm
Wed Apr 27, 2022	📝 **Final exam (https://canvas.ubc.ca/courses/85173/assignments/1126195)**	due by 8:30am
	📝 **WebWork link (https://canvas.ubc.ca/courses/85173/assignments/1126202)**	