Math 223 – Vector Calculus

Term: Fall 2020
Sections: 002 (8AM) ; 006 (11AM) ; 011 (2PM)
Modality/course meetings: Live online
Websites: https://calculus.math.arizona.edu/math223
http://math.arizona.edu/∼cjewell/223

Instructor: Chris Jewell
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Text: *Multivariable Calculus* 6^{th} Ed. Hughes-Hallet, et al.

Course Description, Objectives, and Expected Learning Outcomes

Course Catalog Description

The course covers differential and integral calculus of functions of several variables. Topics include vector valued and scalar functions, partial derivatives, directional derivatives, chain rule, local optimization, double and triple integrals, the line integral, Green's theorem, Stokes' theorem and the Divergence theorem.

Course Objectives and Expected Learning Outcomes

Upon successful completion of this course, students should be able to:

- Recognize and sketch surfaces in three-dimensional space
- Recognize and apply the algebraic and geometric properties of vectors and vector functions in two and three dimensions
- Compute dot products and cross products and interpret their geometric meaning
- Compute partial derivatives of functions of several variables and explain their meaning
- Compute directional derivatives and gradients of scalar functions and explain their meaning
- Compute and classify critical points of two-variable functions
- Parameterize curves in 2- and 3-space
- Evaluate integrals through scalar or vector fields and explain some physical interpretation of these integrals
- Graphically and analytically synthesize and apply multivariable and vector-valued functions and their derivatives, using correct notation and mathematical precision.
- Synthesize the key concepts differential, integral and multivariate calculus.
- Evaluate double integrals in Cartesian and polar coordinates; evaluate triple integrals in rectangular, cylindrical, and spherical coordinates; and calculate areas and volumes using multiple integrals.
- Use double, triple and line integrals in applications, including Green's Theorem, Stokes' Theorem, Divergence Theorem and Fundamental theorem of line integrals.

Course Format/Class Meetings

This class will conducted as a Live Online class as defined by the University of Arizona. This means that the class will meet during the officially scheduled class time as determined by the University of Arizona and presented in the Schedule of Classes. Except for the added layer of viewing the class through a computer screen, the class will be run as closely as possible to a "normal" in-person class. This includes, but is not limited to, the expectation that students be present for each class meeting.

Attendance

Attendance of each class meeting is expected from every student. While the course will be delivered online, "live" attendance is expected. The course will be run and content will be disseminated as a remote course – just a normal course delivered to 35 different locations, rather than 35 people in 1 location. Participating in the course and attending lectures is important to the learning process. While no points/portion of the final grade calculation is directly tied to attendance, absences may negatively affect a student's final course grade.

It is the student's responsibility to notify the instructor in advance of an absence related to religious observation or an activity for which a Dean's excuse has been granted, and to arrange for how any missed work will be handled. It is also the student's responsibility to keep informed of any announcements made during scheduled classes.

Students who need to miss more than one week of classes in any one semester must provide a doctor's note of explanation to DOS-deanofstudents@email.arizona.edu.

Class Recordings

Lectures from each class session may or may not be recorded and made available for students to view at a later time. For lecture recordings, which are used at the discretion of the instructor, students must access content only via D2L. Students may not modify content or re-use content for any purpose other than personal educational reasons. All recordings are subject to government and university regulations. Students accessing unauthorized recordings or using them in a manner inconsistent with University of Arizona values and educational policies are subject to suspension or civil action.

Communication with Students

If it is necessary to make announcements or disseminate other important course information outside of normal class meetings, such information will be sent to each student's official University email. It is the student's responsibility to check for messages and announcements regularly.

Required Texts and Materials

Text and Related Material

The course materials include the textbook (Multivariable Calculus; Sixth Edition by Hughes-Hallett et al.; published by Wiley) and access to the online homework system (WebAssign). These course materials are delivered digitally via D2L through the Inclusive Access program. Students will have access to the course materials free of charge until September 6, 2020. You must take action (even if you have not accessed the materials) to opt-out if you do not wish to pay for the materials, and choose to source the content independently. The deadline to opt-out is 9:00pm MST, September 6, 2020. If you do not opt-out and choose to retain your access, the cost of the digital course materials will appear on your Bursar account.

For more information, visit the FAQs page at https://shop.arizona.edu/textbooks/Inclusive.asp

The *WebAssign* material must be initially accessed through the D2L course page.

Calculators

A graphing calculator is an important tool and will be helpful for much of this course. You may be required to complete some coursework without a calculator. Any model of calculator, including those which perform symbolic manipulation (such as the TI-89 or 92), is permitted on the final exam, provided it is not capable of wireless connectivity.

Equipment and Software Requirements

Since this class will be a Live Online course, you will need daily access to a desktop computer, laptop, or other web-enabled device with webcam and microphone, along with a reliable internet connection. You will need regular access to a device that can reliably and consistently

- Access D2L
- Join Zoom meetings
- Access WebAssign and the eText
- Scan and upload written work (as a PDF)
- Download and view PDF documents

Note: Enrolled students can borrow technology from the UA Library on a first come, first served basis. See https://new.library.arizona.edu/tech/borrow for details.

Grades

Breakdown of points:

Homework/quizzes	100 points
WebAssign	100 points
Midterm exams total	300 points
Final exam	150 points
Total possible points	650 points

You will earn a grade of

A if you earn at least 585 points
B if you earn between 520 and 584 points
C if you earn between 455 and 519 points
D if you earn between 390 and 454 points
E if you earn less than 390 points

Classroom Behavior Policy

To foster a positive learning environment, students and instructors have a shared responsibility. We want a safe, welcoming, and inclusive environment where all of us feel comfortable with each other and where we can challenge ourselves to succeed. To that end, our focus should be on the tasks at hand and not on extraneous activities.

Students are asked to refrain from distracting and/or disruptive behavior during lecture. Students are asked to keep their Zoom feed on mute unless asking or answering a question, or otherwise positively interacting and engaging in the class session. Students observed engaging in disruptive activity will be asked to cease this behavior. Those who continue to disrupt the class will be asked to leave class and may be reported to the Dean of Students.

Academic Integrity

Students are encouraged to share intellectual views and discuss freely the principles and applications of course materials. However, graded work/exercises must be the product of independent effort unless otherwise instructed. Students are expected to adhere to the UA Code of Academic Integrity as described in the UA General Catalog.
http://deanofstudents.arizona.edu/academic-integrity/students/academic-integrity

Selling class notes and/or other course materials to other students or to a third party for resale is not permitted without the instructor's express written consent. Violations to this and other course rules are subject to the Code of Academic Integrity and may result in course sanctions. Additionally, students who use D2L or UA e-mail to sell or buy these copyrighted materials are subject to Code of Conduct Violations for misuse of student e-mail addresses. This conduct may also constitute copyright infringement.

Submitting work for credit which is not your own is a violation of the Code of Academic Integrity and will be handled as such. Getting help for ideas/problems with which you are struggling is appropriate, recommended, and strongly encouraged. There is, however, a strong distinction between getting assistance to help **you** solve a problem, and simply mimicking or blatantly copying someone else's solution. No form of violation of the Code of Academic Integrity will be tolerated in this class, and any violation will result in a course grade of "E" for this class, with possible additional penalties, following the appropriate policies and procedures as described in the Code of Academic Integrity.

Other Relevant University Policies

More information on the polices listed below can be found at
https://academicaffairs.arizona.edu/syllabus-policies

- Absence and Class Participation
- Threatening Behavior Policy
- Accessibility and Accommodations
- Nondiscrimination and Anti-harassment Policy

Homework/Quizzes

Written homework assignments can be found by following the "Course Calendar/Homework Assignments" link from the course homepage. You will find a calendar view of the semester with links to the assignments, each in the form of a pdf file. You are expected to print the relevant assignment, and complete your work on those sheets, which will then be uploaded to Gradescope (gradescope.com or accessible from D2L).

On the course homepage, you will also find a link labeled "Suggested Problems". This is exactly what the name implies: these are problems which should be done for your benefit, but will not be collected. They should not be taken lightly; Even though you will not receive any direct credit for the recommended problems, doing them will pay dividends. You will find the required problems much more bearable if you have first done the recommended problems which will usually form a basis for the more difficult required ones.

The computer aided grading program called WebAssign will also be used for homework in this course. The due dates for WebAssign homework can also be found on the "Course Calendar" mentioned above. Course content and assignments in WebAssign can be accessed via D2L (d2l.arizona.edu).

There will be quizzes given approximately weekly throughout the term, which will also be administered via WebAssign. The quizzes will have a much shorter window of availability than normal WbAssign assignments, will be timed, and will have fewer submission attempts than an assignment.

Written Homework and Quizzes will combine to account for 100 (65/35) points in the course, and WebAssign assignments will account for 100 points. At the end of the course, roughly 10% of the lowest homework scores (including missing assignments) of each type will be dropped. Those subtotals will then be scaled to a score out of the appropriate number of points. The tentative plan is that you will have between 20 and 25 written homework assignments with 2 dropped scores, between 10 and 15 Quizzes, with 1 dropped score, and approximately 33 WebAssign assignments with 2 scores dropped.

Discussion of homework problems ("working together") is encouraged, but each student is required to write his/her OWN solutions. Students are advised to seek help whenever needed and are encouraged to ask questions during office hours and to use the free tutoring available.

Specific homework procedures, policies, and instructor pet peeves involving homework can be found in the section of this document titled *Specific Homework Policies, Procedures, etc.*.

The intent of the homework assignments is to give you some practice with the material and to provide an opportunity for feedback prior to taking an exam. You should treat all required and optional assignments and problems in this manner– it is a learning experience for you. Ultimately you are in this class to learn the material. It is a bad mistake to become overly (or only) concerned with receiving as many points as possible on each assignment. Obviously, everyone wants as many points as possible, but earning those points is best done as a consequence of **knowing the material**. It may sound overly cliché, but if you are only concerned with getting points by any means necessary (liberal use of "help" from other sources), you are ultimately only cheating yourself.

Midterm Exams

There will be three midterm exams. All exams are closed-book and closed-notes, and no calculators will be allowed on the exams. The exams are *tentatively* scheduled for Friday September 25, Friday October 30, and Thursday December 3. Each test will be worth 100 points. The exact dates of the midterm exams will be announced in class at least one week in advance and posted on the Course Calendar. Any questions regarding the grading of exams need to be cleared up within one week after the exam has been returned.

Midterm exams will be proctored, timed exams. The exams will be administered/disseminated via WebAssign though not all answers/solutions will be submitted in WebAssign. The majority of each midterm exam will consist of "free-response" questions for which each student is expected to write a complete solution which will be submitted for grading. At the completion of the exam, students will uploaded all written work to Gradescope for grading.

Midterm exams will be proctored via Zoom. Each student will be required to join the Zoom meeting on two devices, which are both capable of sharing video. For most students this will mean using both a laptop (or desktop) computer and a cell phone. Students will be required to share video (have the camera on) on at least one of the devices, and will be required to share their screen (privately, with only the instructor having access to the shared screen) on the other device.

More detailed information regarding exam procedures will discussed in the week prior to each exam.

Missed Exams

Students are expected to be present for all exams at the time scheduled. In general, there will be no make-up exams in this course. Make-up exams may be granted on a case-by-case basis, but such exceptions are at the discretion of the instructor. If a verifiable emergency arises which prevents you from taking an exam at the scheduled time, you must notify the instructor as soon as possible. If a student is allowed to make up a missed exam, (s)he must take it at a mutually arranged time. No further opportunities will be extended. Failure to contact me as stated above or inability to produce sufficient evidence of a real emergency will result in a grade of zero on the exam.

Final Exam

There is a comprehensive common final exam. The final exam is worth 150 points of your final course grade. As scheduled by the University (http://www.registrar.arizona.edu/schedules/finals.htm), the Final Exam is on **Tuesday December 15, 2020 .** The University's Exam regulations (https://www.registrar.arizona.edu/courses/final-examination-regulations-and-information) for final exam week will be strictly followed.

Information contained in the course syllabus, other than the grade and absence policy, may be subject to change with advance notice, as deemed appropriate by the instructor. In particular, the dates of midterm exams, the number of exams, and the order in which topics are covered may differ from the dates and arrangement in the tentative daily schedule.

Specific Homework Policies, Procedures, etc.

- Written homework is due by 6:00PM (MST) on the due date stated on the Course Calendar; No exceptions. Homework is to be submitted to Gradescope before that deadline. Homework which is emailed, submitted via D2L, or any means other than directly to Gradescope will not be accepted.
- Assignments must be submitted with spacing and formatting which matches the blank assignment found via the links in the Course Calendar. The simplest way to achieve the correct spacing is to print the blank template from the Course Calendar and submit your completed work on that template. Otherwise, when writing on blank paper you will need to make sure that the spacing matches the appropriate template.
- **Solutions** for each problem should be neatly written with all intermediate steps included. Written explanations should be included whenever appropriate. You need to show and explain all relevant work to earn full credit. A correct but unsupported answer will earn no credit.
- If your writing is illegible I will likely be unable to understand your solution and will be able to assign at most minimal credit. It is in your interest to write neatly.
- If your submitted PDF is of poor quality and cannot be read (is too light, blurry, etc), I will not be able to grade it and must assign a score of zero. It is a good idea to be in the habit of double-checking the readability your PDF after creating it.
- Answers should be clearly indicated (boxed, circled, highlighted, etc.).
- Notation is an important part of this class. Make sure you understand the notation and terminology and use them correctly. Incorrect use of notation is a common cause of lost points, so beware.
- Wherever practical, answers given should be exact (for example, $\sqrt{2}$ not 1.414), unless the problem asks you to estimate.
- If you have questions on the required or optional homework, do not hesitate to visit my office hours or email me. If you do email me, it is always helpful to include a description of what you have tried and what you are confused about. Questions such as "I am having trouble with number 7" are difficult to address directly.
- Do not use the paper you are going to turn in as scratch paper. Work you do not use may make your solution unclear and cause you to lose points. Instead, do the work on a separate sheet of paper and then carefully transcribe your **solution** onto the sheet you intend to turn in.
- You are expected to write **solutions** to problems. You are beyond the level where simply "getting the right answer" is the entirety of the goal. I strongly encourage you to look at the handout (which can be found on the course webpage) titled "How to Write a Solution" for examples of what is expected, and what is not acceptable.

Failure to meet these requirements and guidelines will result in a loss of points or may cause an assignment to not be accepted.