

# SYLLABUS : MATH 1410 : Prof. Ghrist : Fall 2022

**PRESS START:** This is a course about multivariable calculus. It's one of my favorite things to teach & is, for many, the subject which makes all the math you learned thus far come alive. The course will be challenging but satisfying.

**YOUR GUIDE:** I'm Professor Ghrist, and I will be your guide on this journey.

What to call me: **prof/g** or **profg** or **prof. g.**, depending on how formal the occasion.

Where to find me: under normal times, **DRL 3E5B**.

How to contact me: [ghrist@math.upenn.edu](mailto:ghrist@math.upenn.edu) . I don't check canvas mail, due to the canvaspam.

How to follow me:

twitter: <http://www.twitter.com/robertghrist> (Links to an external site.)

instagram: <https://www.instagram.com/profghristmath/> (Links to an external site.)

youtube: [www.youtube.com/c/ProfGhristMath](http://www.youtube.com/c/ProfGhristMath) (Links to an external site.)

(*nota bene*: if you have a private account on tw/ig, i will assume you want privacy and i will not request to follow you back; if public, and if i recognize your name, i probably will follow out of politeness. and interest! i like seeing what my students are up to after the semester is over...)

Office hours by appointment: via <https://profghrist.youcanbook.me> (Links to an external site.)

Please use this, but responsibly -- do not reserve times unless you have something specific to discuss, as this prevents others from reserving that time. You are welcome and indeed encouraged to come in small groups.

**Who are you?** You are a hardworking student who, though having mastered (single variable calculus) urgently desires to know "WHAT COMES NEXT?!" Either that, or this is a required course. Or both maybe.

**How is this class different?** A few of you may have seen some multivariable calculus previously. What you saw was a watered-down Khan-academy-style version. We're going to do it right, with an emphasis on matrix algebra, high-dimensional settings, differential forms, and lots of applications, spanning neuroscience, robotics, navigation, systems, finance, game theory, statistics, machine learning, graphics, and more. The applications presented and the perspectives used are specifically crafted to give you foreshadowings of a broad set of ideas in modern applications.

**This class will be a challenge!** Not only is there a lot of work (lectures to watch, problems to do), the concepts will go very deep and will require time spent in deep contemplation. Many of you were raised in a mathematics environment that emphasized "brain-training" -- if you just do enough repetitions of basic problems, you train your neural network to do them automatically, without knowing why the rules work. Those days are over. Now is the time to learn like a human. That way is slow, difficult, and rewarding.

**What book do we use?** The Mathematics Department has switched to a video-text model, in order to save you \$\$\$, give you the flexibility of watching lectures when you like, and giving you the chance to pause/rewind. The videotext for this course was written/produced by me

over the period of 2015-2019, with a few more updates to come. Please see [www.youtube.com/c/ProfGhristMath/](http://www.youtube.com/c/ProfGhristMath/) and subscribe for the latest.

I have also written a set of optional e-books custom-designed to complement the videos (since it's hard to take notes from or study from a playlist). *These are not required at all* -- you'll be fine without them. However, they are available at a small cost for those who would find them helpful. There are four e-books, each covering one quarter of the class. These books are called *Calculus BLUE Multivariable* Volumes 1-4 and are available on Amazon. First comes [Calculus BLUE Multivariable Volume 1](#) on Vectors & Matrices. You will need to use Amazon's [free] Kindle app for your phone and/or laptop. (There is no Apple iBooks version -- I can't get Apple to match Kindle's use of bookmarks, ToCs, flash cards, highlighting, etc.). Unlike most math books, these are easy to read on small screens (but laptops are great too). The kindle app from amazon is free and works mostly-well on modern phones & laptops (though, not linux).

**YOU ARE IMPORTANT TO ME:** This is not merely my job, it is my vocation -- my calling. I want to be your guide, no matter who you are, where you come from, or how different from me or others you may think you are. For example, if you are not a native english speaker and you find my diction or mode of speech confusing, do not hesitate to ask me to repeat something I say. Or, let's say, if you are a FGLI student (1st-generation and/or low-income) or if you identify as LGBT+, please know that I am one of many many allies that you have on this campus, and I will strive to make my course a place where you have the freedom to learn unobstructed.

**Speaking of FGLI students.** As faculty co-director of the Penn First Plus program, I am eager to support you and to chat about any issues you might be dealing with. Please note that you are not required to purchase anything for this class. The videos are free. The e-books are helpful and inexpensive, but not needed -- most students prefer the videos to the e-texts.

**If you AP-ed out of MATH 104 or are trying to do retroactive credit, this class is doable, but dangerous.** Most of you have taken MATH 104, so you can skip this. If not, let me repeat: *you are at risk*, and you need to take this course very seriously from the beginning to make sure you succeed. High school AP courses do a great job at preparing you for the AP test, and that's about it. You need to understand differentiation, integration, and Taylor expansion at a deep, conceptual level to proceed. Being "good at math" will not suffice, so, *please be prepared*. There are some videos I made for 104 a long time ago: [go here for a list of videos](#). I recommend using the streaming player, so that you can speed-up the [slow] talking. An update to these (in the works) appear on my YT channel under the banner of "Calculus GREEN".

**How does this class work?** This is complicated, so read carefully.

- LECTURES: Following the instructions on this site (see the Modules), you will watch videos every week. I suggest doing this over the weekend or very early in the week.
- PREPQUIZ: Next, try looking at the 10 PrepQuiz problems for that week. You are permitted to discuss these with others, so long as you are collaborating actively, and not just sharing answers. Please, work together and help one another to learn. You get two submissions on these. The first should ideally be done before you go to ClassTime; the second should be done by the end of Thursday, as you are preparing for the Friday Quiz.

- **CLASSTIME:** Each week, there will be a 1-hour session with me on zoom during the standard lecture time. Half of you will come on Tuesday; the other half on Thursday. It will be assumed that you have watched the lectures, studied the material on your own or in groups, and worked through the PrepQuiz problems in small groups. We will spend ClassTime answering questions and working on deeper & sometimes much harder problems together, as a way of solidifying the material and resolving any questions. We might talk about how this week's material is used in applications & in later courses that you might take. That's fun.
- **RECITATION:** Your weekly recitation time with you TA will be similar to ClassTime (ask questions, do problems) but in a smaller setting, Most students find the recitation to be extremely helpful & valuable.
- **QUIZZES:** Instead of the former system of "2 midterms & a final", we have moved to a new system of weekly low-stakes quizzes. This will help you stay on-track and reduce anxiety. Most Fridays, you will take a 40-minute quiz covering material from this week and the previous.
- **REQUIZZES:** Once per month, you may take an optional quiz that covers material from the previous month. The score on the requiz will replace the lowest of your previous three scores (assuming it helps you; if not, no worries).
- **FINAL:** There will be a comprehensive final exam.

**THE PAST IS PAST:** In the past, calculus classes at Penn permitted a formula sheet during exams. This is no longer the case. There will be no formula sheets permitted during quizzes or finals. This means that you need to know certain important things from memory. For example, if you do not know the formula for the Taylor expansions for the exponential function or sine or cosine about zero, then you are not fully prepared for what is to come: please fix that now.

Other items that you may have read on the department website or other sources may be out of date. Please check with me if you have any questions.

**What's the grading policy?** No letter grades will be issued until the final course grade. Final percentages will be computed as follows:

PrepQuizzes	10%
Friday Quizzes	60%
Final exam	25%
Participation	5%

**Participation.** The participation grade can be earned in a few ways. The best is by coming to class and recitation, and being engaged. Are you an introvert? Me too! Don't worry, there are other ways to be engaged, including going to your TAs office hours, asking and answering questions on Piazza, and more.

**Time!** You should budget spending 12-15 hours per week on this class. This breaks down to: watching lectures (2), class-time and recitation (2), studying (3-6), prepquizzes (2) and review (3) in hours-per-week. This number may fluctuate.

**HELP!** Don't wait until you are drowning before daring to come to office hours or asking for help. If you can't make office hours, use the youcanbook.me site listed above. I and your TAs will try hard to accommodate your schedule.

**HELP HELP!** Life is hard. Penn is hard. Your profs understand, and we want to push you into success, not into distress. If you are having trouble dealing with things, please reach out to me. I have helped a lot of students in the past through lots of situations; if I can't help you, I'll find someone who can.

**Attendance is imperative.** Everyone misses a class now and then, but don't think that you can learn this material without coming to ClassTime and Recitation. *Every single week* will have a **lot** of often-challenging material: **don't ever skip**. If you do have a valid excuse for missing class, please use the university's course absence system so that it appears in my records. I know it's early in the morning, but I'll do my best to make it worth your time & energy.

**And the Legal Stuff:** The materials for this course -- including the texts, videos, and the homework problems -- are custom-designed by me at great care and expense. I maintain copyright and expect you to follow the law and respect that. If I find that you are posting content to course-sharing sites or otherwise disseminating copyrighted materials, I will exercise my legal rights.

**Academic Dishonesty:** There were significant issues with cheating in upper-division courses during the pandemic. Cheating is absolutely not tolerated in this class. You may be tempted -- that's okay, everybody is tempted. You may think that the odds of getting caught are low. Maybe yes, maybe no. You may think that cheating hurts nobody: that is wrong. *It hurts the honest students, and I will not allow that.* Know now that if you are caught engaging in academic dishonesty, you will be penalized to the maximum extent possible. If you cheat, you will fail in life, and you will fail this course.

**Summary:** I want you to succeed in this course and go on to rock your future classes as a calc star. The best way for this to happen is (1) you work like crazy to learn well, and (2) I work like crazy to teach well. I've got (2) covered, and I and my team are going to help you with (1).

**Smile:** Life can get hard -- but don't despair. There's much more to life than classes and grades.