

Math 3600 (Advanced Calculus)
Section 002, Fall 2023
1 Credit Hour

Instructor: Sarah Strikwerda

Office: David Rittenhouse Laboratory 4N63

Office Hours: Tuesday 3:15pm-4:15pm, Thursday 12:30pm-1:30pm

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Course Meeting: Tuesday and Thursday from 1:45pm-3:15pm in David Rittenhouse Laboratory 3N1H and a Recitation either on Monday or Wednesday from 7:00-9:00pm in David Rittenhouse Laboratory 4C4. The first Wednesday meeting will be September 6. The first Monday meeting will be September 11 and will be identical to the September 6 meeting. Every Monday meeting will be identical to the proceeding Wednesday meeting until after Thanksgiving when the Wednesday meetings will be identical to the proceeding Monday meetings.

Prerequisite: MATH 2400 (Calculus 3). I recommend taking MATH 2020 as a prerequisite or corequisite since this is a proofs based course.

Materials/book: Notes will be posted on the Canvas page. Free textbook: “Basic Analysis : Introduction to Real Analysis” by Jiří Lebl; available online for free at <https://www.jirka.org/ra/realanal.pdf>

Student Learning Objectives/Outcomes

We will focus most of our attention on constructing and critiquing mathematical arguments and proofs, communicating mathematics, developing mathematical conjectures, and mastering basic definitions, concepts, and mathematical results related to real numbers and calculus.

Below we provide more detail on what students are expected to be able to do by the end of the course.

By the end of MATH 3600, students should be able to write, read and understand mathematical arguments related to calculus. Arguments will be done directly or using contradiction or the Principle of Mathematical Induction. Students should be able to think through the ideas needed to come up with proofs and critique arguments. More specifically students should learn the following:

1. Understand basic logical statements ($P \Rightarrow Q$)
2. Prove statements using the Principle of Mathematical Induction
3. Understand set notations and basics of set theory
4. Know basic properties of the real numbers and where they come from
5. Show if sets are finite, countably infinite, or uncountable

6. Prove if a sequence converges or is divergent
7. Prove properties of limits of sequences
8. Know Bolzano-Weierstrass Theorem and prove related results
9. Prove properties of the \limsup and \liminf of sequences
10. Prove if a sequence is convergent or divergent
11. Prove common series tests learned in Calc II
12. Know Riemann's Rearrangement Theorem
13. Be able to prove if a given function is continuous or discontinuous
14. Prove the Intermediate Value Theorem and Extreme Value Theorem
15. Prove properties of derivatives with the limit definition
16. Prove Fermat's Theorem, Rolle's Theorem, Mean Value Theorem, Inverse Function Theorem, and Taylor's Theorem
17. Find and prove at what x-values a given power series converges
18. Determine if a sequence of functions pointwise/uniformly converges to f
19. Prove basic properties of integrals
20. Understand the Fundamental Theorem of Calculus and its proof
21. Prove u-substitution and integration by parts
22. Know how uniform convergence of function sequences impacts limits of function integrals and derivatives
23. Know how trigonometric, exponential, and logarithmic functions are defined and prove basic properties of them

Course Structure and Rules of Engagement: In class, we will review concepts from the previous class, discuss new topics, and participate in group work. These sessions should be beneficial for all class members. If you understand the concepts, your understanding can be deepened by guiding your classmates to a deeper understanding. We will strive to be open with each other when concepts are confusing and refrain from being condescending. You will be expected to persevere when the problems are challenging. There will be times when you are asked to critique the ideas and arguments of others. While it is OK to disagree with those ideas and arguments, it is not OK to make personal attacks.

Outside of class, you will be expected to review notes, work through homework problems, and post to the discussion part of the Canvas page.

Homework: There will be a homework assignment in Canvas for each week. I will add problems until Thursday at 5pm. The homework will then be due the following Tuesday at 1pm and will be turned in via Gradescope.

You may discuss homework problems with your classmates. You should not be looking up problems on the internet as this takes away from your learning. However, in order for you to learn how to communicate mathematical ideas, I expect that you write up your final solutions on your own. Turning in homework assignments that you did not write up independently will be an academic integrity violation which I will report to The Center for Community Standards and Accountability.

Tests: There will be two tests taken during class throughout the semester and a 2 hour written final exam that will be scheduled by the University:

Test 1: Thursday, October 5

Test 2: Thursday, November 9

The tests and exam will be closed book. You are not permitted to use notes or resources of any kind. You are not permitted to communicate in any way with anyone other than me during the test. Failure to follow these rules is an academic integrity violation that I will report to The Center for Community Standards and Accountability.

If you cannot make it to one of the exams, you must communicate this to me before the test begins with enough time for me to respond. Failure to do so, may result in a zero on the test.

Emails: You may email me or our TA. I prefer if quick questions are asked before or after class rather than emailed to me. If you will be sending me an email to ask for help on a homework problem, please include everything you have tried so far or thoughts you have had. You can expect a response from me within 24 hours of sending the email (or 48 if you send it over the weekend). Please consider this policy when thinking about when you will complete your homework assignments. I will try not to send out many emails. However, there will be times when an announcement needs to be made and this will be the way that I communicate with you.

Project: At the end of the semester there are various topics that would be interesting to study. However, we do not have time for all of them. You will be able to select one that you would like to explore on your own to do a project on. You will submit a project proposal between November 9 and November 17. The project will be due on December 1.

Class Forum: Our Canvas page has a Discussions tab. Throughout the semester you will be required to start a discussion or participate in other discussions. To receive full credit, you will be expected to post 2 times throughout the semester plus an additional time for each class you are absent.

Grading:

1. Homework Assignments	30%
2. Two Hourly Exams (17.5% each)	35%
3. Final Exam	25%
4. Class Participation	5%
a) Forum	
b) In class, group work	
5. Project	5%

Important Notes:

1. Your lower test score will be averaged with your final exam grade if your final exam grade is higher.
2. On your homework assignments and tests, you must always justify your answers and write in complete sentences.

Grading Scale: I will use the following grading scale:

$97 \leq A+ \leq 100$, $93 \leq A < 97$, $90 \leq A- < 93$, $87 \leq B+ < 90$, $83 \leq B < 87$, $80 \leq B- < 83$, $77 \leq C+ < 80$, $73 \leq C < 77$, $70 \leq C- < 73$, $67 \leq D+ < 70$, $65 \leq D < 67$, $F < 65$.

Note that this will not change, thus there is no reason to compete with your fellow students in this class.

S/U Grading: If you are registered for the S/U grading option, you will need to complete the course and receive at least a C- to pass the course.

Incomplete Grades: I am willing to assign an incomplete grade in appropriate circumstances. Please let me know if this is something you would like to discuss. More information can be found: <https://www.college.upenn.edu/incompletes>

Attendance Policy: You are expected to attend all classes on time. However, I understand that situations may come up in which you are unable to attend class. In these situations, you are required to post one additional time to the discussions tab on Canvas. Late assignments and make-up work will only be allowed for excused absences unless otherwise stated.

Academic Integrity/Honesty: Students are required to follow the Code of Academic Integrity:

<https://catalog.upenn.edu/pennbook/code-of-academic-integrity/>

Violations of academic integrity will be reported to The Center for Community Standards and Accountability

Digital Course Components: In this course we will use Email, Poll Everywhere and Canvas. You can find assistance here: <https://www.isc.upenn.edu/student-services>. Please let me know if this causes you stress in any way.

Students may be required to disclose personally identifiable information to other students in the course, via electronic tools like email or web-postings, where relevant to the course. Examples include online discussions of class topics and posting of student coursework. All students are expected to respect the privacy of each other by not sharing or using such information outside the course.

Please be advised this course may at times be recorded for current and potential future educational purposes. By your continued participation in this course, you are providing your permission to be recorded.

Diversity, Equity, and Inclusion: Diversity, equity, and inclusion are important to the success of students. Every student, every faculty member, and every staff member who comes to the University of Pennsylvania enriches us through their varied perspectives, knowledge, and backgrounds. Our classroom is one in which every student is respected and feels heard.

To affirm and respect the identities of transgender students in the classroom and beyond, please contact me if I use incorrect pronouns or names when referring to you.

I recognize that each student has their own unique experiences which are all different from my own. I want to affirm and listen to your experiences and to the experiences of all my students if you would like to share them with me. I hope to create a learning environment

where all of my students feel safe and listened to, and I will do what I can to advocate for your needs.

I welcome any additional suggestions you have for making our classroom more welcoming and inclusive.

Weingarten Center: The Weingarten Center offers a variety of resources to support all Penn students in reaching their academic goals. All services are free and confidential. **To contact the Weingarten Center, call 215-573-9235.** The office is located in Stouffer Commons, 3702 Spruce Street, Suite 300.

Academic Support: Learning consultations and learning strategies workshops support students in developing more efficient and effective study skills and learning strategies. Learning specialists work with undergraduate, graduate, and professional students to address time and project management, academic reading and writing, note-taking, problem-solving, exam preparation, test-taking, self-regulation, and flexibility.

Undergraduates can also take advantage of free on-campus tutoring for many Penn courses in both drop-in and weekly contract formats. Tutoring may be individual or in small groups. Tutors will assist with applying course information, understanding key concepts, and developing course-specific strategies. Tutoring support is available throughout the term but is best accessed early in the semester.

Disability Services: The University of Pennsylvania is committed to the accessibility of its programs and services. Students with a disability or medical condition can request reasonable accommodations through the Weingarten Center website. Disability Services determines accommodations on an individualized basis through an interactive process, including a meeting with the student and a review of their disability documentation. Students who have approved accommodations are encouraged to notify their faculty members and share their accommodation letters at the start of each semester. Students can contact Disability Services by calling 215-573-9235.

Find more information here:

<https://weingartencenter.universitylife.upenn.edu/academic-accommodations/>

Student Health and Wellness: You have many resources to use through Wellness@Penn. Don't let these go to waste! You can find more information here: <https://wellness.upenn.edu/>. One resource is counseling. I have utilized counseling services during my education and have found them useful. You can make an appointment by calling 215-746-9355 24/7. You can also drop by unannounced at 3624 Market Street during business hours.