MWF 10:30-11:45AM, MD G115

Instructor: Sarah Iams
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Email: siams@seas.harvard.edu (I don't often check email after 8pm or on weekends, so please don't expect a response until the next day.)
Office hours: See Canvas. I'm available by appointment - just email me.
Course Team: Mary Agajanian, Johnny Berman, Eva Cai, Paul Nebres, Emily Venable, Zachary Zieper.

What will you gain from this course?
Learning goals:

- We will work to connect the multivariable framework to objects and phenomena in the world, furthering a quantitative viewpoint.
- This course will contribute to your knowledge of the discipline of mathematics, including your understanding of the power of mathematics.
- Learning to learn the material in the course will create an opportunity to develop new skills, as needed, to progress towards mastery of the material, and to engage in mathematical inquiry.

Learning objectives:
During the semester you will be learning how to

- identify, select, and apply relevant methods from the course given a problem related to the course material.
- describe concepts from the course using geometric ideas.
- express and solve problems using vector notation and vector operations.
- describe, approximate, and represent curves, functions and surfaces in 2- and 3-space, using graphs, cross-sections, level sets, and Taylor approximation when appropriate.
- identify the sensitivity of one or more quantities to change in the other quantities using partial derivatives, the directional derivative, the gradient, or the chain rule.
- apply methods of differentiation and integration to vector-valued functions and to functions of several variables.
- apply multivariable differentiation and integration to real-world problems (e.g. optimization, probability, flux).
- compute line integrals, surface integrals, circulation, flux, curl, and divergence.
- simplify calculations of flux and circulation using theorems of vector calculus (Greens, Divergence, Stokes).
- visualize functions and compute quantities using Matlab.
- communicate mathematical reasoning in an organized, clear, and detailed way.

Course Resources:

- Information about all of the materials related to the course, including this syllabus, can be accessed via the course **Canvas site**.
- The course **text** is Calculus: Multivariable by William McCallum, Deborah Hughes-Hallett, Andrew Gleason, et. al. (Calculus Consortium), Wiley 2013
  ISBN 9780470888674. (I'd suggest the 5th, 6th, or 7th edition.)

  The textbook is on reserve at Cabot Science Library (two copies, along with the student solutions manual). Call number QA303.2 .M85 2013 for the text; QA303 .H834 2013 for the solution manual.
- Our **discussion** board is on Piazza. Access is through Canvas. Piazza is for all of your questions related to the course - course material or logistics, problems with course resources, or whatever else comes up.
- **Online homework** is via WeBWorK. There is a link on the Canvas site. WeBWorK has a library of thousands of multivariable calculus questions and is able to offer you immediate feedback on your procedures. Questions about WeBWorK problems are welcome on Piazza and at Office Hours.
- Written **homework submission** involves the software Gradescope. Written assignments can be scanned and uploaded or completed digitally. Access Gradescope through Canvas. Feedback about your work on problem sets and exams will be available on Gradecope.
- We will use Matlab as computation and visualization **software**. Download and install the software for free from `http://downloads.fas.harvard.edu/download`, by following their instructions.
  For a reference, download the text Multivariable Calculus with Matlab by Ronald Lipsman and Jonathan Rosenberg, Springer 2017
  The text is available for free through the Harvard Library: `https://link-springer-com.ezp-prod1.hul.harvard.edu/book/10.1007%2F978-3-319-65070-8`

Class Expectations: The instructor (that's me) is expected to come to every class (I may have a sub for one) prepared to do mathematics. The instructor should bring the necessary materials for the day's activities and should be prepared to introduce the topics of the class by planning ahead of time.

The instructor is expected to be respectful and supportive of her students.

You'll be expected to come to class prepared to do mathematics, equipped with the materials you may need (pen, paper, pencil, phone). You should be prepared by completing assignments ahead of time.

You're expected to be respectful and supportive of your classmates and the instructor. This extends to the use of electronic devices in the classroom. Use them appropriately (to take notes, perform calculations, answer questions, etc). If you are using a laptop, please sit towards the rear of the room so that there are not other students behind you.

Grading Philosophy: Grades are a reflection of your communication of your understanding of the course material through the graded assignments of the course. They may be impacted by a range of factors not related to your understanding of the material. Grades are not a reflection of your self-worth or of the esteem in which I hold you.

Grading:

- Problem sets 15%
  (If you have an average of 85% across all problem sets and above 50% on each problem set you'll receive all 15%.)

- Quizzes 10%
  (Lowest score is dropped.)
- Exam 1 15%
  (Redo one problem after the exam for partial credit returned.)
- Exam 2 20 %
  (Redo one problem after the exam for partial credit returned.)
- Final 30 %
- Best of Quizzes / Exam 1 / Exam 2 / Final 5%
- Participation 5%
  (If you attend 85% of classes when you are not ill, attend either section, workshop, or office hours during 9 weeks of the course, and try out either section or workshop at least once you'll receive all 5%)

Problem Sets:

- **Philosophy**: Math (like many other skills) is mainly internalized by doing. Problems sets are an opportunity to learn. Start the problem set on your own, and then seek help from classmates, course staff, peer tutors, or from me.
- **Acknowledging sources:** Acknowledge where you received help from written sources (textbooks, web resources, solutions manuals), other people, or computational tools. This can be done by filling out the weekly log on Canvas associated with each problem set.
- **WeBWorK**: WeBWorK problems are often taken directly from our course text. Using WeBWorK makes it possible for you to have instant feedback about whether your procedures or understanding are correct. This can feel frustrating; post to Piazza, ask a classmate, or come by office hours after a couple of tries.
- **Gradescope**: Problems that are more involved or that require you to show or explain something will involve a write-up of your solution. Those write-ups are due at the same time as WeBWorK problems and should be submitted for feedback via Gradescope.
- **Due dates and late work:** Due dates will be posted on Canvas. On Gradescope, late work will be accepted for up to two days after the assignment has closed and will count as 95% of the score. For WeBWorK, extensions are more difficult to arrange, so late work is not accepted routinely. In the case of documented illness or a religious conflict, contact Emily to arrange a WeBWorK extension.

Quizzes: There will be a weekly quiz on Mondays, assigned via Canvas to be completed between 11:45am and 8pm. We have quizzes because the retrieval of information involved in taking a quiz is powerful for improving learning. Your lowest quiz grade will be dropped at the end of the semester.

Exams: There will be two evening exams (Tues Oct 16th and Nov 13th, 7-9pm) and a final exam scheduled by the Registrar.

Participation: In class you'll be asked to talk about math with your classmates, work in small groups, and answer mathematical questions via polls. Out of class you'll be asked to collaborate on problems,

explain your mathematical ideas, and coach classmates as they work on a problem where you've already made progress.

Extra help: Learning math is often frustrating, involving hard work and moments of doubt. There is no need to despair - most people experience this. There are ways to access more help:

- Ask classmates! Form a study group, or ask a classmate for help at office hours or workshop. Coaching you through a problem or collaborating on a problem cements their understanding even as it helps yours.
- Office hours - come to work on your assignments, meet your classmates, and benefit from the help of the course staff.
- Ask a member of the course staff during office hours or during your section.
- Attend section to benefit from additional worked examples and to get help from course staff.
- Attend workshop to learn from peers and to work on problems with easy access to help from course staff.
- Register for a peer tutor with the Bureau of Study Counsel.

Academic Integrity and Collaboration:

Collaborating with classmates in planning and designing solutions to homework problems is encouraged. Collaboration, cooperation, and consultation can all be productive. Work with others by discussing the problem, brainstorming, walking through possible solution strategies, and outlining solution methods.

Most of the assigned homework problems will be taken from the course textbook or similar resources. It is not acceptable to consult solutions to these problems (whether from an external resource or generated by a classmate) and treat those solutions as "collaborators".

- If you have worked together to construct a joint solution, put it away and work individually (without consulting the jointly developed work) to generate your own solution.
- It is consistent with the policy in this course to show work that you believe still has errors to other students or course staff, explaining your reasoning and ideas and asking for feedback.
- Once you believe your work to be correct, talk others through your ideas, and suggest techniques or procedures for others to try. Avoid showing other students your completed write-up, though, or working the problem for them.

Accessibility: If you have a disability for which you require accommodations, please make an appointment to see your instructor within the first two weeks of classes so that we can make appropriate arrangements. You will need documentation from the AEO. All discussions will remain confidential.

Inclusion: This class has participatory components, and different students bring different perspectives, experiences, and areas of expertise. Every voice in our classroom is important. We ask you to work to purposefully maintain a respectful environment during all interactions with your classmates.