MAT 441: Real Analysis

Fall 2024

Instructor:	Jared McBride	**Time:**	MWF 9:00 – 9:50
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"We could compare learning to . . . the way a pianist prepares for a concert. A pianist cannot cram his knowledge of music and his playing skill into one week or even one month of solid practice to prepare for a concert. But he prepares himself through consistent diligent practice, day by day over a long period of time."

—Joseph B. Wirthlin
(*Finding Peace in Our Lives*, p. 75)

Student Hours: Student hours are just office hours with a better name. They are held at these times:

MWF 1:00 PM – 3:00 PM, Tuesday 7:30 **PM** – 9:00 **PM**, Thursday 7:30 **AM** – 9:00 **AM**,

or by appointment. Student hours will be held in my office or the Magnolia Conference room (right next to my office), which I have reserved for these times. Usually during these times I will be in the conference room (109 Magnolia Hall). If I am not, I will likely be in my office (next door to the conference room). Please, feel free to come and study. No appointment is necessary. If you wish to discuss something privately, it likely would be better for you to make an appointment for some time other than student hours. However, you are welcome to try your luck and come to student hours and see if I can meet with you privately then.

My tentative weekly schedule is as follows, but is subject to change:

Time	Monday	Tuesday	Wednesday	Thursday	Friday
7:00 AM				Student Hours	
8:00 AM				Student Hours	
9:00 AM	MAT 441	MAT 221	MAT 441	MAT 221	MAT 441
10:00 AM	MAT 343		MAT 343		MAT 343
11:00 AM	MAT 221		MAT 221		
12:00 PM		MAT 221		MAT 221	
1:00 PM	Student Hours		Student Hours		Student Hours
2:00 PM	Student Hours		Student Hours		Student Hours
3:00 PM					
4:00 PM					
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7:00 PM		Student Hours			
8:00 PM		Student Hours			

Course Purpose: The purpose of this course is to teach you how to do mathematical analysis. You will gain a strong ability to think critically and produce highly technical arguments (which we call rigorous proofs). You will learn to reason in world of the infinite. This is certainly one of the most cognitively demanding courses on campus.

You will practice learning an assimilating concepts and vocabulary in a very short amount of time.

You will learn to write in a very precise and concise manner.

You will learn to think abstractly and creatively within the constraints of the abstraction.

These and more cognitive skills are the main outcome of this course for most of you. A significant byproduct will be an expert level mastery of the theory of calculus.

Text Books: We will be using *Understanding Analysis 2e* by Stephan Abbott.

Required Materials:

- A one-year subscription to XYZHomework.com is required to complete toughlove mastery assessments.

  NOTE: The easiest way to purchase the subscription is through Canvas so that it is already linked to the course. You can sign up for free and use the software for 14 days before you have to purchase.

Course Description: A rigorous treatment of one-variable calculus including: limits, continuity, differentiation, the Riemann integral, metric spaces, sequences and series of functions.

Prerequisites: MAT 343: Linear Algebra.

Class Policy:

- Regular attendance is essential and expected.
- It is suggested to spend at least 2 hours outside of class for each hour in class in order to understand the material. To achieve excellence, more time may be required. So, budget at least 6 hours each week (in addition to class time) to spend learning this material. Note that if you are taking 15 credits that comes to about 45 hours of work a week.
- Cell phone usage during class is very distracting. Unless you are expecting an emergency call, keep your cell phone on silent. Please do yourself a favor and allow yourself to focus by not using your phone.
- Class time is work time. During the times we meet, I expect you to be ready to work. This is not a lecture series in which you can sit and listen passively. My goal will be to get each of you to exercise your minds each day in class.

General Instructional Format: This course will be taught in the style of a *flipped classroom*. For a good explanation of a flipped classroom as used here, see this video. Of course, for a more general explanation see Wikipedia here. Basically, a flipped classroom is one in which the students study assigned material before class, then the class time is devoted to unpacking and discussing the material in order to clarify and solidify what was learned. The student then completes the homework and starts into the next topic.

Basically, each lesson will have the same four parts:

- assigned reading,
- reading quiz (A short canvas quiz on the lesson, to be done **before class**),
- class discussion, and
- Homework from the book.

Associated with each chapter of the book is collection of concepts and definitions (math facts), these are referred to as toughloves (more on this below). There is a toughlove quiz for each chapter, which you will be able to take once each weekend for as many weekends as you like. I will take the highest score in calculating for final course grade.

Grading Scheme:

Reading Quizzes	10%
Homework	30%
Toughlove Quizzes	10%
3 Celebrations of Knowledge (10% each)	30%
Final Celebration	20%
Total	100%

(The percentages guarantee at least the following letter grades.)

A	93%	C+	77%
A-	90%	C	73%
B+	87%	C-	70%
B	83%	D+	67%
B-	80%	D	63%

Reading Quizzes (10%): These quizzes will be given prior to almost every class meeting and are designed to incentivize your reading of the material and guide your study of it. They cover material from their associated section in the book as well as some past material. These quizzes cannot be made up, but can be done in advance. Because these quizzes cannot be made up, I will drop your 5 lowest reading quizzes at the end of the semester when calculating your final grade.

Homework: Homework will be assigned mostly from the book, but sometimes I will provide exercises. These assignments will be submitted through Canvas. 1 point of extra credit will be awarded for each assignment submitted in LaTeX. In general homework will be due a week after we are scheduled to finish the section. However, Homework is guaranteed to not be due before two class meetings after the discussion of the section concluded.

All work for the course (except for the finale) must be completed and submitted by December 13 at 11:59 pm to be included in your final grade.

Toughlove Quizzes: To succeed in this course there are concepts and terms that must be engrained upon your soul or at least be memorized. To incentivize this I have created a series of quizzes that will, somewhat ruthlessly, I admit, test your knowledge of these concepts. These quizzes will available to take and retake every weekend on XYZHomework.com. Your final score for a quiz will be the highest score you achieve on that quiz. You will be given a list of all the facts that may be tested on the quizzes, and we will spend time in class discussing them (which is inevitable as they are so foundational to what we do in class each day).

Late Work: I do accept some late work:

- Homework: I accept three late homeworks. Beyond that I reserve the right award extensions when requested. Such requests must be made prior to the homework's due date.
- Reading Quizzes: I do not accept late reading quizzes. If for any reason you feel you may miss one you should make arrangements to do it in advance. I will drop your lowest **5** reading quizzes at the end of the semester. The strictness of this policy is meant to communicate the importance of reading the material before class.
- Toughlove Quizzes: you will be given an opportunity to retake toughlove Quizzes each weekend (Friday and Saturday).
- Celebrations of knowledge: If you miss a celebration you may be allowed to take it later and I may exact a penalty of not more that 5% per day late.
- The cut-off date for late work is December 14th at 11:59 PM. No exceptions.

Midterm Celebrations of Knowledge: You have worked hard learning this difficult material. Three times during the semester (at the end of each of the three units) you will be given the opportunity to test yourself and appreciate how very far you have come. This will be done with a midterm exam which I will refer to as a *celebration of knowledge*. Now, don't let this Orwellian newspeak fool you, a celebration of knowledge is nothing more than an exam with a happier sounding name. But your score on this exam will clearly demonstrate to me and to you how much you have learned, giving us cause to celebrate.

There will be three midterm celebrations of knowledge throughout the semester. They be closed note, closed book, paper-pencil tests taken in the **testing center**. No time limit will be imposed, though you will be subject to the hours of

operation of the testing center, which are 4 - 10 pm Monday through Thursday. The Celebrations of Knowledge will be available according to the following Schedule:

Celebrations of Knowledge	Chapters Covered	Week	Dates Offered
Celebrations of Knowledge 1	Chapters 1-2	Week 6	Tuesday, Oct 1 to Thursday, Oct 3
Celebrations of Knowledge 2	Chapters 3-4	Week 11	Tuesday, Nov 5 to Thursday, Nov 7
Celebrations of Knowledge 3	Chapters 5-6	Week 16	Tuesday, Dec 10 to Thursday, Dec 12

If you are unable to take a celebration of knowledge during the times it is offered, Please let me know as soon as possible so that we can make arrangements for you to take it at a different time.

Final Celebration: The final celebration will be comprehensive and will be given during the final exam period, which is **Monday, December 16, 4:00-6:50 pm**.

Core Learning Goals (CLG): Students completing Southern Virginia's core curriculum are expected to attain the following college-level competencies:

- *Careful Writing:* Ability to present arguments in clear written English with proper spelling, grammar, vocabulary, and transitions.
- *Critical Thinking:* Ability to separate a conclusion from its premises and evaluate how well the premises support the conclusion.
- *Analytic Reasoning:* Ability to evaluate a body of evidence and draw appropriate conclusions.

Core Values: Students demonstrate:

- *Scholarship* by coming prepared to class, focusing on activities in class, and meticulously completing homework assignments.
- *Discipleship* by being respectful of others and showing courtesy and concern for others and the learning environment.
- *Accountability* by faithfully attending class and coming on time, coming prepared, being aware of assignments given and completing them on time.
- *Enthusiasm* by participating in class discussions and completing in-class activities, showing interest in cultural material and discussions about mathematics in general.
- *Refinement* by going above and beyond in living the dress and grooming standards, their manner of speech and actions, cleaning up the classroom and following proper classroom etiquette. This includes not using cell phones (texting, etc.) or other electronic devices that may disrupt learning in the class.

Student Learning Outcomes (SLO) for the Mathematics Major: A student successfully completing this major will;

1. Competently work with the concepts of calculus, differential equations, geometry, analysis, algebra, and statistics. (Foundation-Formulate)
2. Learn to read, understand, analyze, and produce proofs at increasing depth. (Mathematical Proofs-Prove)
3. Use appropriate technology to enhance mathematical thinking and understanding, solve mathematical problems, and judge the reasonableness of results. (Technology-Solve)

4. Exhibit knowledge of formulating and solving problems, interpreting solutions, and modeling techniques central to applications of mathematics. (Mathematical Modeling -Model)
5. Demonstrate the ability to effectively communicate mathematics and other quantitative ideas in written and oral forms. (Communication-Communicate)

Course Goals: After completion of the course you should be able to do the following:

- Obtain a level of proficiency in the fundamental concepts and their applications necessary for further study in courses that require the knowledge of Real Analysis. (SLO 1 and 4)
- Show that you have learned the basic facts of this course, including mathematical notation and terminology. You should be able to read, interpret, use and give precise definitions of the vocabulary used in this course. (SLO 1, 4 and 5)
- Give and understand complete proofs of many theorems relevant to the course material. (SLO 2)
- Write mathematics professionally using LaTeX. (SLO 3 and 5)
- Work with other students in solving difficult problems or discovering proofs together. (SLO 1, 2, 4 and 5)

Accommodations: Southern Virginia University is committed to providing a learning environment that accommodates and supports students with disabilities through accommodations. The Office of Accessibility Services oversees Academic Accommodations. Students with any type of physical, medical, psychological, or emotional disability may be eligible - through the Americans with Disabilities Act (ADA) - to receive accommodations to provide equal access to academic settings. Any student seeking accommodations should contact the Office of Accessibility Services by emailing accessibility@svu.edu. Students are advised to take care of the necessary documentation and paperwork early in the semester. Accommodations are not made until the student follows the procedures outlined on the website, (https://catalog.svu.edu/reasonable-accommodations/) receives an official accommodation letter AND discusses it with their professors.

Title IX: Southern Virginia University is committed to providing an environment that promotes personal integrity, civility, and mutual respect and is free of all forms of sex discrimination and gender-based violence, including sexual assault, sexual harassment, gender-based harassment, domestic violence, dating violence, and stalking.

Title IX of the Education Amendments of 1972 states that "No person in the United States shall, on the basis of sex, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any education program or activity receiving Federal financial assistance." Title IX applies to all employees and students, and covers discrimination in programs, admissions, and activities.

You can report any concerns to the Deputy Title IX Coordinator (Stephanie Hardy, titleix@svu.edu), your professor, the Wellness Center, or any university administrator. Please be aware that all instructors are mandated reporters, so by law, we must disclose details relayed to us about any possible Title IX infraction to the University's Title IX coordinator.

SVU's Title IX can be found at https://catalog.svu.edu/title-ix/

Academic Honesty: Cheating, plagiarism, and other forms of dishonesty are against the code of conduct (https://svu.edu/campus-life/code-of-conduct/) and will be reported to the provost and office of the registrar. Students have the right to appeal decisions on academic honesty (https://catalog.svu.edu/academic-honesty/) to the appropriate division chair following the Student Grievance Procedure (https://catalog.svu.edu/student-grievance-procedure/).