

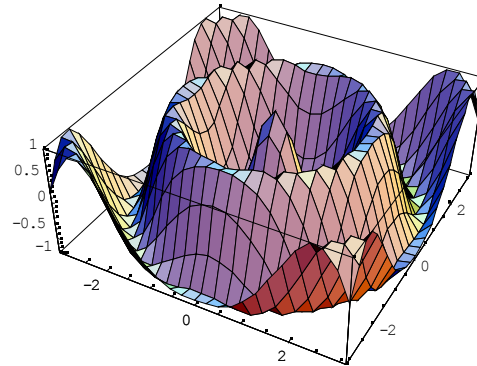
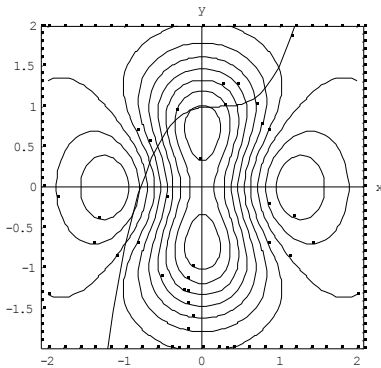
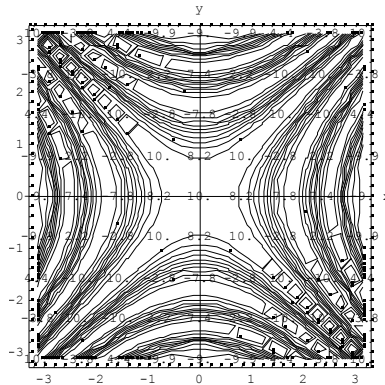
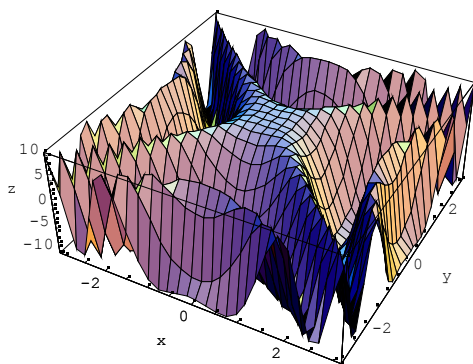


DEPARTMENT OF MATHEMATICS, ENGINEERING, and COMPUTER SCIENCE

# MULTIVARIABLE CALCULUS

MATH 233

FALL 2004



INSTRUCTOR: Dr. Mark Parker  
OFFICE: 118 Science  
E-MAIL: [mparker@carroll.edu](mailto:mparker@carroll.edu)

WEB: <http://web.carroll.edu/mparker>  
OFFICE PHONE: 447-4572  
HOME PHONE: 457-8289  
(before 8 p.m., please)

OFFICE HOURS: MWF 3:00-5:00 TR 8:00 – 9:00 or by appointment

**Welcome to Math 233!** Up until now, your mathematics courses have mainly focused on functions of one variable, and this has meant essentially working in the  $xy$ -plane. Since the real world is three-dimensional, we need to consider functions of more than a single variable! Luckily everything you've learned in calculus up to now is important, since we will often reduce multi-dimensional problems to one-dimensional problems. But we will also go in the other direction, as we will expand the concepts of derivatives and integrals into higher dimensions. Because the world is multi-dimensional, this course has many real-world applications.

We will continue our threaded approach to learning mathematics by taking side tours from calculus to tie together concepts from your previous courses and demonstrate their applicability in our current setting. In our journey, we will make use of both the calculator and Mathematica. Being comfortable with both technologies will help you when trying to solve problems on your own.

**Prerequisites:** You need to have a grade of C or better in Math 131, or in both Math 121 and Math 122, or have been placed here because of your calculus AP exam score.

**My Goals for you:**

- Extend your knowledge and understanding of mathematical concepts, specifically in the study of differential and integral calculus for multivariable and vector functions.
- Develop your geometric and analytical sense of multivariable and vector calculus concepts.
- Refine your skills in formulating and solving problems involving multivariable and vector functions, differential calculus, integral calculus, and optimization.
- Mature your skills in designing mathematical models using the tools of multivariable calculus to capture the essence of real-world patterns and phenomena.
- Classify, analyze, transform, and solve mathematical constructs involving multivariable functions.
- Interpret mathematical models and their solutions in the context of their real-world applications.
- Critique mathematical models to identify their strengths and weakness and modify them to make them better models.
- Expand your knowledge and understanding of the real world through mathematical analysis.
- Cultivate your skills to effectively use modern computing, information, and communication technologies

**Textbook:** The text is *Multivariable Calculus*, by McCallum, Hughes-Hallett, Gleason, et al., © 2002, John Wiley and Sons, Inc (ISBN 0-471-40952-9). There is also a Student Solutions Manual available (ISBN 0-471-44193-7), which has detailed solutions written out for many of the odd problems in the text. I will supplement the text with handouts and other resources, as we need them.

The authors of our textbook motivate each topic through various real-world applications and analogies, and concepts are presented from several different points of view. There is a heavy emphasis on geometry and visualization. Read the book! An important part of being a technical major is learning how to read technical material. This will become more and more true as you get into your upper division courses.

**Other Resources:** A graphing calculator: TI-89, TI-92+, or TI-Voyage 200

**Grades:** You have the opportunity to demonstrate your proficiencies in a variety of ways. Your final grade will be based upon the weightings in the table below:

| <b>ASSIGNMENT</b>                 | <b>% OF TOTAL</b> |
|-----------------------------------|-------------------|
| Homework and In-class assignments | 15%               |
| Computer Labs                     | 10%               |
| Project                           | 15%               |
| 3 Exams (15% each)                | 45%               |
| Final Exam (cumulative)           | <u>15%</u>        |
|                                   | 100%              |

**Homework:** To help you master the skills we are learning; homework will be collected a few times each week. See the **Grading Standards** for more information on how it will be scored. Homework is due **at the beginning of class** on its due date. To make sure that homework can be handed back in a timely manner, no late homework will be accepted. Since everyone has off days, at the end of the semester, I will drop your 3 lowest homework scores.

Since this is a calculus class, we want to keep your calculus skills fresh. While we encourage the use of calculators on difficult problems, there are certain basics which you should have at your fingertips. So every week or two we will have a quick no-calculator exercise, to remind you of these basic ideas.

**Computer Labs:** We will meet in the computer lab (Fortin 115) most Thursdays. The labs are an integral part of this course, and you should come prepared to work during the lab time we have reserved. My experience has been that labs work better when you have a partner to bounce ideas off of, so I prefer that you work in pairs. For those labs that are handed in, you should:

1. include comments on your work
2. include a summary sheet describing the lab in **your words**,
3. write using complete sentences.

**Group Project:** The project is designed to help you refine your analysis and reporting skills – whatever your chosen vocation, **no matter how great your technical skills, there will be little demand for them if you lack the skills to communicate your results to both your peers and those less technical than yourself.** You will be given a grading rubric for the project when it is assigned.

**Exams:** We will have three exams during the semester, as well as a cumulative final exam. All exams will be equally weighted, accounting for 45% of your final grade. Exam dates will be announced in class **at least one week** prior to their occurrence. For each exam, you will be allowed an 8.5" x 11" sheet of notes and either a calculator or Mathematica. Policies on academic integrity are in the Carroll College catalog. If you cheat on one of my exams, at a minimum I will give you an F for the entire course.

**Final Exam:** You will have the opportunity to demonstrate your mastery of the topics in the course on a cumulative final examination, which will account for 15% of your final grade. The final exam will take place on **Wednesday 15 December 2004, 8:00 – 9:45.**

**Course Late Policy:** In order to be successful in this course, you must stay caught up, so I encourage you to keep up with your homework. In order for me to hand back assignments in a timely manner, it is imperative that work be turned in **on time**.

No work beyond the due date will be accepted; students will receive a grade of zero for work not turned in on the due date.

Let me know as soon as possible if you have circumstances (health or personal) that will require extended absences so that we can work out an acceptable arrangement.

**Help! I'm lost:** Stop by if you need help! My office is always open; however, you may find that I'm not always the person in my office. I will be on campus MWF afternoons (1:00 – 5:00) and TR mornings (8:00 –12:00) only. If you stop by at other times, you will find my wife Holly inhabiting our shared office. If my office hours don't work for you, **let me know** and we can schedule another time to meet.

**Other information:** For your **success** in the class it is **crucial** that you attend regularly. If you are going to miss a class where we have an exam scheduled or an assignment due, it is imperative that you let me know as soon as possible, preferably in advance. As a general rule, I do **not** give make-up exams – if you have a legitimate extreme excuse, we can make other arrangements for missed assignments.

If you have special needs or problems, please be sure to speak to me or see Joan Stottlemeyer in the Academic Resources Center about them as early as possible in the semester. There is additional information in the Carroll College catalog.

I welcome your constructive comments to help me make this the best course possible. The key to your success in this course depends mainly upon your attitude, your study habits, and your desire to learn. My role is to facilitate the process; but I can't do it alone! Good luck, I'm looking forward to a great semester!

### **Tentative Course Outline:**

|   |           |  |
|---|-----------|--|
| <b>Multivariable Functions</b>  | (2 weeks) | Chapter 12   |
| 3-D coordinate systems<br>Multivariable Functions   |           | Graphs and Contour Diagrams<br>Limits and Continuity                                   |
| <b>Vectors</b>  | (2 weeks) | Chapters 13 and 17   |
| Vectors, vector operations<br>Projections   |           | Parametric equations   |
| <b>Multivariable Calculus</b>   | (6 weeks) | Chapters 14, 15, and 16  |
| Partial Derivatives, gradient, directional derivatives<br>Tangent planes, local linearity<br>Optimization, LaGrange multipliers |           | Double and Triple integrals, applications<br>Polar, cylindrical, spherical coordinates |
| <b>Vector Calculus</b>  | (4 weeks) | Chapter 17, 18, 19, and 20   |
| Line Integrals, Work, and Flux<br>Green's Theorem   |           | Divergence<br>Curl   |