Math 212: Multivariable Calculus
Spring 2020

Jay Daigle

Course Goals

In this course we will extend our theory of calculus to cover functions of multiple variables. We will understand these functions algebraically and geometrically, and learn how to use the tools of differential and integral calculus to further understand them.

Topics will include: 3D graphing, planes, partial derivatives, vectors, directional derivatives, gradients, the chain rule, optimization and Lagrange multipliers, integration, parametrization, vector fields, line and surface integrals, and Green's, Stokes's, and the Divergence theorem.

Instructor Info

Lectures:	MWF 3:00–3:55 PM	Fowler 201	
Instructor:	Jay Daigle	**Office Hours:**	MWF, 1:30 - 2:45 PM
Office:	Fowler 325	**Usually in Office:**	TR, 12:30 - 1:30 PM
Email:	`gdaigle@oxy.edu`		TR, 3:00 - 5:00 PM
Textbook:	NONE	**Course Webpage:**	`http://jaydaigle.net/multi`

Learning Objectives

1. Perform basic vector operations such as the dot product and cross product and utilize these operations in applications.
2. Find equations of lines and planes in 3-space, sketch level curves and contour dia- grams from a given 3-variable equation, and recognize simple surfaces like paraboloids and ellipsoids from their level curves and contour diagrams.
3. Evaluate derivatives and integrals of vector-valued functions of one variable.
4. Compute limits, partial derivatives, directional derivatives, and gradients for func- tions of several variables, and use differentiation to determine tangent planes, rela- tive extrema, and absolute extrema of continuous functions on closed and bounded regions for functions of several variables.
5. Use Lagrange multipliers to find extrema of a function subject to one constraint.
6. Set up and evaluate multiple integrals in 2 and 3 dimensions, in rectangular, polar, cylindrical, and spherical coordinates, and apply these integrals to solve physical problems.
7. Evaluate line integrals directly. Identify conservative vector fields and find poten- tial functions for conservative vector fields, and be able to apply the Fundamental Theorem of Calculus for Line Integrals and Green's theorem appropriately.

Course Description

Calculus of functions of several variables, parametric curves and surfaces, and vector fields in 2- and 3-space with applications. Vectors, graphs, contour plots. Differentiation with application to optimization. Lagrange multipliers. Multiple and iterated integrals change of variable, and the Jacobian. Line and surface integrals. Vector analysis, Green's, Gauss', and Stokes' Theorems. Applications to physics economics chemistry and mathematics.

Math 212 is a 4-unit course. It is expected that students in this class will be devoting at least twelve(12) hours a week (including in-class time) on average. Math 212 satisfies the Core Math/Science (CPMS) requirement.

References

There is no official textbook for this course, and you won't need to purchase any book for the course.

If you would like references or other perspectives, I recommend the following free online textbooks:

- *Calculus III* by Jerrold Marsden and Alan Weinstein at `https://authors.library.caltech.edu/25043/`
- *Vector Calculus* by Michael Corral at `http://www.mecmath.net/calc3book.pdf`
- *Calculus Volume 3* by the Openstax project at `https://openstax.org/details/books/calculus-volume-3`

Grading

- WeBWork Homework: 40%
- Written Homework: 10%
- Midterms: 10% each
- Final: 20%

Course Policies

- **Homework:** Homework is in many ways the most important part of this class. Math is a skill, and, like all skills, requires practice to develop and learn. I encourage you to collaborate with classmates on your homework. However, you must turn in your own writeup in your own words.

  I strongly encourage you to start the homework sets early. In addition to making them easier to finish on time, it's often easier to understand the material we cover if you go into the lectures with some specific questions; thus it's useful to at least read even the questions you're not prepared to start on yet.

  Each week we will have a couple of written problems you must submit, generally at the start of class on Friday. The rest of your homework will be through the (free) online homework system WeBWork hosted by the MAA. I plan to make this homework due Tuesday afternoons.

  Late homework will usually not be accepted except by prior arrangement or a note from Emmons or the deans. Please try to email me at least the night before the due date if you need to request an extension. (I often keep late hours; don't feel shy about emailing at two in the morning).

- **WeBWork:** Much of the homework in this class will be administered through the free online WeBWork system run by the MAA. Each week you will have a series of problems to complete through this system. You can find a link through the course web page.

- **Exams:** There will be three midterms and a final. Tentative dates for the midterms are February 12 (21), March 6 (21), and April 8 (11).

  The final exam is at 1:00 PM on Friday, May 11, in the usual classroom.

  Graphing calculators will **not** be allowed on tests. Scientific, non-programmable calculators will be allowed. I will have some to share, but not enough for everyone.

College Policies

- **Academic Ethics:** Students are expected to comply with the Student Handbook, in particular the section on Academic Ethics. You can find the policy at `https://www.oxy.edu/student-handbook/academic-ethics/academic-misconduct`

- **Title IX:** In the event that you choose to write or speak about having experienced sexual or interpersonal violence, including sexual assault, dating violence, domestic violence, stalking, sexual exploitation or any other form of sexual harassment, federal and state education laws require that, as your instructor and a designated Responsible Employee, I notify the Title IX office. They will contact you to let you know about accommodations and support services at Oxy and reporting options both on and off-campus.

  If you do not want the Title IX Office notified, instead of disclosing this information to your instructor, you can speak confidentially with the following people on campus:

  - Marianne Frapwell, Survivor Advocate, Project SAFE (`survivoradvocate@oxy.edu`)
  - Emmons Counseling (For appointments, call: 323-259-2657)
  - Rev. Dr. Susan Young, Office of Religious and Spiritual Life (`young@oxy.edu`)

  The sexual misconduct policy, along with additional resources, can be found at: `http://www.oxy.edu/sexual-respect-title-ix/policies-procedures`.

- **Special Accommodations/Learning Differences:** Students with documented disabilities and learning differences who are registered with Disability Services are required to present their accommodation letter to the instructor at the beginning of each semester or as soon as possible thereafter. Any student who has, or thinks they may have, a physical, learning, or psychological disability may contact Disability Services at (323) 259-2969 to learn about available services and support. More information is available at `http://www.oxy.edu/disability-services`.

- **Accommodations for Reasons of Faith and Conscience:** Consistent with Occidental College's commitment to creating an academic community that is respectful of and welcoming to persons of differing backgrounds, we believe that students should be excused from class for reasons of faith and conscience without academic consequence. While it is not feasible to schedule coursework around all days of conviction for a class as a whole, faculty will honor requests from individual students to reschedule coursework, to be absent from classes that conflict with the identified days. Information about this process is available on the ORSL website: `https://www.oxy.edu/office-religious-spiritual-life`.