Mathematics 220
Multivariable Calculus
Fall, 2025

Instructor: George Ballinger
Office: Ewing 260
E-mail: ballinger@camosun.ca
Website: georgeballinger.ca (follow the MATH 220 link for course information)
Telephone: 250-370-3116

Timetable:

Time	Monday	Tuesday	Wednesday	Thursday	Friday
8:30 am – 9:20 am					
9:30 am – 10:20 am					
10:30 am – 11:20 am					
11:30 am – 12:20 pm					
12:30 pm – 1:20 pm	MATH 220-001 Room Y219	MATH 220-001 Room Y219	MATH 220-001 Room Y219	MATH 220-001 Room Y219	MATH 220-001 Room Y219
1:30 pm – 2:20 pm	MATH 100-004 Room Y219	MATH 100-004 Room Y219	MATH 100-004 Room Y219	MATH 100-004 Room Y219	MATH 100-004 Room Y219
2:30 pm – 3:20 pm	Office Hour E260	Office Hour E260	Office Hour E260	Office Hour E260	
3:30 pm – 4:20 pm	MATH 101-001 Room Y219	MATH 101-001 Room Y219	MATH 101-001 Room Y219	MATH 101-001 Room Y219	
4:30 pm – 5:20 pm					
5:30 pm – 6:20 pm					

Important Dates:

September 2	First day of class
September 8	Add Course deadline
September 8	Drop Course with 80% Tuition Refund deadline
September 16	Deferred Tuition & Fee Payment deadline
September 30	Truth and Reconciliation Day (no class)
October 13	Thanksgiving Day (no class)
October 16	"ShakeOut" earthquake preparedness drill at 10:16am
November 11	Remembrance Day (no class)
December 5	Last day of class
December 6	Withdrawal deadline
December 8-16	Final exam period

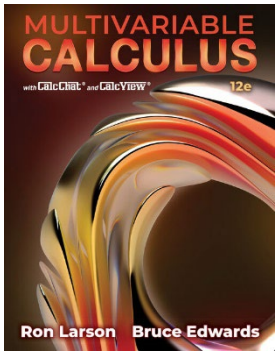
Calendar Description: This course is an introduction to multivariable calculus. Topics include: vectors, solid analytic geometry, differentiation of vectors, differential calculus of several variables, multiple integrals, and the theorems of Green, Gauss and Stokes. [3 Credits]

(Source: Camosun College Calendar calendar.camosun.ca/preview_course_nopop.php?catoid=25&coid=45645)

Prerequisites: C in MATH 101.

Textbook: Ron Larson and Bruce Edwards, *Multivariable Calculus,* 12th Edition, Cengage Learning, 2023.

Course Content:



Chapters and Sections

11. Vectors and the Geometry of Space
    - 11.1 Vectors in the Plane
    - 11.2 Space Coordinates and Vectors in Space
    - 11.3 The Dot Product of Two Vectors
    - 11.4 The Cross Product of Two Vectors in Space
    - 11.5 Lines and Planes in Space
    - 11.6 Surfaces in Space
    - 11.7 Cylindrical and Spherical Coordinates
12. Vector-Valued Functions
    - 12.1 Vector-Valued Functions
    - 12.2 Differentiation and Integration of Vector-Valued Functions
    - 12.3 Velocity and Acceleration
    - 12.4 Tangent Vectors and Normal Vectors
    - 12.5 Arc Length and Curvature
13. Functions of Several Variables
    - 13.1 Introduction to Functions of Several Variables
    - 13.2 Limits and Continuity
    - 13.3 Partial Derivatives
    - 13.4 Differentials
    - 13.5 Chain Rules for Functions of Several Variables
    - 13.6 Directional Derivatives and Gradients
    - 13.7 Tangent Planes and Normal Lines
    - 13.8 Extrema of Functions of Two Variables
    - 13.9 Applications of Extrema
    - 13.10 Lagrange Multipliers

Multivariable Taylor Series *(notes)*

14. Multiple Integration
    - 14.1 Iterated Integrals and Area in the Plane
    - 14.2 Double Integrals and Volume
    - 14.3 Change of Variables: Polar Coordinates
    - 14.4 Center of Mass and Moments of Inertia
    - 14.5 Surface Area
    - 14.6 Triple Integrals and Applications
    - 14.7 Triple Integrals in Other Coordinates
    - 14.8 Change of Variables: Jacobians
15. Vector Analysis
    - 15.1 Vector Fields
    - 15.2 Line Integrals
    - 15.3 Conservative Vector Fields and Independence of Path
    - 15.4 Green's Theorem
    - 15.5 Parametric Surfaces
    - 15.6 Surface Integrals
    - 15.7 Divergence Theorem
    - 15.8 Stokes's Theorem

Learning Outcomes: The Intended Learning Outcomes for this course, as approved by the Education Council, are as follows. Upon completion of this course a student will be able to:

1. Solve three-dimensional geometry problems involving points, lines, planes, vectors, vector projections, and distances.
2. Sketch, differentiate, and integrate vector-valued functions to find velocities, accelerations, tangents, and normals.
3. Differentiate functions of many variables and use chain rules to differentiate composite functions. Compute gradients, directional derivatives, and multivariable Taylor series.
4. Setup and evaluate multiple integrals to find areas, volumes, masses, centres of mass, and moments of inertia.
5. Change variables in multiple integrals to cylindrical, spherical, or general coordinates.
6. Compute the divergence or curl of a vector field, and find the potential function for conservative fields.
7. Setup and evaluate line and surface integrals.
8. Use Stokes theorem and the divergence theorem to evaluate line and surface integrals.

Math Lab: Ewing 224: This drop-in centre is freely available for your use to work on math homework and to seek help from the instructional assistant. Hours are posted on the door or online at camosun.ca/services/academic-supports/help-centres/math-help.

Academic Integrity: The Department of Mathematics and Statistics has prepared a handout called *Student Guidelines for Academic Integrity* to help you interpret college policies involving student conduct, academic dishonesty, plagiarism, etc. It is your responsibility to become familiar with the contents of the document and the college policies it references.

Calculator Policy: As per department policy, the only calculator permitted for use on tests and the final exam is the Sharp EL-531 (or EL-510R) scientific calculator. No other calculator or any other electronic device including cell phones, smartwatches, etc. is allowed.

Homework: There will be periodic assignments (10 all together) to be completed and handed in for marking. They must be completed on the worksheets provided (not on blank paper), copies of which will be handed out in class. While collaboration with your classmates is permitted, you must submit your *own* work and ensure you don't let collaboration turn into plagiarism. You may not post assignment questions to, or copy solutions from, "cheat" websites such as Chegg and ChatGPT.

Due dates for assignments will be posted on the course webpage, and assignments are due by the end of class on the due dates. If you are unable to hand in a hard copy of your assignment solutions, you may scan and email me a single PDF file (not JPG images) of your assignment so long as it prints legibly and arrives by the deadline. Solutions will be posted soon after assignments are collected. As such*, late assignments will not be accepted under any circumstances*. To further accommodate situations where a student is unable to submit his or her assignment on time (e.g. due to illness), the lowest assignment mark will be dropped when computing the assignment average.

Tests:

Two term tests are tentatively scheduled for the following dates:

- Test 1 on Friday, October 10
  Sec 11.1-11.7, 12.1-12.5 and 13.1-13.2

- Test 2 on Friday, November 21
  Sec 13.3-13.10, 14.1-14.8 and Multivariable Taylor Series (notes)

If you miss a test for a legitimate reason such as illness, accident or family affliction, you should notify me (by email, phone/voicemail, or in person) *as soon as possible* and *before* the test, and be prepared to provide supporting documentation upon your return. There will be no "make-up" tests, but instead, in the event of an excused absence, the mark from your final exam, or relevant subset thereof, will replace your test mark.

Final Exam:

A comprehensive, 3-hour final exam will take place during the final exam period of December 8-16. The specific date, time, and location will be announced on or about October 17. You must write the final exam at the scheduled time as per Camosun College's policy on final examinations. See camosun.ca/registration-records/policies-and-procedures-students/academic-policies-and-procedures-students#examinations-evaluation.

Grade Calculation:

The final grade will be calculated according to the following breakdown:

10 Assignments:	20%*
Test 1:	20%
Test 2:	20%
Final Exam:	40%

* The lowest assignment mark will be dropped when calculating the assignment average. This allows you to miss one assignment for any reason, including illness, without penalty. *Late assignments will not be accepted.*

Grade Scale:

Final letter grades are assigned as follows:

0-49	50-59	60-64	65-69	70-72	73-76	77-79	80-84	85-89	90-100
F	**D**	**C**	**C+**	**B–**	**B**	**B+**	**A–**	**A**	**A+**

For information on Camosun College's grading policy, see policy E-1.5 online at camosun.ca/about/policies/education-academic/e-1-programming-and-instruction/e-1.5.pdf.