MATH 249 -02 & -03: Multivariable Calculus, Fall 2011

Instructor:	Erin McNicholas Office: Ford Hall, Room 211	email: emcnicho@willamette.edu Phone: 503-370-6590

Office Hours: Tu 10:30-11:30, W 12:30-1:30, and Th 1:10-2:10

Math Tutoring: Sunday - Thursday 6:30-9:30 in the math hearth

Class Listserv: math-249-02@willamette.edu and math-249-03@willamette.edu

Class Meetings: Section 02 meets in Ford 201 every Monday, Wednesday and Friday from 10:20-11:20 am. Section 03 meets in Ford 201 every Monday, Wednesday and Friday from 1:50-2:50 pm

"The tantalizing and compelling pursuit of mathematical problems offers mental absorption, peace of mind amid endless challenges, repose in activity, battle without conflict, 'refuge from the goading urgency of contingent happenings,' and the sort of beauty changeless mountains present to sense tried by the present-day kaleidoscope of events." -Morris Kline

"The essence of mathematics is not to make simple things complicated, but to make complicated things simple." -S. Gudder

Class Objectives

Multivariable calculus lies in the intersection of three of the most important branches of mathematics: algebra, analysis, and geometry. It demonstrates the elegance and beauty of mathematics, as well as its sublime utility. By extending the concepts of one-variable calculus to higher dimensions, we encounter a variety of new issues and subtleties, many of which require a deep geometric understanding to resolve. Through this course you will: learn vector calculus; strengthen your geometric visualization skills; practice translating between algebraic, analytic, and geometric perspectives; and develop your technical writing skills. In addition to being a course about the power of integrating multiple mathematical perspectives, the second half of the course will be the story of a theorem - an amazing, beautiful theorem which will unify a number of course concepts. Your grade will be based on your level of achievement in each of the following student learning outcomes:

- Your content knowledge[1]

  As demonstrated on in-class exams and quizzes
- Your geometric reasoning and visualization skills

  As demonstrated on exams and supplemental integrative problems
- Your technical writing ability

  As demonstrated on the supplemental integrative problems

Required Course Materials:

Calculus: Multivariable, 5^{th} ed., by McCallum, Hughes-Hallett, Gleason, et al.

[1] Including your demonstrated ability to make judgments and draw appropriate conclusions based on quantitative information.

Course Components

Exams: There will be three in-class exams worth 100 points each, and one cumulative final worth 150 points. The final for section 02 is **Tuesday, December 13, from 8-11am**. The final for section 03 is **Monday, December 12, from 2-5pm**.

Quizzes: There will be eight quizzes. These brief, in-class quizzes are each worth 5 points.

Integrative Problems: In addition to the homework, there will be four supplemental integrative (geometry) problems, each worth 10 points. These puzzle-like problems are designed to increase your geometric reasoning and technical writing skills. Writing technical explanations of mathematical ideas is an important part of this course, and a valuable skill in many different fields. These integrative problems are small writing assignments due roughly every two weeks. Your lowest integrative problem grade will be dropped.

Homework: Readings from the textbook and WISE site will be assigned to complement class lecture. Lecture format will assume students have completed the appropriate reading before class. Because of the accelerated pace of this course, it is essential that you start exploring the ideas before class and use lecture to strengthen and clarify your understanding. Problem sets for each covered section of the text will be assigned using WeBWork, and will count towards 100 points of your final grade. The goal of these assignments is to give you practice applying concepts covered in class, and a means for checking your understanding. WeBWorK is an online homework distribution and grading system. The best feature of WeBWorK is that when you enter an answer to a homework problem, the system immediately tells you whether the answer is correct. You can try a problem as many times as you like. Once you get the answer right, that fact is immediately recorded (provided it is before the due date), and any wrong answers are not counted in your grade. Here are some tips on using WeBWork:

- Get started early on WeBWorK, and enter some answers at least a couple days before the due date. That way you will have time to seek help on the harder problems (and the ones that looked easy at first but turned out to be tricky) before the set is due. Avoid the last-minute rush. The system often becomes overloaded and slow in the last couple hours before a set is due, since everyone is trying to enter their answers at the same time.

- WeBWorK usually requires very precise answers. For instance, if the correct answer is 1.60045 and you enter 1.6, the system will say that's incorrect. If you are entering a decimal answer, give at least five digits of accuracy. On most problems, you can enter answers like cos(9.81sqrt(340)) instead of a messy decimal, and WeBWorK will do the calculation for you.

- Some WeBWorK problems require formulaic answers, like $x \wedge (2/3)$, which means x raised to the power of 2/3 (two-thirds). However, if you enter $x \wedge 2/3$, the system will say that's wrong, since WeBWorK interprets that as one third of x^2. So be careful and check your syntax. (WeBWorK Set 0, which is recommended but not counted in your grade, will help you learn about entering formulaic answers.)

- WeBWorK has a previewing feature which allows you to see how a complicated formula you just entered is actually interpreted by WeBWorK. The previewer will help you track down syntax errors and ensure that your answer is being interpreted the way you want without having to add three hundred parentheses.

- Last, and MOST IMPORTANT, do not spend large amounts of time guessing random answers and entering them into WeBWork. This is a waste of your time! If you don't know how to do a problem, consult the WISE chatroom to get help from your peers or come to my office hours. If you think you are doing everything correctly and WeBWork doesn't accept your answer, please come to my office hours or email me with an explanation of what you have done, so I can help. Banging your head against the computer, yelling at it, or throwing the computer out the window does not change whether or not WeBWork accepts your solution. *I will give extra-credit to students providing thoughtful, well-written answers to the questions posted on the WISE chatroom.*

Colloquium Talks: Students are expected to attend 2 of the math colloquium talks given throughout the semester. These talks will be announced in class and a schedule can be found on the Math Department website. An excellent essay on how to approach math colloquium talks is available here: `http://www.willamette.edu/~emcnicho/courses/Multi249/How_to_listen_to_a_Math_Lecture_Korner.pdf`. The goal of this attendance requirement is to introduce students to the diversity and vitality of current mathematics research, and to include them in the Math Department culture. Colloquium attendance counts for 20 points towards your final grade.

Grades: Your grade will be based on the percentage of points you earn out of 650 total possible points. 90% and above guarantees you an A-, 80% and above guarantees you a B-, 70% and above guarantees you a C-, and 60% and above guarantees you a D.

Student Responsibility:

You already know this, but previous experience has shown that a friendly reminder is sometimes helpful. You are all adults and responsible for your own education. I will do everything in my power to help you learn. You should always feel free to stop by my office or make an appointment to meet with me. You should also feel free to ask me questions in class. Stop me if you are confused and ask me to explain things again. I welcome student questions! Although I will do everything in my power to help you in this class, you are ultimately responsible for your grade. The following is a list of things I expect from you.

- READ THE TEXTBOOK. This class is formatted under the assumption that you have completed the assigned reading before class. Class time will consist of lectures highlighting the main points of the section, ConcepTests, and in-class examples. It will be difficult to engage in the material during class if you have not looked over the content ahead of time.
- DO THE ASSIGNMENTS. Mathematics is not a spectator sport. You will only learn mathematics by practicing, that is what homework is for. I encourage you to work with your fellow students on homework assignments. Make it a social activity and you will not only learn a great deal, you will have fun doing it.
- THINK CRITICALLY. Your goal in this class should be to understand the concepts and strengthen your mathematical reasoning skills. Mimicking problem solving strategies, or working through processes you don't understand is a waste of your time. Throughout the course you should be asking yourself "Why are we doing this? Why does this method work? How is this related to other topics I've learned?"
- ASK QUESTIONS & SEEK HELP! Ask questions in class, after class, during office hours, whenever! If you are confused or having problems with a certain section of the material see me AS SOON AS POSSIBLE. I am happy to help you but it is impossible to go over several weeks worth of material right before an exam.
- STUDY. The standard rule of thumb is that you should spend *three hours outside of class on course work for each hour spent in class.* To master the content of this course and to earn a good grade you will need to invest time and effort. Set aside time for both homework and studying.

Late Assignments and Missed Classes:

I expect everyone to attend all classes and turn in all assignments. If for some reason you are unable to attend class or turn in an assignment, please let me know as soon as possible, preferably *before* the missed class or assignment.

Cell Phone/Screen Policy:

No laptops, iPads, or other devices which take your eyes off your fellow classmates and the class discussion. Electronic devices such as cell phones, pagers, iPods, etc. must be turned off during class meetings. *If your cell phone goes off during class you will be responsible for bringing treats for the entire class at the next class meeting.* Papers should not be read during class, though I applaud your efforts to stay abreast of current events and tackle the latest crossword or sodoku puzzle.

Academic Integrity:

In accordance with Willamette University CLA catalog: "Plagiarism and cheating are offenses against the integrity of the courses in which they occur and against the College community as a whole... Ignorance of what constitutes plagiarism shall not be considered a valid defense. If students are uncertain as to what constitutes plagiarism for a particular assignment, they should consult the instructor for clarification." Cheating is unethical and I take it very seriously. The Deans Office will be notified if anyone is found cheating and appropriate sanctions will be given. If you are unsure of what constitutes cheating, please ask.

Tentative Schedule

The following schedule is subject to change.

Day	Class Activities & Discussions	Assignments
W (8/31)	Ch. 13 Vectors	
F (9/2)	Ch. 13 Vectors	
M (9/5)	No Class: Labor Day	
W (9/7)	Ch. 13 Vectors	
F (9/9)	Ch. 12 Functions of Several Variables	GP 1 & Quiz 1
M (9/12)	Ch. 12 Functions of Several Variables	
W (9/14)	Ch. 12 Functions of Several Variables	
F (9/16)	Ch. 12 Functions of Several Variables	Quiz 2
M (9/19)	Ch. 12 Functions of Several Variables	
W (9/21)	Exam 1	
F (9/23)	Ch. 14 Derivatives	
M (9/26)	Ch. 14 Derivatives	
W (9/28)	Ch. 14 Derivatives	
F (9/30)	Ch. 14 Derivatives	Quiz 3
M (10/3)	Ch. 14 Derivatives	GP 2
W (10/5)	Ch. 14 Derivatives	
F (10/7)	Ch. 16 Integration	
M (10/10)	Ch. 16 Integration	
W (10/12)	Ch. 16 Integration	Quiz 4
F (10/14)	Ch. 16 Integration	
M (10/17)	Ch. 16 Integration	
W (10/19)	Exam 2	
F (10/21)	No Class: Mid-semester break	
M (10/24)	Ch. 17 Parameterization and Vector Fields	
W (10/26)	Ch. 17 Parameterization and Vector Fields	
F (10/28)	Ch. 17 Parameterization and Vector Fields	Quiz 5
M (10/31)	Ch. 18 Line Integrals	GP 3
W (11/2)	Ch. 18 Line Integrals	
F (11/4)	Ch. 18 Line Integrals	
M (11/7)	Ch. 18 Line Integrals	
W (11/9)	Ch. 19 Flux Integrals	
F (11/11)	Ch. 19 Flux Integrals	Quiz 6
M (11/14)	Ch. 19 Flux Integrals	
W (11/16)	Ch. 19 Flux Integrals	
F (11/18)	Exam 3	
M (11/21)	Ch. 20 Calculus of Vector Fields	GP 4
W (11/23)	Ch. 20 Calculus of Vector Fields	
F (11/25)	No Class: Thanksgiving Holiday	
M (11/28)	Ch. 20 Calculus of Vector Fields	
W (11/30)	Ch. 20 Calculus of Vector Fields	Quiz 7
F (12/2)	Ch. 20 Calculus of Vector Fields	
M (12/5)	Ch. 20 Calculus of Vector Fields, the Three Fundamental Theorems	
W (12/7)	Ch. 20 Calculus of Vector Fields, the Three Fundamental Theorems	Quiz 8
F (12/9)	Ch. 20 Calculus of Vector Fields, the Three Fundamental Theorems	
M (12/12)	Final Exam, Section 03, 2-5pm in Ford 201	
Tu (12/13)	Final Exam, Section 02, 8-11am in Ford 301	

From Previous Students To Future Students

Attending Math Colloquia:

> "Between cookies, tea, and enough colloquium opportunities that it's easy to find at least two you want to see, there's no reason to view this as a chore! If anything, I'm jealous the computer science department doesn't have anything like this."
>
> "Topics were very interesting, I'd just keep reminding people to do them earlier rather than the last two. It's nice to choose your topics."
>
> "I really liked these. They got me really excited about upper-level math."
>
> "Enjoyable for sure. Helpful because it shows students what is being done with mathematics in the real world."

WeBWorK:

> "DON'T LISTEN TO ANYONE WHO HATES WEBWORK. Seriously, I love WeBWorK (despite its horrible capitalization). There is nothing better than knowing you got a 100% on your homework assignment. I can't tell you how many times I've longed for a WeBWorK-style system in other classes. WeBWorK ensures high homework grades and high material understanding. I would not have done nearly as well in the class without WeBWorK, I guarantee you. WeBWorK catches your misconceptions so they do not perpetuate. And unlike getting written homework corrections, there's a tangible benefit to retrying a problem until you get it right (namely a higher homework grade)."
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> "Every time I have a math class that has non-webwork homework, I can't help but feel annoyed. I know webwork is a hassle when things don't work correctly, but being able to get that immediate feedback on whether we're doing things right or not is SO helpful for me. Also helping other students/getting help with webwork online in the chat room was very helpful and enjoyable. I would tell students to USE THE CHAT ROOM to help each other!"

Integrative Problems:

> "I really, really enjoyed the technical writing aspect of the problems."
>
> "I liked them, they were hard but helped us think outside the box and it was possible to get help with them when we needed it."

ConcepTests:

> "The discussion around these answers was way helpful, and it's much easier to make a mistake anonymously then to admit confusion in front of the whole class."
>
> "Definitely helpful and enjoyable. They forced us to think about the material rather than just sitting there mindlessly taking notes. If we didn't get the right answer, being able to get an immediate explanation of why the correct answer was correct was really helpful! I'd tell students to pay close attention when these come up because they are often very similar to homework and test problems."

Quizzes:

> "Oh, the dreaded quizzes! As much as I hate to admit it, they were helpful. They forced me to study the essentials. I'd tell students to make sure to study definitions!"