Fall 2023 MATH 4300-02 (class # 82742): Real Analysis[1]

Community Agreement[2]. This course aims to offer a joyful, meaningful, and empowering experience to **every** participant; we will build that rich experience together by devoting our strongest available effort to the class. You will be challenged and supported. Please be prepared to take an active, critical, patient, and generous role in your own learning and that of your classmates.

Lectures: TRF 10:30AM - 11:45AM in JB-385 (Please note that classes in the first week for 8/24, 8/25, and 8/29 will be held asynchronously but with rewards available if you meet with your team in-person during our class time at our classroom, see Canvas for detail instruction and assignments due)

Instructor: Dr. Min-Lin Lo
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Student Hours: TBD (check Canvas course site for details)

Prerequisite: Semester Prerequisite: MATH 2320 and MATH 3100. Quarter Prerequisite: MATH 252 and MATH 355.

Administrative Drop: Students who **fail to attend two consecutive class meetings during the first four weeks** of the term without contacting the faculty member or making special arrangements may be dropped. Students in on-line or hybrid classes who **fail to contact the instructor either in person or electronically (via e-mail) within the first four days of the start of the term** may also be dropped during the first four weeks of the term. Please review add/drop policy in CSUSB bulletin.

Textbook: In this course, you will write most of the text! Classes will be conducted from packets of "research guide" you will receive (available from our course web site) containing problems to solve and theorems to prove.

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[1] This syllabus may be modified in order to better meet your needs and progress. Notification of any changes will be made in class as well as through the Canvas Announcements page and/or the Canvas email feature. You are responsible for monitoring all announcements. It is your responsibility to know all of the information contained in the syllabus and in the University bulletin.

[2] Community agreement written by (or adapted from) Federico Ardila–Mantilla, Todxs cuentan: building community and welcoming humanity from the first day of class.

Reference Texts: I understand how insecure you might feel without a textbook, so here is one that you may use to help you understand the material in addition to our course notes:

- *Introductory Real Analysis* (ISBN: 0-395-95933-0), by Dangello and Seyfried.

The main purpose of the reference book is for you to understand definitions that are involved in a statement that you are trying to prove or a problem that you are trying to solve. However, you are **not allowed to look into the proofs of theorems**, and I encourage you to use paper to cover the proofs in your book to limit the temptation to "cheat". Of course, searching online or other real analysis book for terms/definitions (only) you are confused on and reading them will help too!

Content: In this course, we will DISCOVER: Properties of the set of real numbers and foundations of calculus: Equivalence relations, functions, cardinality, convergence of sequences and series of real numbers, topology of the real line, continuity, and differentiation. Emphasis on rigorous proof and mathematical communication. Professional mathematical typesetting and visualization technology. Formerly MATH 553 and part of MATH 355; students may not earn credit for both MATH 553 and MATH 4300. We might not be able to cover as many sections as in a regular lecture class do, but the **important thing for me is to teach you the ability to learn by yourself**, not just rushing to cover lots of sections.

Overview of Class: This course will be conducted in Inquiry Based Learning (IBL) style:
Try to understand the theorem or problem that you are trying to prove or solve via

- Research and understanding of the definitions of all related terms;
- Creation of examples and diagrams; and
- Construction of conjectures.

This course will be YOU-oriented. You will be asked to create solutions to problems and prove theorems. You will have the opportunity to present results to others and provide thoughtful feedback on the work of others. I would like each student to feel comfortable sharing ideas and learning from mistakes. With this aim, it is important that we all commit to fostering an inclusive, respectful, and professional learning environment. Learning from each other will form a substantial part of the classroom experience as you engage in cooperative work with your classmates, as well as sharing ideas in whole class discussions.

To have meaningful discussion in class, it is important to be prepared for each class by working on assigned pages from the research guide for each class. During classes, I will randomly call on students to present problems assigned or answer questions. During student presentations/teaching sessions, the rest of the class is encouraged to ask questions, and to think critically about the solution presented by the classmate. The class is responsible for determining the validity of arguments presented, and I will occasionally allow incorrect solutions to stand in class. These incorrectly presented problems might appear on tests. See Presentation Rubrics and Guidelines in our Canvas Modules.

Like a mathematician, you will also learn to work with your peers and be required to present your solutions by professionally typesetting your work with LaTeX, giving oral presentations, and possibly doing a poster presentation. You also get to **be a professor for a day**!! You get to teach some part of a section using my notes and design the lecture notes for a section that you will be teaching and possibly get to create some homework or test problems😊 An important objective of the course is for you to develop your creative and critical mathematical skills; the dynamics of classroom interaction are thus crucial. You are expected to actively participate in every class. **30% of your course grade will be based on your participation, preparation for class, quality of your presentations, and the level of**

engagement with class activities. I will take attendance daily to be used as part of your participation score. Persistent tardiness and early departures will count as absences.

Common questions I will ask you during Q&A sessions:
"What's the definition of this?" "Can you give me an alternative definition?" "Can you give me an example (or non-example)?" I gave you an example and ask you if it satisfies some properties and why, "Can you draw a picture to help me visualize it"? I give you a statement and ask you if it is true or false and why, etc.

No Textbook Rule: In this class, you will do mathematics the way mathematicians do, discovering theorems and proving them. This means that sometimes you will be stuck. This is OK! When this happens, it is important to talk to your MATH 4300 classmates and to me to help you refresh your perspective on problems that seem intractable. I look forward to coaching each of you and helping you develop strong proof skills. However, **you are not to discuss any problems with anyone other than your classmates (and me), and you are not to investigate any resources (except for definitions) from outside the class such as the proofs in our reference text, other textbooks, other professors, or the internet.**

Student Learning Outcomes (SLO): This course is designed to support the Mathematics Department undergraduate program learning goals, namely, that by completing the program you will build the following proficiencies: (1) Demonstrate a conceptual understanding of mathematics; (2) Attain procedural fluency in mathematics; (3) Demonstrate adaptive reasoning and problem-solving skills in mathematics; (4) Demonstrate mathematical communication skills; and (5) Understand and produce correct mathematical proofs. In particular, Math 4300 will emphasize and assess the following learning outcomes:

1.1 – Demonstrate an understanding of fundamental concepts, algorithms, operations, and relations
2.1 – Correctly apply mathematical theorems, properties, and definitions
3.3 – Critique mathematical reasoning, both correct and flawed
4.1 – Demonstrate mathematical communication skills using appropriate mathematical vocabulary and references
5.1 – Understand valid mathematical proofs
5.2 – Produce valid mathematical proofs

A complete list of SLOs and department student learning goals can be found on the Math Department webpage at Assessment | Department of Mathematics.

Assignments:

Assignments, both in and out of class, will be designed to provide you with the opportunity to learn key concepts in a meaningful way, develop your ability to communicate mathematics precisely and professionally, and help guide you through the learning process. In addressing the student learning outcomes, the goals of homework assignments are to improve the development of valid reasoning skills and the development of mathematical communication skills.

In order to help you pace your learning, homework will be assigned regularly and will consist of learning new concepts following instruction, solving problems and explaining the work presented, as well as typing assignments in LaTeX. Homework problems will be assessed based on mathematical

reasoning, conceptual understanding, communication, explanation, and justification. Homework that is suspected to be plagiarized will earn 0 points (see section on Plagiarism and Cheating).

All submitted assignments (including quizzes and exam solutions) must be professionally presented and follow the policy below:

- Solutions to problems may be handwritten or typed in LeTeX, unless otherwise instructed. The write-up of your assignment must be neat, organized, use appropriate language, and show relevant work. Explanations must be clear and complete.
- You should solve and explain problems clearly, with nothing left to the imagination. Justify each step completely, making sure the structure of your solution is crystal clear!
- Do not cram work into the bottom of a page or in the margins, and do not write in columns. Problems should be written in numerical order.
- Late assignment submission will not be accepted without PRIOR permission.
- All LaTeX assignments must be in formal writing that following the writing guidelines you learned in MATH 3100.
- I encourage you to discuss problems and share mathematical ideas with your peers. I understand that collaborative work may lead to use of similar strategies and ideas. This is fine as long as your final product is written up independently in a way that demonstrates your own thinking. If you use ideas of someone else, remember to give credit and cite your source. Professional always give credit where it is due using footnotes, bibliographies, references, and acknowledgements. (Please see "Intellectual Honesty" on the syllabus.)
  As a general rule, it's best to avoid sharing your final product with another student. Identical or nearly identical assignments that do not include citations will be considered plagiarism and will not be accepted. Identical work with acknowledgements may divide up a single homework score between those who submitted it. Of course, you are not allowed to work with your peers or using any resources during tests!

Quizzes: To lower your stress level so that you can focus on deep learning and have fun learning, I have replaced two midterm exams with lots of lower-stakes quizzes. Total of six quizzes will be given. To offer you some flexibility, you **can drop one lowest quiz score**. **Make-up quiz is not allowed**.

Final Exam: (The following rules also applies for quizzes, except the bonus question part)

► You are required to know the concepts covered in the lectures, not just the types of problems covered in class. Therefore doing homework will help in measuring your understanding.

► I might ask you to state certain theorems and definitions as well. Grading will be focus on your understanding (how well/thorough you show your work and how correct is your work), not just on the final answer. Therefore, partial credits will be given. There will be a bonus question for you to earn up to 5 bonus points☺

► The final exam will be comprehensive and the format will be announced at least one week before the exam date-Tuesday, December 12, 2023 from 10:30AM to 12:30PM.

Grading Policy:

- **NO "make-up" quiz or final exam.**
- There will be opportunities to obtain bonus points in class and exam, and by attending certain math events (will be specified in Canvas course site). The **max.** total number of bonus points you can earn for our class is **20 bonus points**.
- **NO CALCULATORS** will be allowed during quizzes or final exam.
- Actively participate in each class will **increase your chance** of getting a higher grade☺ we do this because face-to-face collaboration is crucial for our problem-solving activities.
- Since actively participate in class is an essential part of the course, **for each class you miss, your grade will be diminished by 1% of your final grade (i.e., 5 points)**. (unless prior permission and plan to make-up absence is approved)
- If you fail to present at least once, the highest grade you can get for this course is C.

Grade Breakdown:

6 in-class *Quizzes* (pick the best 5× 40 points)	→	200 points
Final Exam	→	100 points
Assignments (mostly LaTeX assignments)	→	50 points
Participation/Preparation before each class/Presentation	→	150 points
Total		500 points maximum

i.e., Grading Weights: Quizzes 40%, Final Exam 20%, Assignments 10%, Participation/Preparation before each class/Presentation 30%

A	445-500	**A-**	435-444	**B+**	426-434	**B**	390-425	**B-**	381-389	**C+**	371-380
C	335-370	**C-**	312-334	**D+**	291-311	**D**	270-290	**D-**	250-269	**F**	0-249

In order to pass this course, you must achieve an overall score of **65% or better on the final exam**, and get **at least a D** according to the above grading scale.

Intellectual Honesty:
Using the internet or looking in the back of the book to find solutions can easily lead to, perhaps unintentional, cases of plagiarism. It may seem that you are learning how to do assigned homework when you use the internet and/or book solutions; however, this practice is very strongly discouraged

since this approach often gives a false illusion of learning. How will I know if you are struggling with a problem if the work presented originated from someone else? Furthermore, this kind of "learning" does not translate well to exams or being able to apply the content in future classes.

Have faith in yourself. Some homework problems are intended to be challenging. Know that the problems are chosen with your skillset in mind. True learning occurs when you engage in a productive struggle with a problem and discover how to make use of the problem-solving tools you have developed during your studies. The only way to learn concepts deeply is to work thoughtfully and engage your brain. Did you know that when we learn a new idea, an electric current fire in our brains, crossing synapses and connecting different areas of the brain? (From Jo Boaler – *Mathematical Mindsets*) You are growing your brain when you struggle with new ideas.

Plagiarism and Cheating:

Plagiarism and cheating will be dealt with as harshly as University regulations permit including expulsion. Identical, or nearly identical solutions will result in all parties involved receive zero point for the whole test or assignment and the incident will be reported to the university. Any act that is suspicious of academic dishonesty will be reported. You have the right to make your case in front of the Judicial Affairs Officer. Once you cheat or plagiarize in any way, you will obtain **F** automatically for your course grade and noted in your academic record.

Support for Student with Disabilities:

If you need an accommodation for a disability in order to participate in this class, please contact Services to Students with Disabilities (SSD) via go to the SSD website. You can also contact SSD by phone at 909.537.5238 or by email at ssd@csusb.edu.

Statement of Diversity, Inclusion, and Equity:

I firmly believe in *Federico Ardila-Mantilla*'s axioms, and use them as guiding principles in this course's design. It is my intent that students from all diverse backgrounds and perspectives be well served by this course, that students' learning needs be addressed both in and out of class, and that the diversity that students bring to this class be viewed as a resource, strength, and benefit. I encourage you to read and think about each:

Axiom 1: Mathematical talent is distributed equally among different groups, irrespective of geographic, demographic, and economic boundaries.

Axiom 2: Everyone can have joyful, meaningful, and empowering mathematical experiences.

Axiom 3: Mathematics is a powerful, malleable tool that can be shaped and used differently by various communities to serve their needs.

Axiom 4: Every student deserves to be treated with dignity and respect.

How to Do Well in this Course: This is a very difficult course. We cover a lot of material quickly. You are expected to understand it really well, and **you will be required to do new proofs on the quizzes and exam**. You should plan on spending a minimum of 10 hours a week in preparation/homework.

Come to class and actively participate in class! Come visit me during student hours! Read the textbook (except proofs)! Try the problems! Smile! Discuss homework problems with your classmates! Study hard! Read your class notes! Make sure you keep up with the material in class! Don't Panic! Enjoy! Most important of all, if you feel that you are falling behind, or that you do not understand a certain topic, or if you would just like to discuss a mathematical idea (or anything else), come to visit me in my virtual office. That's why I am here! ☺

Real Analysis!

Just follow my lead

Fall 2023 MATH 4300-02 All assessment dates are tentative.

Tuesday	Thursday	Friday
	8/24 First Class, asynchronous class, see Canvas for detail instruction and assignments	8/25 asynchronous class, see Canvas for detail instruction and assignments
8/29 asynchronous class, see Canvas for detail instruction and assignments	8/31	9/01
9/05	9/07	9/08 **Quiz #1**
9/12	9/14	9/15
9/19	9/21 CENSUS (Last day to drop classes via MyCoyote)	9/22 **Quiz #2**
9/26	9/28	9/29
10/03	10/05	10/06 **Quiz #3**
10/10	10/12	10/13
10/17	10/19	10/20 **Quiz #4**
10/24	10/26	10/27
10/31	11/02	11/03 **Quiz #5**
11/07	11/09	11/10 Veterans Day. (no classes, offices closed)
11/14	11/16	11/17 **Quiz #6**
11/21	11/23 Happy Thanksgiving!! (no classes)	11/24 Thanksgiving Break (no classes)
11/28	11/30	12/01
12/05	12/07	12/08 Last Class