M273 Multivariable Calculus – Fall 2019

Instructor information:

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Office hours: Monday 2-3 PM; Wednesday 10-11 AM; or by appointment.

Course description: Welcome to Math 273, Multivariable Calculus. This course is by far my favorite of the calculus courses; in fact, it's one of my favorite courses in the math major.

In this class, you'll learn how to extend the big ideas from calculus to functions of more than one variable. To do this, you'll have to begin to think in 3 and 4 dimensions. This will be a challenge at first, but I really enjoy it and I hope you will too.

Content-wise, the goal of M 273 -- the big main result that we will spend all semester building up to -- is a collection of higher-dimensional analogues of the Fundamental Theorem of Calculus. Known as Green's Theorem, Stokes' Theorem, and the Divergence Theorem, these theorems explain how integration and differentiation relate for different types of functions of multiple variables.[1]

I also have another goal for us this semester, which I have for every class I teach: I want you to improve your ability to communicate math, not just to enhance your mathematical knowledge.

Learning Outcomes:

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

1. Compute dot and cross products, and work with equations of lines, planes, cylinders and quadric surfaces;
2. Find formulas for vector-valued functions and space curves, and compute their derivatives, arc length, curvature and motion;
3. Compute limits, partial derivatives, directional derivatives and gradient vectors of functions of several variables;
4. Find tangent planes to surfaces, and linear approximations;
5. Use the chain rule, find extreme values, and solve constrained optimization problems with Lagrange multipliers;
6. Compute double and triple integrals, including in polar, cylindrical and spherical coordinates;
7. Compute line integrals and use the Fundamental Theorem of Line Integrals;
8. Use and understand Green's Theorem, and curl and divergence of vector fields;
9. Calculate surface integrals, and use Stokes' Theorem and the Divergence Theorem.

Required textbooks: Hartman et al, "Apex Calculus III version 4;" and Schlicker et al, "Active Calculus - Multivariable," 2018 edition.

Both textbooks are available in PDF format online for free; you can also purchase a print copy on Amazon for approximately $15-$20.

Course Structure: There will be weekly **written homework**, due on Fridays, and also **WeBWorK** (usually due Mondays at 11:59 PM). We will also have biweekly **quizzes**, two midterm exams (tentative dates: **Tuesday October 1** and **Friday November 8**, in class) and a cumulative final exam (Wednesday December 11, 8-10 AM).

The WeBWorK assignments will consist primarily of review problems, or extra practice with tricky concepts. Regularly revisiting the topics you've already learned will make the material stick better and hopefully make studying for the exams less intimidating. The written homework will focus on the material which was new that week.

On both the WeBWorK and the written homework, I encourage you to work together to figure out the solutions, but what you turn in should represent the understanding in your own brain. For that reason, please **use only your own brain** (and pencil/paper/LaTeX) to write up the homework solutions! Don't write the homework up while you're in office hours or a group discussion – wait till later. Take notes on the results of the discussion, by all means, but try to **write the solution without consulting those notes** (or your textbook, or the internet, or a friend). If you get stuck, look at the notes/textbook/etc for a hint – but try to use as few hints as possible. This way, you will build up the

[1] In fact, all three theorems, and also the Fundamental Theorem of Calculus, are a special case of an even more general theorem, known (confusingly) as Stokes' Theorem, which you will learn about if you take a course on Multivariable Analysis or Differential Geometry.

"mental muscles" that will enable you to succeed in this course, and in particular on the exams (where you won't have notes/internet/friends helping you).

The **quizzes** will be given at the beginning of class on alternate Fridays, starting on Friday September 6. They will be based on the written homework. The goal of the quizzes is to highlight what you understand and what you're still struggling with, so that you know what you need to study before the exams. A low score on a quiz is NOT the end of the world – rather, it's a prompt to come to office hours and ask for clarification, an alternate explanation, or extra practice problems.

There will be 7 10-point quizzes during the semester, but the "Quizzes" category of your grade will be evaluated out of 60 points, to give everyone a buffer for busy weeks and unforeseen circumstances.

Reading the textbook will be another regular component of the course. Learning how to learn from the textbook will serve you well in any future math or science courses (or if you have to consult your old textbooks for a refresher!). Plus, reading the book gives you a model for how to write mathematics that will complement what I demonstrate in class, and which I hope you will incorporate into your homework assignments.

To that end, I will usually ask you to read a section of one of our course textbooks before class, and post a comment in the relevant Discussion forum in Moodle **by 8 AM** the morning before class. I don't expect you to be able to understand everything in the textbook at the beginning of the semester -- this is the role of the Discussion forums, for you to tell me what you didn't understand from the textbook and what you want to focus on in class that day. However, I do expect you to **put serious effort** into the reading assignments, so that your ability to learn math from the textbook will improve over the course of the semester. We will spend time in class discussing strategies for reading a math textbook; one aspect of this is to **budget 10 minutes per page** for the reading assignments.

Your comments in the Discussion forums will be graded on a scale of 0 to 2, based on how well you convince me that you have read the section and thought about it, and I will drop your lowest 4 scores.

For example:

- You will receive a 0 if you don't post any comment.
- A comment like "Everything makes sense, I have no questions" will earn a score of 0. (Even if everything makes sense, I'm sure you can find something more specific to say! How does this section connect with other sections? What did you think was interesting? Was there any part of the section that didn't make sense at first? What was it that eventually made that part make sense?)
- If your comment asks a question that indicates to me that you only skimmed the textbook, you will earn a score of 1. For example: "In figure 10.2.7 in Apex Calculus, why does 2v have the same length as v?" [2v and v do not have the same length; this is explained in the text to the left of figure 10.2.7.]
- A comment such as "Where does the formula for the magnitude of a vector come from? It looks like the distance formula; is there a connection between the two?" will earn a score of 2. This question demonstrates that its author read the section and thought about what s/he read.

You are welcome to consult other textbooks for the reading assignments, if you prefer. To facilitate this, in each Moodle discussion forum, I will describe the topic of the reading so that you can find the appropriate material in another textbook.

If you do consult other textbooks, please be careful to either use the notation from the course textbook on homework assignments and when posting in the Discussion forums, or to define the notation you use.

Course guidelines and policies:

Classroom and Course-related Behavior

University policy requires that all of us in the classroom treat each other with respect, and refrain from behavior that will disrupt the educational process. Please refrain from using any electronics during class that are not directly related to what we are doing.

I encourage you to ask questions at any time, and I will ask lots of questions of the class. To make sure that I haven't lost the majority of the class, I may call on people randomly to answer my questions. Saying "I don't know" is a perfectly acceptable answer! You are almost certainly not the only one who's confused, so this is a signal for me to try another explanation, or give some more details.

If you would prefer to be called by a different name, or gender pronoun, than is listed on the course roster, please let me know.

Student Conduct Code

All students need to be familiar with the Student Conduct Code. You can find it at http://www.umt.edu/student-affairs/dean-of-students/default.php or by searching in the "A to Z Index" on the UM home page. In particular,

discrimination and harassment are not tolerated at the University of Montana. If you feel that you have been subjected to discriminatory or harassing behavior, please contact the Office of Equal Opportunity and Affirmative Action at 243-5710 or http://www.umt.edu/policies/browse/personnel/discrimination-harassment-sexual-misconduct-stalking-and-retaliation for help in addressing the situation. You can also report the discrimination or harassment to me or to another faculty member you trust.

Academic Honesty

All students must practice academic honesty. Academic misconduct is subject to an academic penalty by the course instructor and/or a disciplinary sanction by the University.

Disability modifications

The University of Montana assures equal access to instruction through collaboration between students with disabilities, instructors, and Disability Services for Students. If you think you may have a disability adversely affecting your academic performance, and you have not already registered with Disability Services, please contact Disability Services in Lommasson Center 154 or call 406.243.2243. I will work with you and Disability Services to provide an appropriate modification.

Due Dates and Late Work

Unless stated otherwise, all assignments are due at the beginning of class on the day on which they are due. Late work will receive no credit. However, to give everyone a buffer for busy weeks and unforeseen circumstances, the Homework category will be graded out of 120 points, although there will be 140 possible points to earn (10 points for each of 14 assignments). Similarly, the Quizzes category will be graded out of 60 points although there will be 70 possible points to earn (7 10-point quizzes), and there will be a similar policy for WeBWorK.

Except in exceptional circumstances, exams must be taken at their scheduled time. If you know you have a conflict with an exam, please contact me **early** to see what arrangements can be made.

Grading policy

Grade Category:	Percentage:
Discussion posts	5
Written homework	12
WeBWorK	10
Quizzes	15
Midterm exams (2)	34 (17% each)
Final exam	24