

Syllabus

MATH 105A – Real Analysis
Summer 2023 • MWF: 9:30 – 10:45 AM

Instructor: Deewang Bhamidipati

(Please address me by my first name, pronounced [thee-waang](#) (or see NameCoach on Canvas). Pronouns: he/him/his.)

Lectures: The lectures will be **synchronous** and will take place on Zoom (so will Office Hours). Lectures **will be recorded** and will be available for asynchronous viewing on Yuja via Canvas. You're highly encouraged to attend the lectures synchronously, or office hours if you can't attend lectures synchronously.

Office Hours: Wednesdays and Fridays, 11:00 AM - 12:30 PM

(This is when you come and talk to me if you have any questions, or otherwise.)

Teaching Assistant: John McHugh

TA's Office Hours: Mondays, 12:00 - 3:00 PM

Canvas: I will be using Canvas primarily as a course repository. It will also be a place where you will receive course announcements, access homework etc.

(Log in at <https://canvas.ucsc.edu> using your CruzID and Gold password.)

Ed Discussion: We will be using Ed Discussion as a discussion forum for anything and everything course related. It will be checked frequently and unresolved questions will be answered. You're highly encouraged to collaborate with each other and answer each other's questions; engaging in such discussions amongst yourselves is an incredibly invaluable part of succeeding in this course. You can access it by navigating to it from the Canvas menu on the left on our Canvas course page.

Gradescope: Any assessment (see below) that needs to be turned in will have to be uploaded to Gradescope; links and more details will be available on Canvas.

Learning Outcomes:

- You will be able to write clearly, concisely, and precisely; this is a writing-intensive course.
- You will develop a healthy respect for the importance of definitions.
- You will understand the structure and importance of theorems.
- You will understand the structure and importance of proofs.
- You will be able to abstract appropriately.

References: Lectures will be self-contained, they will largely be based on the following books. You are **not** expected to buy copies of these books. We will largely follow the excellent text *Real Analysis: A Long-Form Mathematics Textbook* by Jay Cummings (main reference), which can be bought [here](#).

Here are some other books that would be worthy additions to your library:

- ▷ *Understanding Analysis* by Stephen Abbott (available digitally [HERE!](#))
- ▷ *How to Think About Analysis* by Lara Alcock (can be bought [HERE!](#))
- ▷ *Principles of Mathematical Analysis* by Walter Rudin
- ▷ *The Way of Analysis, Revised Edition* by Robert S. Strichartz

Assessment Distribution:

- HOMEWORKS (60%)

There will be 8 weekly problem sets, they will be weighted as in the second row. Also indicated are the weeks they are due in, the lectures they cover, and the acceptable formats. A random subset of the assigned problems in the Homeworks will be graded for credit.

HWs	HW 1	HW 2	HW 3	HW 4	HW 5	HW 6	HW 7	HW 8	HW 9
Weight	5%	5.5%	6%	6.5%	7%	7.5%	8%	8.5%	6%
Due	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10
Covers	1 – 3	4 – 6	7 – 9	10 – 12	13 – 15	16 – 18	19 – 21	22 – 24	25 – 27
Format	Written	Written	Written	Written	L ^A T _E X	L ^A T _E X	L ^A T _E X	L ^A T _E X	L ^A T _E X

You are expected to turn in your HWs using L^AT_EX (see below). I will accept (scanned) written work for the first four HWs, but only T_EX-ed HWs will be accepted starting HW 5.

- WORKSHEETS (20%)

There will be two long-form worksheets. Each worksheet will have a single theme and all problems will be related to it; furthermore, it will focus on L^AT_EX. You will have two weeks each to work on it, Weeks 3 – 5 and 8 – 10 respectively.

- PROOF PORTFOLIO (20%)

You will maintain a proof portfolio. It will consist of two parts: four carefully written and edited proofs, they must be typed in L^AT_EX, and a roughly page-long essay on what you have learned in the course and role that proofs play in mathematics. More details will be available on Canvas. A preliminary draft will be due in Week 5, while the final portfolio is due by end of the quarter.

- EXTRA CREDIT (5%)

You can earn this by completing surveys on Canvas, participation on Ed Discussion, extra credit problems and class participation (which includes attending office hours).

Grading Scale: Passing grade is C or above.

A+	≥ 95%	B+	80 – 84%	C+	65 – 69%	D	40 – 54%
A	85 – 94%	B	70 – 79%	C	55 – 64%	F	< 40%

L^AT_EX: L^AT_EX (LAH-tekh or LAY-tekh) is the preferred choice among mathematicians for creating mathematical documents. You will need to learn basic L^AT_EX for and during this course. This will likely be done by looking at the .tex (tekh, the L^AT_EX file extension) files that I provide you, mimicking the L^AT_EX in them, and heading to [TeX Stack Exchange](#) for anything that is not included in them. Most of you will be able to pick up the basics very easily. You can start this journey by using [Papeeria](#) or [Overleaf](#), both online L^AT_EX editors. **Please contact me if this is not a viable option for you for any reason**, and, of course, if you need help getting started.

Course Schedule: Find below a tentative list of topics that will be covered each week.

- Week 1.** (week of Jun. 26th) *rules of quantifiers, basic set theory, countable and uncountable sets, power sets, cardinality*
- Week 2.** (week of Jul. 3rd) *rational numbers, (axioms of) ordered fields, completeness axiom, real numbers, sup and inf, the Archimedean principle*
- Week 3.** (week of Jul. 10th) *sequences, bounded, convergent and divergent sequences, limit laws, monotone convergence theorem, subsequences, Bolzano-Weierstrass theorem, the Cauchy criterion*
- Week 4.** (week of Jul. 17th) *sequence of partial sums, series, series convergence tests, absolute convergence, rearrangements*
- Week 5.** (week of Jul. 24th) *topology of reals, open sets, closed sets, open covers, compact sets and Heini-Borel theorem*
- Week 6.** (week of Jul. 31st) *limits of functions and limit laws, continuity, topological continuity, essential discontinuity, jumping discontinuity, removable discontinuity*
- Week 7.** (week of Aug. 7th) *extreme value theorem, intermediate value theorem, uniform continuity*
- Week 8.** (week of Aug. 14th) *the derivative, affine approximations, tangent line, continuity and differentiability, differentiability rules, (local) maximum and minimum*
- Week 9.** (week of Aug. 21st) *mean value theorem, calculus of differentiability, L'Hôpital's rule*
- Week 10.** (week of Aug. 28th) *applications, second order derivatives, higher order derivatives and Taylor's theorem*

Guidelines:

- HOMEWORKS (AND OTHER ASSIGNMENTS)
 - ▷ Please turn in the homework on the due date.

Extension Policy. If you need an extension, please ask, but make sure you ask before the due date. You can ask for, and will be awarded when asked, at most a two day extension.
 - ▷ Discuss the homework with your peers on Ed Discussion. (I insist on this.)
 - ▷ Write your work, **individually**, using \LaTeX .
 - ▷ Pay close attention to the presentation and clarity of your reasoning in your answers.
 - ▷ Cite resources you have used while solving the homework.
 - ▷ Name your peers with whom you have discussed the homework.
 - ▷ Only a portion of the problems will be graded, chosen at the grader's discretion.
- COMMUNICATION
 - ▷ Please contact me primarily via Canvas, especially if the topic is of a sensitive or personal nature. If your question is math-related, please ask it on Ed Discussion directly or anonymously.
 - ▷ Please make sure you give me as much information as you possibly can about the subject you intend to discuss when you contact me.

- ▷ You are more than welcome to contact me at any time, you will get a response from me promptly between 8 AM - 7 PM, Monday to Saturday.
- ▷ You can send me an email (at bdeewang@ucsc.edu) if, and only if, your attempts at contacting me on Canvas have yielded no response from me.
- ▷ **Never hesitate to reach out, I always want to hear from you.**

practice, discuss, ask

practice problems

discuss problems with your peers

ask me questions; more importantly: ask *follow-up* questions

SUBSEQUENT ADDENDUMS, IF ANY, TO ABOVE WILL BE MADE VIA CANVAS.
I RESERVE THE RIGHT TO CHANGE ANY PARTICULAR OF THE SYLLABUS ABOVE.
(ANY CHANGES WILL BE TO YOUR ADVANTAGE, AND YOU WILL BE INFORMED OF THEM PROMPTLY VIA CANVAS.)

Other Important Information

Summer Deadlines:

- (Session 1) Drop: **Monday, July 3**; Request for "W": **Sunday, July 16**;
- (Session 2) Drop: **Monday, August 7**; Request for "W": **Sunday, August 20**;
- (8-Week & 10-Week) Drop: **Monday, July 10**; Request for "W": **Sunday, July 30**.

Land Acknowledgement: The land on which we gather is the unceded territory of the Awaswas-speaking Uypi Tribe. The Amah Mutsun Tribal Band, comprised of the descendants of indigenous people taken to missions Santa Cruz and San Juan Bautista during Spanish colonization of the Central Coast, is today working hard to restore traditional stewardship practices on these lands and heal from historical trauma.

DRC (Remote) Accommodations: The Disability Resources Center (DRC) reduces barriers to inclusion and full participation for students with disabilities by providing support to individually determine reasonable academic accommodations. Operations continue via remote appointments. If you have questions or concerns about exam accommodations or any other disability-related matter, email the DRC Schedulers at drc@ucsc.edu for an appointment; you can also visit their website at <http://drc.ucsc.edu>.

CAPS (Counseling and Psychological Services): This is a stressful time, so if you are in distress,

managing heightened stress and anxiety, or want to get more support and a counselor's perspective on something you're going through, CAPS provides a variety of services for your needs, please visit their website for more information <https://caps.ucsc.edu>.

Title IX: The university cherishes the free and open exchange of ideas and enlargement of knowledge. To maintain this freedom and openness requires objectivity, mutual trust, and confidence; it requires the absence of coercion, intimidation, or exploitation. The principal responsibility for maintaining these conditions must rest upon those members of the university community who exercise most authority and leadership: faculty, managers, and supervisors.

The university has therefore instituted a number of measures designed to protect its community from sex discrimination, sexual harassment, sexual violence, and other related prohibited conduct. [Information about the Title IX Office](#), the [online reporting link](#), applicable campus resources, reporting responsibilities, the [UC Policy on Sexual Violence and Sexual Harassment](#), and the UC Santa Cruz Procedures for Reporting and Responding to Reports of Sexual Violence and Sexual Harassment can be found at titleix.ucsc.edu.

The Title IX Office is actively responding to reports and requests for consultation. If you are not currently working with someone in the office and want to make a report/request a consult, you can expect the fastest response by using our [online reporting link](#). For more information please visit the [Title IX Operations under Covid-19](#) page.

Report an Incident of Hate or Bias: UC Santa Cruz is committed to maintaining an objective, civil, diverse and supportive community, free of coercion, bias, hate, intimidation, dehumanization or exploitation. The Hate/Bias Response Team is a group of administrators who support and guide students seeking assistance in determining how to handle a bias incident involving another student, a staff member, or a faculty member. To report an incident of hate or bias, please use the [Hate/Bias Reporting Form](#).

Religious Accommodations: UC Santa Cruz welcomes diversity of religious beliefs and practices, recognizing the contributions differing experiences and viewpoints can bring to the community. There may be times when an academic requirement conflicts with religious observances and practices. If that happens, students may request the reasonable accommodation for religious practices. The instructor will review the situation in an effort to provide a reasonable accommodation without penalty. You should first discuss the conflict and your requested accommodation with your instructor early in the term. You or your instructor may also seek assistance from the Dean of Students office.

Small Group Tutoring: Small Group Tutoring (SGT) supports students academically to advance educational equity by designing inclusive learning environments outside of the classroom. In SGT, you can expect the Tutor to facilitate cooperative group activities designed to have students work together on the course content and develop study skills for the course, please visit their website for more information <https://lss.ucsc.edu>.

Academic Integrity: Academic integrity is the cornerstone of a university education. Academic dishonesty diminishes the university as an institution and all members of the university community. It tarnishes the value of a UCSC degree. All members of the UCSC community have an explicit responsibility to foster an environment of trust, honesty, fairness, respect, and responsibility. All members of the university community are expected to present as their original work only that which is truly their own. All members of the community are expected to report observed instances of cheating, plagiarism, and other forms of academic dishonesty in order to ensure that the

integrity of scholarship is valued and preserved at UCSC. For the full policy and disciplinary procedures on academic dishonesty, students and instructors should refer to the [Academic Integrity page](#) at the Division of Undergraduate Education.