Acknowledgment

UBC's Point Grey Campus is located on the traditional, ancestral, and unceded territory of the xʷməθkʷəy̓əm (Musqueam) people. The land it is situated on has always been a place of learning for the Musqueam people, who for millennia have passed on in their culture, history, and traditions from one generation to the next on this site.

Course Information

Course Title	Course Code Number	Credit Value
Multivariable Calculus	Math 253	3

Prerequisites

Pre-reqs: One of MATH 101, MATH 103, MATH 105, MATH 121, SCIE 001.

Contacts

Section	Course Instructor(s)	Contact Details	Office Hours
101	Colin Macdonald	`cbm[at]math.ubc.ca`	Online office hours TBA
102	Alex Weekesal	`weekesal[at]math.ubc.ca`	Online office hours TBA
104	Ming Zhang	`zhangming[at]math.ubc.ca`	Online office hours TBA
105	Samer Dweik	`dweik[at]math.ubc.ca`	Online office hours TBA

See Canvas for alternative ways to contact us including Piazza discussions if your question is of general interest.

Other Instructional Staff

Various TAs are also involved in the teaching of this course. You may meet some of them over the course of the term. However, any concerns about grading should come to your instructors via mechanisms outlined on Canvas (namely, the grade change request form).

Course Structure

The instructional format for the course will consist of 2.5 hours of synchronous lectures per week at the scheduled times for each section. These live online lectures can be accessed either from the common Canvas site or a section-specific site, or using the links provided by your section instructor. Students are expected to participate in the regularly scheduled synchronous lectures for their section. Your instructor might choose post recordings of lectures and if so will probably be comfortable with you watching those "time-shifted" instead of attending live—if you're unsure just ask.

There will be ample WeBWorK to help you practice technical skills and also develop understanding of the main concepts. You are encouraged to be active on Piazza—asking questions and providing answers (and generally discussing mathematics with your colleagues) is an excellent way to learn!

Schedule of Topics

This is an approximate week-by-week outline of topics for the course. An online version on Canvas will be updated as the course progresses.

Week	Topics	CLP-3 Sections
1	Three-dimensional coordinate systems, vectors, dot product	1.1, 1.2.1, 1.2.2
2	Dot product (cont.), cross product, equations of lines and planes	1.2.2, 1.2.5, 1.4, 1.5
3	Equations of lines and planes (cont.), cylinders and quadric surfaces, functions of several variables: domain, range, graphs, level curves/surfaces	1.7, 1.8, 1.9
4	Limits and continuity, partial derivatives	2.1, 2.2, 2.3
5	Tangent planes and linear approximations, chain rule	2.4, 2.5, 2.6
6	Chain rule (cont.), directional derivatives and the gradient vector	2.7
7	Directional derivatives and the gradient vector (cont.), maximum and minimum values, Lagrange multipliers	2.7, 2.9, 2.10
8	Lagrange multipliers (cont.), double integrals over rectangles	2.10, 3.1
9	Double integrals over general regions, double integrals in polar coordinates	3.1, 3.2
10	Double integrals in polar coordinates (cont.), applications of double integrals	3.2, 3.3
11	Applications of double integrals (cont.), triple integrals	3.3, 3.5
12	Triple integrals (cont.), triple integrals in cylindrical coordinates	3.5, 3.6
13	Triple integrals in spherical coordinates	3.7

Learning Outcomes

Multivariable calculus provides the language and tools to analyze the outcomes that depend on more than one parameter (which means, most situations in our world). Multivariable calculus is used in many fields of natural science, social science, computer science, and (of course most importantly) engineering.

The main goal of the course is to develop an understanding of the fundamental concepts of multivariable calculus and the skills necessary for its applications. Upon completion of this course, students should be able to:

1. Manipulate vectors to perform geometric calculations in three dimensions.
2. Calculate and interpret derivatives of functions of several variables.
3. Integrate functions of several variables.

Learning Activities and Assessments of Learning

Course mark will be based on homework assignments (20%), approximately five tests (60%), and the final exam (20%). The final exam may cover material from the entire course.

Homework and Piazza There will be weekly homework (typically on WeBWork) which must be accessed from the common Canvas page. The main goal of WeBWorK Homework is to help you learn the material. You are encouraged to work in groups on the more difficult problems, but then complete your individualized problems yourself. Do post questions and answers about homework (and other parts of the course) on Piazza, but when posting the answers, refrain from solving the problem completely, instead, point out relevant ideas from the course.

Tests There will be approximately five tests, the dates of which will be announced near the start of the term and posted on the common Canvas page. The tests will be held during your scheduled class time but the precise arrangements for virtual rooms may differ from standard lectures. Please be aware of Student Conduct during Examinations

Concessions There will be no make-up tests, and no late homework will be accepted. Students with concessions (e.g. for medical emergencies) will have the weight of a test transferred to the other tests and/or the final exam; the weight of a WeBWorK assignment will be transferred to the other assignments. You can receive **one** concession during the term by submitting the Concession request form (it can be downloaded at: `https://www.math.ubc.ca/Ugrad/ugradForm/`) to your instructor. Further concessions or missed final exams need to be discussed with the Academic Advisors of your Faculty. There cannot be any exception to this university-wide policy.

Final Exam The final exam will be scheduled during the examination period December 7–22 inclusive. For a full description of the final exam regulations, see the UBC Calendar page on Student Conduct during Examinations.

Scaling Grades may be scaled to be in line historical standards and to ensure fairness across the sections. No scaling will be decided upon until all assessments are completed.

Learning Materials

All course materials are available online at no cost and some are under free licenses that explicitly allow reuse or encourage community development.

- Lectures will happen live online during scheduled class time. Course information, materials and resources for all sections can be found on the common Canvas page.
- Piazza is our main discussion forum.

Academic Integrity

The academic enterprise is founded on honesty, civility, and integrity. As members of this enterprise, all students are expected to know, understand, and follow the codes of conduct regarding academic integrity. At the most basic level, this means submitting only original work done by you and acknowledging all sources of information or ideas and attributing them to others as required. This also means you should not cheat, copy, or mislead others about what is your work. Violations of academic integrity (i.e., misconduct) lead to the breakdown of the academic enterprise, and therefore serious consequences arise and harsh sanctions are imposed. Be sure you understand UBC's expectations: see the UBC Calendar entries on "Academic Honesty", "Academic Misconduct", and "Disciplinary Measures", and the Student Declaration and Responsibility.

University Policies

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 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 on the UBC Senate website.

Learning Analytics

This course will be using the following learning technologies: Canvas, Piazza, WeBWorK, and perhaps others as needed. Many of these tools capture data about your activity and provide information that can be used to improve the quality of teaching and learning. In this course, we may use analytics data to:

- View overall class progress
- Track your progress in order, e.g., to provide you with feedback or advice
- Review statistics on course content being accessed to support improvements in the course
- Track participation in discussion forums
- Assess your participation in the course

Copyright

All materials of this course (course handouts, notes, slides, assessments, readings, recordings, etc.) are either copyright of the Course Instructor or licensed to be used in this course by the copyright holder. Redistribution of these materials by any means without permission of the copyright holder(s) constitutes a breach of copyright and may lead to academic discipline. This sounds more draconian than the reality: many materials explicitly allow or encourage redistribution.

Lecture recordings, if provided, are for use in-term by registered students only.

It would be at the very least *impolite* to record your colleagues without their permission. Your instructors' recordings—if provided—will strive to be respectful in this manner and we ask that you do the same.

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This document is based on work by Brian Wetton, Philip Loewen, and Ailana Fraser. Sections on Academic Integrity are influenced by the document "Approaches to Addressing Academic Integrity in the Syllabus" by Jaclyn Stewart, Laurie McNeill, Simon Albon and others (Creative Commons Attribution-NonCommercial).