



MATH-205 – Multivariable & Vector Calculus

University Arts and Science

Effective Term & Year: Fall 2022

Course Outline Review Date: 2023-04-01

Program Area: Math and Sciences

Description:

This course takes calculus from the two dimensional work of single variable functions into the three dimensional world, and beyond, of multivariable functions. This course is an accelerated version of MATH 201 and MATH 202 presented in one semester. It is intended for science and engineering students. Topics include: vectors in two and three dimensions, vector-valued functions and vector fields, multivariable functions, partial derivatives with applications, Taylor's formula for functions of two and three variables, multiple integrals with applications, divergence, gradient, curl, line integrals with applications, conservative fields and potential functions, and the theorems of Green, Stokes and Gauss.

Program Information:

Calculus is a required course for a Bachelor of Science or Bachelor of Commerce degree in most universities. It can be used as three of the six units in Calculus, which are required for an Associate of Science degree at College of the Rockies. A student should take MATH 201 and 202, or MATH 205.

Delivery Methods: On-campus (Face-to-Face)

Credit Type: College of the Rockies Credits

Credits: 3

Course type/s: Sciences

Instructional Activity and Hours:

Activity	Hours
Classroom, Directed Studies or Online Instruction	45
Seminar/Tutorials	
Laboratory/Studio	
Practicum/Field Experience	
Co-op/Work Experience	
Other	
Total	45

Course Requisites:

- Complete all of the following
 - Completed the following:
 - [MATH104](#) – Integral Calculus (3)
 - PHYS 104 is strongly recommended.

Flexible Assessment: Yes

In some cases students may be able to apply for recognition of prior learning outside the classroom. This flexible assessment process provides equivalent course credit. It is a rigorous process that may include external evaluation, worksite assessment, demonstration, standardized test, self-assessment, interview, products/portfolio, and challenge exam, or other measures as appropriate. Tuition fees apply. Contact an education advisor for more information.

Course Transfer Credit:

For information about receiving transfer credit for courses taken at other BC institutions, please see <http://www.bctransferguide.ca>. All requests for course transfer credit from institutions in BC or elsewhere should go to the College of the Rockies Enrollment Services office.

Textbook Resources:

Textbook selection varies by instructor and may change from year to year. At the Course Outline Effective Date the following textbooks were in use:

Hass, Joel R., Heil, Christopher E., Weir, Maurice D., *Thomas' Calculus, Early Transcendentals*, 14th Edition, Pearson Educator (2018)

Please see the instructor's syllabus or check COTR's online text calculator <https://textbook.cotr.bc.ca/> for a complete list of the currently required textbooks.

Learning Outcomes:

Upon the successful completion of this course, students will be able to:

- handle vectors fluently in solving problems involving the geometry of lines, curves, plans, and surfaces in space; visualize, sketch, identify, and find intersections of various three dimensional figures including lines, planes, cylinders and quadric surfaces;
- calculate arc length, curvature and torsion; find the TNB Frenet frame of the curve (TNB = tangent, normal, and binormal);
- calculate partial derivatives for functions of several variable; calculate gradients and directional derivatives;
- solve applied optimization problems both without and with constraints; use Lagrange multipliers;
- calculate double and triple integrals in Cartesian polar, cylindrical and spherical coordinates; switch between the various coordinate systems; use the Jacobian to make general substitutions in double and triple integrals;
- calculate line integrals; work; circulation;
- identify conservative fields and construct potential functions for them;
- calculate surface integrals; flux; and
- use the theorems of Green, Stokes and Gauss to calculate integrals.

This course should help students:

- use written and oral communication skills effectively, employing methods appropriate to message and context.
- think clearly and critically, fusing experience, knowledge and reasoning into considered judgment.
- identify, interpret, and solve problems, effectively implementing and evaluating proposed strategies.

Course Topics:

Vectors and the Geometry of Space

- Three dimensional Coordinate Systems
- Vectors
- Dot and Cross Products
- Lines and planes in Space
- Cylinders and Quadric Surfaces

Vector-Valued Functions and Motions in Space

- Curves in space and their tangents
- Integrals of vector functions
- Projectile Motion
- Arc Length in Space
- Curvature and Normal Vectors of a Curve
- Tangential and Normal Components of Acceleration
- Velocity and Acceleration in Polar Coordinates

Partial Derivatives

- Functions of higher variables
- Limits and Continuity in Higher Variables
- Partial derivatives and the chain rule
- Directional derivatives and gradient vectors
- Tangent planes and differentials
- Extreme values, saddle points, and Lagrange multipliers
- Taylor's formula
- Partial derivatives with constrained variables

Multiple Integrals

- Double and iterated integrals over rectangles, general regions and in polar forms
- Area by double integration
- Triple integrals in rectangular, cylindrical, and spherical coordinates
- Moments, and Centers of Mass
- Substitutions in multiple integrals

Integrals and Vector Fields

- Line Integrals
- Work, Circulation, and Flux
- Path independence, conservation fields, and potential functions
- Green's Theorem in the Plane
- Surfaces and Areas
- Surface Integrals
- Stokes' Theorem
- The Divergence Theorem and a Unified Theory

See instructor's syllabus for the detailed outline of weekly readings, activities and assignments.

Evaluation and Assessments

Assessment Type: On-Campus (face-to-face)

Assessment Type	% of Total Grade
Assignments	20%
Midterm Tests – Best 2 of 3	30%
Final Exam	50%
Total	100%

Grade Scheme

A+	A	A-	B+	B	B-	C+	C	C-	D	F
>=90	89-85	84-80	79-76	75-72	71-68	67-64	63-60	59-55	54-50	<50

Pass requirements: None

Evaluation Notes: A grade of “D” grants credit, but may not be sufficient as a prerequisite for sequential courses.

Exam Attendance:

Students must attend all scheduled exams at the appointed time and place. Instructors may approve an alternate exam to accommodate an illness or personal crisis. Department heads will consider other written requests. Any student who misses a scheduled exam without prior approval will receive a “0” on the exam.

Academic Policies:

College of the Rockies policies related to courses can be found at <https://cotr.bc.ca/about-us/college-policies/> and include the following:

- Policy 2.4.3 Students with Documented Disabilities
- Policy 2.4.4 Student Conduct (plagiarism, other cheating, behavioral misconduct)
- Policy 2.5.8 Academic Performance
- Policy 2.5.3 Grade Appeal
- Policy 2.4.9 Student Concerns Re Faculty

Course Changes:

The College of the Rockies updates course outlines regularly to meet changing educational, employment and marketing needs. The instructor will notify students in writing of any updates to this outline during the semester. The instructor reserves the right to revise, add or delete

material while meeting the learning outcomes of this course outline.