APM 503: Applied Analysis

Arizona State University, School of Mathematical and Statistical Sciences
Fall 2026

Course Information

Instructor	Jimmie Adriazola
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Office	GWC 651
Office Hours	Tuesdays 1PM-2PM, Wednesdays 10AM-11AM
Class Meeting	Tuesday and Thursday, 10:30–11:45 AM, Wexler Hall A306

Course Description

Convergence of sequences and series of functions; metric space topology, compactness, completeness and the Ascoli-Arzela Theorem; Contraction Mapping Principle, Implicit Function Theorem; intro to Lebesgue integration leading to L^p spaces; properties of Hilbert spaces, Fourier transform.

This is a first graduate course in applied analysis. The goal is to equip you with the mathematical foundations you'll need to study more advanced topics such as partial differential equations, probability theory, optimization, numerical analysis, and scientific machine learning. We review real analysis basics, develop a proper theory of integration, and then turn to the function spaces and their duals that come up repeatedly in applications. The focus is on how to use these tools and when they apply, while still working through proofs carefully enough to see why they work.

Textbooks

The course is built around the three following textbooks:

- Pugh, *Real Mathematical Analysis*, E-book is $20.
- Hunter and Nachtergaele, *Applied Analysis*. free PDF online from the author.
- Lieb and Loss, *Analysis*, second edition, available at the Library, or for purchase.

For further reference: Folland, *Real Analysis: Modern Techniques and Their Applications*.

Weekly Schedule (subject to slight change)

Week	Reading	Topics
1	Pugh Ch. 1	Review of advanced calculus. Real numbers and completeness, sequences and series of functions, convergence.
2	Pugh Ch. 2	Metric spaces, completeness, compactness. Heine-Borel and Bolzano-Weierstrass theorems.
3	Pugh Ch. 4–5	Arzela-Ascoli, Stone-Weierstrass, Banach fixed point theorem, implicit and inverse function theorems.
4	Pugh Ch. 6	Outer measures, measurable functions, and σ-algebras
5	Pugh Ch. 6, Lieb-Loss Ch. 1	Lebesgue measure and Lebesgue integration
6	Lieb-Loss Ch. 1	Monotone and Dominated Convergence Theorems, Fatou's Lemma, the Fubini-Tonelli Theorem
7	Lieb-Loss Ch. 2	L^p spaces. Hölder, Minkowski, and Jensen inequalities.
8	Lieb-Loss Ch. 2	Completeness of L^p, midterm.
9	Lieb-Loss Ch. 2	Duality between L^p and L^q, Riesz representation in L^p, weak convergence in L^p.
10	Lieb-Loss Ch. 2	Convolution on L^p, density of C_c^∞ in L^p.
11	Hunter Ch. 6	Abstract inner-product spaces and Hilbert space basics
12	Hunter Ch. 6	Orthonormal bases, Bessel and Parseval, Fourier series on $L^2([0, 2\pi])$, Riesz representation on Hilbert space.
13	Hunter Ch. 11	Schwartz space $\mathcal{S}(\mathbb{R}^n)$, tempered distributions $\mathcal{S}'(\mathbb{R}^n)$, distributional calculus.
14	Hunter Ch. 11, Lieb-Loss Ch. 5	Fourier transform on Schwartz space, basic identities, the inversion theorem.
15	Hunter Ch. 11, Lieb-Loss Ch. 5	Plancherel's theorem and the extension to L^2, Fourier transform of tempered distributions, applications.

Assessment

Attendance/Class Participation	10%	Will be noted at the start/end of every lecture.
Problem sets	30%	Lowest scoring problem set will be dropped.
In-class midterm	35%	During week 8, covers Weeks 1-7
Take-home final	25%	Distributed the last week of class.

Letter grades follow the standard scale: A is 90 and above, B is 80–89, C is 70–79, below 70 is insufficient for graduate credit. Pluses and minuses are assigned within equal thirds of each 10 point band. Please note that attendance can make or break your grade.

Problem Sets

You may discuss problems with classmates but must write up solutions independently; list anyone you worked with at top, that includes Claude, Gemini, Chat GPT, etc. LaTeX is preferred, neatly hand written is still great. Plan for six to ten hours per week on problem sets and readings.

Communication

Email is the fastest way to reach me; I aim to reply within a business day. Substantive math questions are better in office hours than over email. If my office hours don't work for you, email me and we will find another time.

Summer Preparation

If you want to get ahead before the semester starts, please email me and I will steer you in the right direction. A more detailed reading guide will go out in late July, but for now, read Pugh.

Accessibility

If you have a disability or condition that affects your access to the course, please contact ASU Student Accessibility and Inclusive Learning Services and let me know early in the semester. Accommodations work best when arranged before assignments are due. If something about the course format makes the material harder for you to access, please tell me.

Academic Integrity

The ASU Academic Integrity Policy applies to this course:
(https://provost.asu.edu/academic-integrity).

Discussing problem-set ideas with classmates is encouraged; copying written solutions is not. Searching the internet and *responsible* and *ethical* use of Generative AI are allowed, but you must *own* your written solutions. The midterm exam is a substantial portion of your grade, so be mindful of that while working on your homework.

Mental Health

If you are struggling, ASU Counseling Services is at https://eoss.asu.edu/counseling. Although I hope you never need it, the 988 Suicide and Crisis Lifeline is available 24 hours a day just in case. If you are having a hard semester, talk to me; I can usually adjust deadlines or point you to other resources on campus.