MATH 3210-003 Foundations of Analysis, Fall 2023

Class Meetings: Lecture: MTuWF 10:45-11:35 am in JTB 320
Instructor: Dr. James Cameron
Email: cameron@math.utah.edu
Office Hours: To be announced
Text: *Foundations of Analysis*, by Joseph Taylor
For information on purchasing the textbook, go to `https://www.math.utah.edu/resources/bookinfo.php`

Course Information: Math 3210 Foundations of Analysis is a 4 credit course. We will cover the first six chapters of our textbook.
Course Description: We will rigorously study single variable calculus. We will introduce/recollect basic logic, sets, and functions. Then we will study an axiomatic approach to natural numbers and construct and describe the integers, rational numbers, and real numbers. We will study sequences and their limits, and continuous functions. We will study differentiation and integration, and will finish the course by examining infinite series. The focus will be on creating concise, correct, and readable proofs, as well as on understanding definitions and others' proofs.

Canvas: Canvas will be used for posting course announcements, homework assignments, grades, files and any relevant supplementary material. You can access the Canvas page through CIS or by logging in at utah.instructure.com. Students should check the Canvas page regularly for course information and resources. Email notifications and correspondence will be sent to the student's UMail address ([u-number]@utah.edu); this email account must be checked regularly.
Grading: The following are the grade components and the percentage each contributes to a student's final grade:

- **Homework Assignments (25%)**- Homework problems will be due most Fridays. Some problems will be graded for completion and some will be graded for correctness. You will turn in homework assignments via gradescope. I will drop the lowest two assignments. You are welcome to work on the homework together, but your work must be your own and you must write up your assignments yourself.
- **Classwork and Participation (5 %)**- There will be weekly opportunites to work on the material in class in groups. This grade will be based on effort and participation.
- **Midterm Exams (45%, 15% each)**- Three 50-minute midterm exams will be given on select Fridays. A practice exam will be posted a week prior to the midterm that will cover the same material. The exams dates are: September 15th, October 20th, and November 17th.
- **Final Exam (25%)**- A two-hour comprehensive exam will be given. As with the midterms, a practice final will be posted a week prior. Our final exam is scheduled for Friday December 15th from 10:30-12:30 am in LCB 215.

Students with university excused absences (band, debate, student government, intercollegiate athletics) should make alternate arrangements with me as soon as possible if the absence interferes with any course components.

The point of dropping two assignments is in case an emergency or illness prevents you from doing the assignment. If this happens to you more than two times please get in touch with me as soon as possible. Late or early exams are not guaranteed. If you unexpectedly miss an exam because of illness or some other unavoidable circumstance get in touch with me as soon possible. If you are unable to take an exam because of some well documented emergency (that you inform me about in a timely manner) I will count the corresponding part of the final in lieu of your exam. This almost always works to your disadvantage so make sure that you take the exams.

Final course letter grades will be determined as follows, where the number is the raw percentage weighted as listed above:

- A: 88 and above
- A-: 85-88
- B+: 82-85
- B: 73-82
- B-: 70-73
- C+: 68-70
- C: 62-68
- C-: 60-62
- D+: 58-60
- D: 52-58
- D-: 50-62
- E: below 50

I might modify this grading scheme depending on how the class performs. I will not raise these cutoffs, but I may lower them.

Additional Resources

- **Tutoring Center & Computer Lab**- There is free tutoring in the T. Benny Rushing Mathematics Student Center (room 155, the lower level between JWB and LCB), as well as a computer lab. For more information see `https://www.math.utah.edu/undergraduate/mathcenter.php`
- **Private Tutoring**- ASUU Tutoring Center, 330 SSB. There is also a list of tutors at the math department office JWB 233.
- **Departmental Videos**- The math department has a full set of lecture videos which you are welcome to use to supplement our course material. These can be found at `http://www.math.utah.edu/lectures/`

Expected Learning Outcomes: Upon successful completion of this course, a student should be able to:

1. Understand definitions, write proofs, and be increasingly fluent in the language of mathematics.
2. Students will know the axioms for the natural numbers and understand proofs by induction, and how to construct the integers and rational numbers from the natural numbers. Students should also know how to construct the real numbers in terms of Dedekind cuts, as well as an axiomatic characterization of real numbers.
3. Students will be the axioms for an ordered field, how to prove properties about arithmetic in ordered fields, and the definition of complete and Archimedean ordered fields.
4. Students will be able to compute and prove properties about $\sup, \inf, \limsup$ and $\liminf$.
5. Students will know the definition of the limit of a sequence, will be able to prove that various sequences either do or do not converge, and prove basic theorems about sequences. Students will also know the definition of a Cauchy sequence, and how to prove that a sequence is convergent if and only if it is Cauchy.

6. Students will know the "epsilon delta" definition of continuity and be able to prove statements using this definition. Students will understand the intermediate value theire and the extreme value theorem, and how to apply these theorems. Students will also understand uniform continuity, and how to prove that a function is or is not uniformly continuous.

7. Students will learn the definition of the derivative and how to prove that functions are or are not differentiable. They will be able to prove and use theorems about differentiable functions such as the mean value theorem.

8. Students will understand the construction of the definite integral of a function, they will be able to compute definite integrals using this definition, and will also understand the proof of the fundamental theorem of calculus. Students will also learn the construction of the logarithm using integration.

9. Students will understand the definition of the convergence of an infinite series, and will be able to prove that sequences do or do not converge. They will also understand and be able to use Taylor's theorem on approximating a function via its derivative. They will understand the difference between uniform and conditional convergence, and will be able to determine the radius of convergence of a power series.

COVID Statement: The COVID-19 guidelines for the University of Utah are adapted often due to the ever-changing status of the pandemic. For the most up-to-date information regarding the campus guidelines, visit `https://coronavirus.utah.edu`.

Student Responsibilities: All students are expected to maintain professional behavior in the classroom setting, according to the Student Code, spelled out in the Student Handbook. Students have specific rights in the classroom as detailed in Article III of the Code. The Code also specifies proscribed conduct (Article XI) that involves cheating on tests, plagiarism, and/or collusion, as well as fraud, theft, etc. Students should read the Code carefully and know they are responsible for the content. According to Faculty Rules and Regulations, it is the faculty responsibility to enforce responsible classroom behaviors, and I will do so, beginning with verbal warnings and progressing to dismissal from and class and a failing grade. Students have the right to appeal such action to the Student Behavior Committee. `http://regulations.utah.edu/academics/6-400.php`

ADA Statement: The University of Utah seeks to provide equal access to its programs, services and activities for people with disabilities. If you will need accommodations in the class, reasonable prior notice needs to be given to the Center for Disability & Access, 162 Olpin Union Building, 801-581-5020. CDA will work with you and the instructor to make arrangements for accommodations. All written information in this course can be made available in alternative format with prior notification to the Center for Disability & Access.

Addressing Sexual Misconduct: Title IX makes it clear that violence and harassment based on sex and gender (which Includes sexual orientation and gender identity/expression) is a civil rights offense subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, color, religion, age, status as a person with a disability, veteran status or genetic information. If you or someone you know has been harassed or assaulted, you are encouraged to report it to the Title IX Coordinator in the Office of Equal Opportunity and Affirmative Action, 135 Park Building, 801-581-8365, or the Office of the Dean of Students, 270 Union Building, 801-581-7066. For support and confidential consultation, contact the Center for Student Wellness, 426 SSB, 801-581-7776. To report to the police, contact the Department of Public Safety, 801-585-2677(COPS).

Student Names and Personal Pronouns: Class rosters are provided to the instructor with the student's legal name as well as "Preferred first name" (if previously entered by you in the Student Profile section of your CIS account). While CIS refers to this as merely a preference, I will honor you by referring to you with the name and pronoun that feels best for you in class, on papers, exams, group projects, etc. Please advise me of any name or pronoun changes (and update CIS) so I can help create a learning environment in which you, your name, and your pronoun will be respected. If you need assistance getting your preferred name on your UIDcard, please visit the LGBT Resource Center Room 409 in the Olpin Union Building, or email

bpeacock@sa.utah.edu to schedule a time to drop by. The LGBT Resource Center hours are M-F 8am-5pm, and 8am-6pm on Tuesdays.

Wellness Statement:. Personal concerns such as stress, anxiety, relationship difficulties, depression, cross-cultural differences, etc., can interfere with a student's ability to succeed and thrive at the University of Utah. For helpful resources contact the Center for Student Wellness at `www.wellness.utah.edu` or 801-581-7776.

Safety Statement: The University of Utah values the safety of all campus community members. To report suspicious activity or to request a courtesy escort, call campus police at 801-585-COPS (801-585-2677). You will receive important emergency alerts and safety messages regarding campus safety via text message. For more information regarding safety and to view available training resources, including helpful videos, visit `safeu.utah.edu`.

University Counseling Center The University Counseling Center (UCC) provides developmental, preventive, and therapeutic services and programs that promote the intellectual, emotional, cultural, and social development of University of Utah students. They advocate a philosophy of acceptance, compassion, and support for those they serve, as well as for each other. They aspire to respect cultural, individual and role differences as they continually work toward creating a safe and affirming climate for individuals of all ages, cultures, ethnicities, genders, gender identities, languages, mental and physical abilities, national origins, races, religions, sexual orientations, sizes and socioeconomic statuses.

Office of the Dean of Students The Office of the Dean of Students is dedicated to being a resource to students through support, advocacy, involvement, and accountability. It serves as a support for students facing challenges to their success as students, and assists with the interpretation of University policy and regulations. Please consider reaching out to the Office of Dean of Students for any questions, issues and concerns. 200 South Central Campus Dr., Suite 270. Monday-Friday 8 am-5 pm.

Student Success Advocates: The mission of Student Success Advocates is to support students in making the most of their University of Utah experience (ssa.utah.edu). They can assist with mentoring, resources, etc. Any student who faces challenges securing their food or housing and believes this may affect their performance in the course is urged to contact a Student Success Advocate for support `https://asuu.utah.edu/displaced-students`.

Course Roadmap: Below is a rough outline of the chapters covered in this course. The schedule is subject to change (except for dates of exams) and will not be updated. If you miss class you are responsible for finding out what was covered and learning that material yourself.

Weeks 1-4 Chapter One and Beginning of Chapter 2. Exam One on Friday September 15th.

Weeks 5-6 Chapter Two.

Week 7-10 Chapter Three. Exam 2 on Friday October 20th

Weeks 11-14 Chapters 4-5. Exam 3 on Friday November 17th.

Week 15-17 Chapter 6.

Week 18 Final Exam Friday December 15th from 10:30am-12:30pm.