USC University of Southern California

Math 425b Syllabus
Fundamental Concepts of Analysis
Lecture 39647R (Leslie)

COURSE INFORMATION AT-A-GLANCE

Math 425b: Fundamental Concepts of Analysis (4.0 Units), Spring 2022

Prerequisite(s): Math 425a

Required Textbook: Instructor-provided notes (updated throughout the semester). Additional recommended textbooks are listed in a section below.

Meeting Times/Location: (See below for additional details.)

- *First two weeks (January 10–21).* Lecture videos will be pre-recorded and posted to YouTube. Instructor will meet with each student individually for 10–12 minutes during the scheduled lecture hour, 9:00am–9:50am.
- *Week 3 through semester end.* Class meetings are 9:00am–9:50am MWF, in person, Taper Hall (THH) room 213.

Instructor: Trevor Leslie, lesliet@usc.edu. Assistant Professor (RTPC) of Mathematics.
Office Hours: 10–11am Mondays and Wednesdays, and by appointment. (Subject to change.)

TA: Ying Tan, yingtan@usc.edu.

Exam Dates

Midterm Exam #1: Wednesday, February 16, during class.
Midterm Exam #2: Friday, April 1, during class.
Final Exam: Friday, May 6, 8am–10am.

The dates and modality of exams is subject to change, according to pandemic-related disruptions and other unforeseen extreme circumstances; barring such circumstances, however, these dates and times should be considered finalized.

COURSE FORMAT AND INSTRUCTIONAL MODE

As of January 7, the University has announced that course meetings for the first two weeks of the semester will run virtually. During these first two weeks, the instructor will record and post lecture videos on YouTube, in an unlisted channel, the URL for which will be available on Blackboard. These videos will have good audio-visual quality. The scheduled lecture hour will be used to hold 10–12-minute individual appointments with each student in the class.

Assuming there are no further changes to the university-mandated instructional mode, the course will run **in person, starting week 3** (January 24). Barring technical difficulties, these in-person lectures will also be recorded (using university-provided equipment) and available on Blackboard. However, students are discouraged from relying on these recordings as a substitute for attending class: the video quality is often not good enough to clearly capture the writing on the board.

Though the plan is to return to in-person instruction starting week 3, we are of course in the middle of a global pandemic. Therefore, the instructional mode is subject to change according to university directives and instructor health. In the event that the university again postpones the return to in-person instruction,

the course will most likely be run via synchronous (live) Zoom meetings starting week 3, until in-person instruction returns.

Attendance and Participation

In-person attendance is strongly recommended, *provided* that you are not sick, that you have no symptoms of any illness, and that you do not have a medical reason to be absent. Attendance on any given day is *not required*; however, if your attendance over the course of the semester is so sparse that I don't know who you are by the end of the semester, I reserve the right to impose a small grade penalty (A to A–, B– to C+, etc.).

Online Participation

USC has installed audio-visual equipment in the lecture room, which I will use to attempt to accommodate students who are not in attendance on a given lecture day. The instructor-provided lecture notes are also available for this purpose. Please be aware that the technology is subject to problems, including, but not limited to the following:

- The camera's resolution is such that it takes some effort to read the board, regardless of how far it is zoomed in or out.
- The camera occasionally freezes and stops recording.

I cannot be responsible for the malfunctioning of the equipment; there is a real possibility that some lecture content may not be available online.

You can access and participate in the Zoom lectures by clicking on 'USC Zoom Pro Meeting' in the left navigation pane on Blackboard. More detailed instructions, including meeting ID's and passcodes, will be provided in a separate document, which will be updated from week to week.

Note on weeks 1 and 2: The lecture videos I will provide during the first two weeks of class will be recorded with my own equipment, on my own board. I can guarantee that the video and audio quality will be satisfactory for these videos. However, my equipment is not compatible with the lecture-hall setup and therefore will not be used once in-person instruction resumes.

Other Online Components

- Blackboard. Lecture notes and Zoom meeting links will be available through Blackboard. Blackboard access is available through `my.usc.edu`.
- Gradescope. You will submit homework assignments through Gradescope. You will receive an email notification when I add you to the Gradescope roster for this course.
- Campuswire. We will use Campuswire as a discussion board for questions on homework. You will be sent an email invitation to join the Campuswire roster.

Lecture Notes and Recommended Supplemental Textbooks

The course 'textbook' for the semester is a set of lecture notes, written by the instructor. They are posted to Blackboard under 'Content' and will be updated weekly. Not everything in the lecture notes will be covered during lecture, but the material that is covered in lecture will follow a presentation that is extremely similar to the lecture notes. Some sections of the lecture notes will be assigned for required reading and not covered during class. Other sections will be recommended for supplemental reading, but not required. All homework problems will be found in the 'Lecture Notes' document.

Though by no means required, students who desire an alternate perspective on the course material may wish to consult one or more of the following textbooks.

- Walter Rudin, *Principles of Mathematical Analysis* (3rd ed.)
- Charles Pugh, *Real Mathematical Analysis* (2nd ed.)
- Andrew Browder, *Mathematical Analysis: An Introduction*
- Elias Stein and Rami Shakarchi, *Fourier Analysis: An Introduction*
- Michael Spivak, *Calculus on Manifolds*

See the 'Preface' section of the lecture notes for more details.

COURSE CONTENT

In Math 425a, the first half of this course sequence, you learned tools necessary for putting the theory of single-variable calculus on rigorous footing, and some context for these tools. This process involved a lot of topological concepts that might not have been previously familiar. This semester, in Math 425b, our primary (but not exclusive) focus will be on the theorems of multivariable calculus. To do this correctly, we'll need tools not only from topology, but also from linear algebra.

A tentative list of topics to be covered is as follows. Some topics (especially the ones near the middle of the list) may be omitted if time is short.

- Power Series and Special Functions
- Improper Riemann Integration
- Convex Functions and Related Inequalities
- Vector Spaces
  - Equivalence of Norms on a Finite-Dimensional Vector Space
  - Function Space Norms
- Convolutions and Approximate Identities
- The Stone–Weierstrass Theorem
- Inner Product Spaces and Best Approximation
- Basics of Fourier Series
  - Mean-Square Convergence of Fourier Series
  - Pointwise Convergence of Fourier Series
- Linear Transformations
- The Derivative as a Linear Transformation
- Multiple Integration: Fubini's Theorem, Change of Variables
- Differential Forms
- Stokes' Theorem

ASSIGNMENTS AND ASSESSMENTS

Written Homework (30% of total grade): Roughly one assignment per week will be assigned and submitted via Gradescope. Your lowest written homework grade will be dropped automatically. A list of assigned problems and a very detailed list of homework policies and procedures can be found in the document titled 'Homework', posted to Blackboard under the 'Content' tab.

Exams (70% of total grade): Two midterm exams (20% each) will be administered in class. The final exam (30%) will be administered per the university's final exam schedule. See page 1 of this syllabus for the dates.

There will be a small amount of extra credit available on each exam, in the following manner: The total points available will exceed 100, but the exam will be scored out of 100. For instance, if the problem sub-scores total to 105, and you earn an 85/105, your exam score will be recorded as 85% rather than $85/105 \approx 81\%$.

The final examination will be comprehensive, covering all topics presented in the course. Some extra emphasis will be placed on the material covered after the second midterm. Make-up exams will be allowed only under exceptional circumstances and will be dealt with on a case-by-case basis.

Final Project (Optional) (Up to 15% of total grade). A student who wishes their final grade to be determined by a formula that is less exam-heavy has the option of completing a final project. This consists of the following:

- A typed report on some topic related to the course content (but not covered in class), and
- An oral presentation of highlights from their report, presented to the instructor at an agreed-upon time.

The length of each of these items will vary on a case-by-case basis, but a typical report will be on the order of 5–10 typed pages, and a typical oral presentation will last 30–45 minutes. (This is for a project worth 15% of the final grade. A student may choose to complete a project of a smaller scale, but worth a smaller percentage of their final grade.)

Students wishing to take advantage of this option should contact the instructor as early as possible in the semester to talk about possible topics of interest. A student who completes a final project may decide how much of their grade they wish to be determined by the project, and which exam or exam(s) they wish to apply the project to. For example, a student who does poorly on Exam 2 but completes a final project can choose to have their Exam 2 score count for only 5% of their total grade, the remaining 15% being displaced by the final project.

Grade Cutoffs

The end-of-semester grade cutoffs will tentatively be determined using the following table. The instructor reserves the right to change these cutoffs in your favor. The student may be interested to know that the anticipated median grade in the course is a B+.

		B+	84.00–87.99	C+	63.00–67.99	D+	40.00–49.99	
A	≥ 92.00	B	74.00–83.99	C	54.00–62.99	D	30.00–39.99	F <20.00
A–	88.00–92.99	B–	68.00–73.99	C–	50.00–53.99	D–	20.00–29.99	

Grading Disputes

If you feel an assignment or assessment has been mis-graded, bring it to the attention of your TA and myself within two days of when it is returned to you. The appropriate person will re-grade the entire assignment or assessment—not just the problem in question. Therefore the overall score may go up or down. Grading grievances aired more than two days after they are returned may not be re-graded.

ADDITIONAL COURSE POLICIES

- DSP approved students should inform the instructor at the beginning of the semester for any requested accommodation.
- Work-related travel must be scheduled outside of the mid-term and final examinations periods. Accommodation to take exams on different dates will be made only for family emergencies, religious observance and documented illness or health-related emergencies.
- Final grades will depend entirely on course performance as outlined above. Financial support requirements (e.g., minimum grade requirement for tuition reimbursement) cannot and will not be taken into consideration.

STATEMENT ON ACADEMIC CONDUCT AND SUPPORT SYSTEMS

The information below applies university-wide and is available at
`https://dornsife.usc.edu/ase/statement-on-academic-conduct-and-support-systems/`

Academic Conduct

Plagiarism—presenting someone else's ideas as your own, either verbatim or recast in your own words—is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in SCampus in Part B, Section 11, "Behavior Violating University Standards" policy.usc.edu/scampus-part-b. Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on scientific misconduct, `https://policy.usc.edu/scientific-misconduct`.

Support Systems

Counseling and Mental Health: (213) 740-9355, 24/7 on call.
`https://studenthealth.usc.edu/counseling`.

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

National Suicide Prevention Lifeline: 1(800) 273-8255, 24/7 on call.
`https://suicidepreventionlifeline.org`.
Free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week.

Relationship and Sexual Violence Prevention Services (RSVP): (213) 740-9355(WELL) (press "0" after hours), 24/7 on call.
`https://studenthealth.usc.edu/sexual-assault`.
Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

Office of Equity and Diversity (OED): (213) 740-5086 / Title IX: (213) 821-8298.
`https://equity.usc.edu`, `https://titleix.usc.edu`.
Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.

Reporting Incidents of Bias or Harassment: (213) 740-5086 or (213) 821-8298.
`usc-advocate.symplicity.com/care_report`
Avenue to report incidents of bias, hate crimes, and microaggressions to the Office of Equity and Diversity /Title IX for appropriate investigation, supportive measures, and response.

The Office of Disability Services and Programs: (213) 740-0776.
`https://dsp.usc.edu`
Support and accommodations for students with disabilities. Services include assistance in providing readers/notetakers/interpreters, special accommodations for test taking needs, assistance with architectural barriers, assistive technology, and support for individual needs.

USC Campus Support and Intervention: (213) 821-4710.
`https://campussupport.usc.edu`
Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

Diversity at USC: (213) 740-2101.
`https://diversity.usc.edu`
Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

USC Emergency. UPC: (213) 740-4321, HSC: (323) 442-1000. 24/7 on call
`https://dps.usc.edu`, `https://emergency.usc.edu`
Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

USC Department of Public Safety. UPC: (213) 740-6000, HSC: (323) 442-120. 24/7 on call
`https://dps.usc.edu`
Non-emergency assistance or information.

Office of the Ombuds. (213) 821-9556 (UPC) / (323) 442-0382 (HSC)
`https://ombuds.usc.edu`
A safe and confidential place to share your USC-related issues with a University Ombuds who will work with you to explore options or paths to manage your concern.