MATH 32: COURSE SYLLABUS SPRING 2018

Calculus III: Calculus of Several Variables

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Office Hours: MF 10:45 am – 11:45 am, W 2:45 pm – 3:45 pm

Course Website: Sakai

Meeting Times

Mondays & Wednesdays – 1:15 pm - 2:30 pm
Fletcher Hall – Room 110

About this course

What is this class?

This course extends the thread of mathematical inquiry of the dual topics of differentiation and integration for functions of several variables. Whereas functions of one variable may be visualized as curves on the plane, we may visualize a real-valued function of two-variables as a surface in three-dimensional space. But what does it mean to take a derivative or a definite integral of a surface? We will address this question and more in this course. Like in Calculus I & II, we will see that there is a beautiful geometry associated with functions of several variables.

Our first task will be to develop a useful language for easily describing geometric objects in two and three dimensions using vectors. Then we will continue to study vector-valued functions, partial derivatives, the gradient vector, Lagrange multipliers, double and triple integrals and line integrals, culminating with the fundamental theorems of Green, Stokes, and Gauss. We will also apply these ideas to a wide range of problems that include motion in space, optimization, arc length, surface area, volumes, and centers of mass, time permitting.

The students should be able to interpret the concepts of Calculus algebraically, graphically and verbally. More generally, the students will improve their ability to think critically, to analyze a problem and solve it using a wide array of tools. These skills will be invaluable to them in whatever path they choose to follow, be it as a mathematics major or in pursuit of a career in one of the other sciences.

Brief Course Outline

This is broad course outline of the topics covered. I will post a separate document with the entire course schedule of readings on Sakai shortly. Consult our Sakai site for updates.

- Chapter 12: Vectors and the Geometry of Space
- Chapter 13: Vector Functions
- Chapter 14: Partial Derivatives
- Chapter 15: Multiple Integrals
- Chapter 16: Vector Calculus
- ⋆ Postscript: What are math courses beyond calculus? What is mathematics?

Learning Goals

To develop an understanding and appreciation of the mathematical concepts and tools in Calculus of Several Variables that provide the ability to model continuously changing quantities. Additionally, by the end of the semester students will be able to:

- demonstrate proficiency in treating mathematical content at an appropriate level.
- demonstrate competence in the use of numerical, graphical, and algebraic representations.
- demonstrate the ability to interpret data, analyze graphical information, and communicate solutions in written and oral form.
- demonstrate proficiency in the use of mathematics to structure their understanding of and investigate questions in the world around them.
- describe lines and curves in $\mathbb{R}^3$ parametrically and via equations.
- describe the graphs of surfaces in $\mathbb{R}^3$, including quadric surfaces.
- compute dot and cross products of vectors and use this to solve geometric problems in $\mathbb{R}^3$.
- compute partial derivatives of functions of several variables, including use of the chain rule.
- compute the gradient of functions of several variables and understand its relation to level sets.
- find local or global extrema of functions of several variables, including using the method of Lagrange multipliers.
- set up and compute multiple integrals of functions of several variables with applications to volume, center of mass, etc.
- work in polar, cylindrical, spherical as well as Cartesian coordinate systems.
- compute line and surface integrals.
- compute and understand the significance of the the curl and divergence of a vector field.
- understand the theorems of Green, Stokes, and Gauss and use them to compute integrals.

Who should take this class?

This course is intended for students interested in advanced study in mathematics or science, students preparing for careers in the health sciences or engineering, and any student wishing to broaden and enrich the life of the mind.

Prerequisites

Completion of Math 31 (or equivalent college-level Calculus II), a suitable score on the mathematics placement exam, or permission of the instructor.

Required Texts

- Online access to the homework system WebAsssign.
- *Calculus: Early Transcendentals*, 8th Ed., by James Stewart.

• Note Bene: The textbook comes with access to the WebAssign system. So if you are ok with studying from an ebook then you DO NOT have to buy a hard copy of the textbook. I would encourage students who plan to take Calc II,III, or more advanced mathematics courses to purchase a hardcopy of the textbook to keep as a reference.
You can buy an earlier edition for cheaper if you plan to use it as a future reference or resource. Since the HW is done online you will not need the textbook for the homework, only to read the book and study.

Optional Resources.

• Paul's Online Math Notes.
Comments: Free and online. The notes are simple and to the point. Excellent for extra examples.
• MIT's OCW Multivariable Calculus course with video lectures and notes.
Comments: Free and online. Haven't really watched the videos so check them out and let me know if you like them.
• Calculus III, by Jerrold Marsden and Alan Weinstein.
Comments: Free and online. A more advanced textbook that is geared towards future engineers and physicists. They are excellent but can be very challenging. Some topics and notation choices are unusual.
• *Vector Calculus* by Marsden and Tromba
Comments: A more refined and theoretical version of the Calc III book by Marsden and Weinstein referenced above. It covers more topics at a higher level. It has wonder sections on history and also more sophisticated mathematical notation. Worth reading for students who plan to major in mathematics. Available at the library.

Calculator

This is a course of mathematical concepts and techniques, not a course of mechanical computation, so we will have little use for calculators. You may bring a calculator or laptop with you to class if you wish. If you bring a laptop please do not use it to check email or chat with friends, or do any tasks that would disturb your fellow classmates. We will discuss the free programs Desmons, Geogebra, Symbolab, Wolfram Alpha, and SAGE and how it can help in learning. Please note that no calculators of any kind will be allowed during exams.

Grading Criteria.

Participation	2%
Miscellaneous (projects, quizzes, etc)	8%
Online HW	15%
Exams (3 @15 % each)	45%
Final Exam (Comprehensive)	30%

In-class Exams.

Exam 1. Monday, 2/12/2018
Exam 2. Monday, 3/19/2018
Exam 3. Monday, 4/30/2018

Dates are subject to change. Exams are scheduled during the end of the class period, approximately 60 minutes long. The first 15 minutes will be reserved for Questions and Answers from students.

Final Exam.

Date. Monday, May 7
Time. 2:00-5:00 pm & Room: Fletcher Hall 110

Missed Exams Policy.

⋆ There are NO make-up or rescheduling of examinations under any circumstances.
⋆ Any student who is absent from an in-class examination will receive a zero for that exam grade.
⋆ Exception(s): Students who can prove that they could not take the examination **due to an unexpected medical emergency** or **an approved (by me) scholarly event** will have the NEXT exam grade substituted for the missing exam.

Letter Grades

A . . . . . 90-100 %
B . . . . . 80-89 %
C . . . . . 65-79 %
D . . . . . 50-64 %
F . . . . . $<$ 50 %

It *may* be the case, depending on how the class does, that the same letter grades might be assigned at slightly lower cutoff?s. Finally, students should note that they will be graded on their total weighted score and cannot be given extra credit for additional assignments, dramatic improvement, or other activities.

Expectations

Readings

Reading the textbook before class is crucial to learning the material at a deep level. Some suggestions for effectively "actively reading" of mathematical texts are provided at the end of this document.

Homework

Homework is to be submitted online using WebAssign, and you can monitor the due dates online. Under no exceptions can WebAssign homework be turned in after the posted deadline.

The first 15 minutes of class time will be devoted to solving problems from the WebAssign homework. To best use this time, please come to class on time and be ready with questions.

Attendance & Class Policies

Attendance is crucial to doing well in the course, and correlates strongly with good grades. Therefore, regular attendance is strongly recommended.

I expect everyone to maintain a respectful and mindful learning environment for all, and to be engaged in our class lecture or discussions. To encourage good classroom behavior, there may be penalties for disruptive behavior:

• Out of courtesy to the rest of the class, please arrive on time, with cell phones turned off and put away. If I see a cell phone showing during class, and I see it on your desk or lap, the student will have 1% of their participation score removed (EVEN IF THE PHONE IS TURNED OFF).

• Students may also lose 1% of their participation grade **for each instance of distracting behavior**. These include: sleeping, eating (drinks are ok), using a cell-phone, having a conversation which distracts me or other students, doing work from another class, or habitually tardiness.

Advice

From Pitzer Professor Jim Hoste:
This is a difficult course for at least three reasons. First, there is simply no substitute for proper preparation. Students who are inadequately prepared face a serious challenge that simply may be too great to overcome, however hard they try. The good news is that by returning to the correct place in the calculus sequence, such students may then succeed wonderfully and eventually be ready for Calculus III. The bad news is that we cannot undertake more than a very quick review of previous material in this course. The second reason that this class is difficult is that we must cover a fairly large amount of material. We cannot slow down too much or we will not reach the end before the semester is over. We will spend roughly 2 weeks each on Chapters 12 through 15 so as to leave 3 weeks for Chapter 16 (leaving time for exams and review). The third reason this class is hard, is that most students seem to have trouble visualizing surfaces in three dimensions. We will work on this and gain experience as we go.
It is extremely important that students work on calculus every day! **About 10-16 hours of work per week**, outside of the class meeting time, will probably be necessary to succeed in this class. Students need to read the text, come to class prepared to ask questions, and come to office hours to ask questions if they are having trouble with the material. Student are urged to form study groups and work together to help one another and to attend the tutoring sessions.

Additional Help

I encourage students who are having difficulty with the course material to meet with me for individualized help during office hours. Students are also encouraged to develop and maintain an email dialogue with me so that I may provide more timely assistance with smaller-scale questions.

Students of this course can also access the free services (including free, walk-in tutoring) several nights per week. Hours will be announced as soon as possible.

Accommodations

If you have a disability that may interfere with your ability to participate in the activities, coursework, or assessment of the objectives of this course, you may be entitled to accommodations. It is imperative that students requesting academic accommodations identify themselves early in the semester. To request academic accommodations due to a disability, please contact Associate Dean/Director of Academic Support Services Gabriella Tempestoso if you are a Pitzer student. She can be contacted via email at Gabriella_Tempestoso@pitzer.edu or at (909) 607-3553. If you attend another one of the Claremont Colleges, please contact your home colleges disability officer.

Students who seek special accommodations outside of regular class time will need to schedule to fulfill these at the office of Academic Support Services at least two weeks in advance. For example, if you may receive time and a half on exams, then you will need to schedule to take the exam at their office and not during class.

Suggestions for Effectively Reading Mathematics

"Read Actively"

1. When confronted with the task of reading a piece of mathematical text, skim the entire reading first to discern its general outline and to identify its main points and objectives.

2. If necessary, review earlier portions of the textbook (or prior mathematical topics studied) to recall forgotten or unfamiliar vocabulary, techniques or theorems before attempting a thorough reading of the current text.

3. Don't rush! Read slowly! Mathematical writing is typically dense with ideas. Spend as much time as necessary to understand the fully intended meaning of each of the author's arguments and examples.

4. Pay particular attention to the precise statement of new definitions and theorems.

5. Do not immediately skip over a portion of the reading that doesn't make sense in the hope that its meaning will become more apparent later. Because of the linear nature of mathematical writing in which one topic builds from those that precede it, it is very important to fully understand one topic before proceeding to the next.

6. Try to identify the cause of any misunderstanding of the topics being studied. Consider all reasonable methods to resolve the misunderstanding. Whenever possible discuss difficult portions of the text with a friend, study partner, or study group.

7. If all else fails, make sure to mark any portions of the text that remain perplexing so that you may raise these issues subsequently in class.

8. Occasionally authors will intentionally leave some details of arguments or examples to the reader to complete as an exercise. Authors do this for pedagogical reasons and not laziness! As a useful check on your understanding of the material, always fill-in in the details omitted by the author.

9. Always keep pencil and paper handy whenever reading mathematical text. It can be very helpful to highlight important passages, insert marginal notes to yourself (a la Fermat!), and make simple calculations while involved in the reading of the text.

10. Examples in textbooks often come with a moral. Discern the author's main point in providing the example. Make sure you struggle to understand every aspect of the computation, manipulation, or procedure presented in the example.

⋆ ⋆ ⋆ **IMPORTANT ASSIGNMENT – COURSE CONTRACT** ⋆ ⋆ ⋆

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Please **hand-write** on a separate piece of paper and print your name, the course title, the course section, AND the following statement. SIGN THIS DOCUMENT and turn it in as soon as you certify that you are able to log into Sakai:

"I certify that I have read the entire contents of the Course Syllabus. I also pledge to regularly check the course Sakai site for updates and hold myself accountable for the information."