Multivariable Calculus

MATH 241-02, Spring 2019

MTWF 1:00 - 1:50 Smith Labs 154

Professor Gareth E. Roberts

Contacting me: Office: Haberlin 305, e-mail: groberts@holycross.edu phone: x2350

Office hours: Mon., Tues., Fri. 2:00 - 3:00, and Wed. 10:00 - 11:00, or by appointment.

Required Text: *Multivariable Calculus: Concepts and Contexts*, Fourth ed. (Enhanced) by James Stewart. A copy of the text as well as a *Study Guide* are available on reserve in the Math/Science Library.

Web page: http://mathcs.holycross.edu/~groberts/Courses/MA241/homepage.html
Homework assignments, worksheets, computer projects, exam materials, useful links and other important information will be posted at this site. Please bookmark it!

Prerequisites: MATH 134, MATH 136, or a score of 4 or 5 on the Calculus BC AP Exam.

Syllabus: This course focuses on the calculus of multivariable functions. It is traditionally thought of as the third semester of calculus. The ideas from the calculus of one-variable functions (such as the derivative and integral) will be generalized to higher dimensions. This can be challenging, but we will use computer simulations and graphics, as well as physical models, to help elucidate the beauty and complexity of this fascinating subject. Applications of multivariable calculus can be found in physics, engineering, economics, chemistry, biology, astronomy, and the social sciences.

A tentative outline of the course is given below, organized by chapters of the text. We will cover most of the material in the text, from Chapter 9 through Chapter 13.

- Vectors: basis vectors, dot and cross products, equations of lines and planes (7 classes)
- Surfaces: quadric surfaces, graph of a two-variable function (2 classes)
- Vector Functions: tangent vectors, arc length, curvature, normal and binormal vectors, velocity and acceleration (6 classes)
- Exam I: Feb. 20 (evening)
- Functions of Several Variables: graphing, contour plots, limits and continuity (4 classes)
- Differentiation: partial derivatives, tangent planes, chain rule, directional derivative, gradient (6 classes)
- Exam II: March 27 (evening)
- Optimization: critical points (max, min, or saddle), Lagrange multipliers (4 classes)
- Integration: double and triple integrals, iterated integrals, changing variables, using polar, cylindrical, and spherical coordinates (9 classes)
- Vector Fields: line integrals, conservative vector fields (4 classes)
- Exam III: April 25 (evening)
- Vector Calculus: Green's Theorem, curl and divergence, Stokes' Theorem, Divergence Theorem (5 classes)
- Multivariable Calculus Jeopardy (last class)

Course Objectives:

- Develop an understanding for the techniques and theory of multivariable calculus.
- Explore some of the applications of multivariable calculus to other disciplines.
- Learn to work with mathematical software (e.g., Maple) to enhance your understanding.
- Work and communicate with your peers.
- Have FUN while learning multivariable calculus!

Homework: There will be homework due every Wednesday at the start of class, except for the weeks in which a midterm exam is scheduled. Homework will consist of two parts, an online component to be completed using the system **WebAssign** and a hand-written portion consisting of selected problems from the course textbook.

Late homework will not be accepted. While you are allowed and encouraged to work on homework problems with your classmates, the solutions you turn in or enter on the computer should be your own work. No help from any Internet sources other than those offered by WebAssign is allowed. Plagiarism will not be tolerated and will be treated as a violation of the Departmental Policy on Academic Integrity.

In order to access WebAssign, you will need a **Class Key**. The Class Key for MATH 241-02 is holycross 2289 9662 . If you did not purchase an access code as part of your bundled textbook from the College Bookstore, then you will eventually need to purchase one directly from WebAssign. You will have free access to WebAssign until Feb. 5th.

The Flipped Classroom: Many of our classes this semester will consist of problems and worksheets for you to complete in groups. For these classes there will not be a traditional lecture, but rather the class is "flipped" so that active student learning is the primary focus. You will be expected to prepare for these classes by completing a few problems on WebAssign, watching videos, and reading the text beforehand.

Computer Projects: There will be three to four computer projects assigned during the semester. The goal of the projects is to use the mathematical software package Maple to gain a better understanding of the subject material and to explore some of the applications of multivariable calculus. Class days involving these projects will meet in the computer lab in Haberlin 136. You are **required** to work on projects in small groups of two or three members. One report is submitted for the entire group.

Exams: There will be three midterm exams and a comprehensive final at the end of the semester. The exam schedule is given below. We will typically review for each midterm during class the preceding day. Please make a note of these dates and plan accordingly. Any conflicts must be legitimate and brought to my attention well before the exam is scheduled.

If you have any specific learning disabilities or special needs and require accommodations, please let me know early in the semester so that your learning needs may be appropriately met. You will need to obtain approval from the Office of Disability Services (Hogan 215A, x3693).

Exam Schedule:

Exam 1	**Wed., Feb. 20**	7:00 - 8:30 pm
Exam 2	**Wed., March 27**	7:00 - 8:30 pm
Exam 3	**Thurs., April 25**	7:00 - 8:30 pm
Final Exam	TBA	2.5 hours

Academic Integrity: The Department of Mathematics and Computer Science has drafted a policy on academic integrity to precisely state our expectations of both students and faculty with regards to cheating, plagiarism, academic honesty, etc. You are required to read this policy and sign a pledge agreeing to uphold it. A violation of the Departmental Policy on Academic Integrity will result in a 0 for that assignment or exam, and a letter describing the occurrence of academic dishonesty will be sent to your Class Dean.

Diversity and Inclusion: It is my intent that students from all diverse backgrounds and perspectives be well-served by this course, that students' learning needs be addressed both in and out of class, and that the diversity that students bring to this class be viewed as a resource, strength, and benefit. Any suggestions you have pertaining to diversity and inclusion are encouraged and appreciated.

Grade: Your course grade will be determined by the scores you receive for each of the following items:

- participation (includes in-class work, preparedness, attitude, effort) 8%
- homework and computer projects 22%
- midterm exams 45%
- final exam 25%

How to do well in this course:

- ATTEND THE LECTURES, PARTICIPATE, and ASK QUESTIONS.
  I take pride in my lectures and will work hard to get you to master the course material. However, this will not be of much use to you if you don't attend class. Furthermore, on those special days when the classroom is "flipped," it is up to you to come prepared for class. Taking some initiative beforehand will result in a better learning experience for you. Do not take for granted the privilege you have of attending college. Value your time here and I will make it worth your while.
- DO YOUR HOMEWORK REGULARLY.
  The best way to learn mathematics is to *do* mathematics. This means mastering the material to the point where you could explain it to your classmates and your friends. "You don't really learn the subject until you teach it," is a common adage amongst mathematicians. It is not enough to know how to mimic an algorithm. A strong student should be able to follow and propose arguments as to why an algorithm is working or not working.
- WORK WITH YOUR CLASSMATES.
  Some of the best assets available to you are the knowledge and abilities of your peers. Learn to explain mathematics to your classmates. Mathematics can be fun and rewarding when there are people around you who enjoy figuring out problems as much as you do. Take advantage of this opportunity and organize study groups.
- ASK FOR HELP WHEN NECESSARY.
  Ask for help when you need to. One of the stumbling blocks for many math students is being afraid to ask for help. Just do it! It's actually ok to admit that you don't understand something. Identifying areas of difficulty and seeking out the help necessary to improve in those areas is the key to being a good math student.

Never regard study as a duty, but as the enviable opportunity to learn.

— Albert Einstein