UBC MATH 317 – Calculus IV

Syllabus for Autumn 2025

Acknowledgement

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

If you would like to know more about the joint history of UBC and Musqueam, one place to start is at UBC's Indigenous Portal.

Resources

New material will be added to the course's Canvas page throughout the term. Please review it regularly.

If you have questions about the material, please ask them on the dedicated Piazza page for MATH 317. It's very likely that some of your colleagues will be interested in them too. For this reason, Prof Loewen prefers to reply on Piazza instead of answering a direct email. (Of course, direct email is appropriate for a private conversation about issues unique to you--like illness, CFA details, missing class, etc. Please use loew@math.ubc.ca instead of the built-in Canvas messaging system.)

Calendar Description

MATH_V 317 (3) Calculus IV Parametrizations, inverse and implicit functions, integrals with respect to length and area; grad, div, and curl, theorems of Green, Gauss, and Stokes.
Please consult the Faculty of Science Credit Exclusion List. [3-0-0]
Prerequisite: One of MATH 200, MATH 226, MATH 253. One of MATH 152, MATH 221, MATH 223 is recommended.

Instructor and Office Hours

- Instructor: Prof. Philip D. Loewen, room MATH 207, loew@math.ubc.ca
- Office Hours: By appointment, please email directly (avoiding the Canvas messenger): loew@math.ubc.ca.

Class Meetings

MWF 10:00-10:50, in room LSK 200

Important Dates

- 03 September (Wed)–First class of the term.

- 15 September (Mon)–UBC's deadline for registration changes.
- 29 September (Tue)–Indigenous Reconciliation Day, UBC Closed.
- 03 October (Fri)**–Midterm test #1 in class**
- 13 October (Mon)–Thanksgiving Day, UBC Closed.
- 07 November (Fri)**–Midterm test #2 in class**
- 10-12 November (Mon-Wed)–Autumn Break, no lectures.
- 05 December (Wed)–Last class of the term.
- 09-20 December inclusive–Formal examination period.

Homework

Practice is essential to deep understanding. So there will be a challenging WeBWorK assignment due every week. The average score on the the best N-1 of N weekly assignments will count for 10% of each student's term grade. (Probably N=12.) Submissions close every Monday morning at 03:00 (this may feel like “late Sunday night”). **Always access the WeBWorK assignment through the link in Canvas** ... otherwise the grades don't sync correctly.

Textbook

Feldman, Joel S., Andrew Rechnitzer, and Elyse Yeager, *Vector Calculus (CLP-4)*. Free online here. The companion Problem Book, available at the same site, will also be useful.

Grading Formula

Your course grade will normally be given by the *maximum* of *A* and *B*, where

- *A* is calculated using 50% Final Exam + 40% Midterm grades + 10% WeBWork Grade, and
- *B* is calculated by subtracting 10% from your score on the Final Exam.

Please note that grades may be scaled.

Midterm 1: In class, Friday 03 October 2025.

Midterm 2: In class, Friday 07 November 2025.

Final Exam: 150 minutes, scheduled centrally by UBC, sometime during the official exam period.

Policies

- All tests, including the final examination, will be strictly closed book: no formula sheets or electronic resources will be allowed.
- Students are encouraged to discuss the material in person and on Piazza.
- There are no make-up midterms. Missing a midterm for a valid reason normally results in the weight of that midterm being re-distributed to the remaining midterm and final exam. Any

student who misses a midterm is to present the Department of Mathematics self-declaration form for reporting a missed assessment to their instructor within 72 hours of the midterm date. This policy conforms with the UBC Vancouver Senate's Academic Concession Policy V-135. Students are advised to read this policy carefully.

- The goal of this course is to train human thinkers. Uncritical use of Artificial Intelligence tools will move you in the wrong direction. If you choose to use AI, please regulate your interactions to strengthen your personal problem-solving and reasoning skills. Learning often involves confusion, struggle, even frustration. The remedy for this is perseverance; the reward is deep and lasting understanding. This course visits several classic problems for which a machine can produce the right answer. Students are urged to demand more than just this.
- Please consult page of General Syllabus Information for notes that apply to all MATH_V courses: topics covered include Academic Integrity, Attendance, Deferred Standing, and more.

Course Topics

The topics fall broadly under two categories:

Vector valued functions of one variable:

We will study parameterized curves, velocity, acceleration, arc length, curvature, torsion, normal and binormal vectors, tangential and normal components of acceleration, and planetary motion.

Vector valued functions of several variables:

We will study vector fields, line integrals, conservative vector fields, and the fundamental theorem of line integrals. We will discuss necessary and sufficient conditions for a vector field to be conservative and learn how to find a potential function. We will study various forms of derivatives in vector calculus: Gradient, Curl, and Divergence. We will learn to parameterize surfaces and study integrals of functions over surfaces and flux integrals over surfaces. We will learn integral theorems: Green's theorem, Stokes's Theorem, and the Divergence Theorem.

Topic Schedule

This is a tentative schedule. As the semester plays out, it will be adjusted accordingly.

Week 1: Introduction, parameterized curves, velocity, arc length. Chapters 1.0, 1.1 of CLP4

Week 2: Reparameterization, curvature, unit tangent vector, principal normal vector. Chapters 1.2 and 1.3, some of 1.4 and 1.5

Week 3: Motion, Velocity, Acceleration, Newton's law, planetary motion. CLP4 1.3, some of 1.4 and 1.5, 1.10

Week 4: Vector Fields, conservative vector fields, potential functions. CLP 2.1, 2.3

Week 5: **Midterm 1.** Line integrals, fundamental theorem of line integrals. Path independence, curl test, simply connected domains. CLP 2.4, 4.5

Week 6: Parameterized surfaces, CLP 3.1

Week 7: Tangent planes, surface area. Integrals of scalar-valued functions on surfaces. Flux integrals. CLP 3.2, 3.3, 3.4, 3.5

Week 8: More flux integrals. Divergence. CLP 4.1,

Week 9: Interpretations of Grad, Curl, Div. CLP 4.1

Week 10: **Midterm 2**. Divergence Theorem. CLP 4.2

Week 11: Green's theorem, Stokes's Theorem CLP 4.3, CLP 4.4

Week 12: Differential forms, generalized Stokes's Theorem. CLP 4.7