COLLEGE OF THE ROCKIES

Multivariable and Vector Calculus – MATH 205

University Studies Program

Course Outline

COURSE IMPLEMENTATION DATE:	**February 2004**
OUTLINE EFFECTIVE DATE:	**September 2018**
COURSE OUTLINE REVIEW DATE:	**April 2023**

GENERAL COURSE 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: This course is delivered face to face.

COTR Credits: 3

Hours for this course: 45 hours

Typical Structure of Instructional Hours:

Instructional Activity	Duration
Lecture Hours	45
Seminars / Tutorials	
Laboratory / Studio Hours	
Practicum / Field Experience Hours	
Other Contact Hours	
Total	45

Practicum Hours (if applicable):

Type of Practicum	Duration
On-the-job Experience	N/A
Formal Work Experience	N/A
Other	N/A
Total	

Course Outline Author or Contact:
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Signature

APPROVAL SIGNATURES:

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EDCO

Valid from: September 2018 – April 2023

Education Council Approval Date

COURSE PREREQUISITES AND TRANSFER CREDIT:

Prerequisites: MATH 104. PHYS 104 is strongly recommended.

Corequisites: None

Flexible Assessment (FA):

Credit can be awarded for this course through FA ☑ Yes ☐ No

Learners may request formal recognition for flexible assessment at the College of the Rockies through one or more of the following processes: External Evaluation, Worksite Assessment, Demonstration, Standardized Test, Self-assessment, Interview, Products/Portfolio or Challenge Exam. Contact an Education Advisor for more information.

Transfer Credit: For transfer information within British Columbia, Alberta and other institutions, please visit http://www.cotr.bc.ca/Transfer.

Students should also contact an academic advisor at the institution where they want transfer credit.

Prior Course Number: N/A

Textbooks and Required 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 http://go.cotr.bc.ca/tuition/tCalc.asp 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 chair rule
- Directional derivatives and gradient vectors
- Tangent planes and differentials
- Extreme values, saddles points, and Lagrange multipliers
- Taylors 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 ASSESSMENT (Face to Face Delivery):

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

Please see the instructor's syllabus for specific classroom policies related to this course, such as details of evaluation, penalties for late assignments, and use of electronic aids.

EXAM POLICY:

Students must attend all required scheduled exams that make up a final grade at the appointed time and place.

Individual instructors may accommodate for illness or personal crisis. Additional accommodation will not be made unless a written request is sent to and approved by the appropriate Department Head prior to the scheduled exam.

Any student who misses a scheduled exam without approval will be given a grade of "0" for the exam.

COURSE GRADE:

Course grades are assigned as follows:

Grade	A+	A	A-	B+	B	B-	C+	C	C-	D	F
Mark (Percent)	≥ 90	89-85	84-80	79-76	75-72	71-68	67-64	63-60	59-55	54-50	< 50

A grade of "D" grants credit, but may not be sufficient as a prerequisite for sequential courses.

ACADEMIC POLICIES:

See www.cotr.bc.ca/policies for general college policies related to course activities, including grade appeals, cheating and plagiarism.

COURSE CHANGES:

Information contained in course outlines is correct at the time of publication. Content of the courses is revised on an ongoing basis to ensure relevance to changing educational, employment and marketing needs. The instructor will endeavour to provide notice of changes to students as soon as possible. The instructor reserves the right to add or delete material from courses.