MAA 4202 Honors Modern Analysis 2
(Continuation of Honors Modern Analysis MAA 4200)

Instructor: Dr. Terje Hoim
Office: HC 150
Phone: 799-8673
E-mail: thoim@fau.edu
Office Hours: Tuesdays 1pm – 3pm and Wednesdays 11am – 3pm
Class meetings: T, Th 9:30 – 10:50 am
Text: N. L. Carothers, *Real Analysis,* published by Cambridge University press

Course Description. This course is a continuation of Honors Modern Analysis 1. We will continue with goals of the first semester. In particular, we will emphasize the process of thinking about math by carrying out rigorous development of the key concepts and theorems of integral calculus. Topics include the Riemann integral and its properties, a restatement of the key concepts of real analysis in the context of metric spaces and function spaces, and an introduction to measure theory and the Lebesgue integral. All of these are fundamental topics whose clear understanding is a prerequisite to any further study of the branch of mathematics called analysis. Assignments will emphasize writing proofs, not just grinding through formulas.

Writing good mathematics takes practice, so we will write a lot. We learn by thinking, comparing, analyzing, inventing, understanding and communicating our thoughts, all of which take time. For each hour we meet in class, you should expect to spend 3-4 hours outside of class working on course material.

Throughout the course, I strongly encourage you to work together. You should make use of all the resources available to you: your classmates, the text, your class notes, any technology you like, the library, and me. When you have questions, please ask!

This course contributes to the Honors College curriculum by serving as an elective in the Mathematics concentration, emphasizing critical thinking and writing, and in contributing to an interdisciplinary approach to learning. In particular, there will be projects with a substantial writing component beyond daily homework and semester exams.

Note of Honors Distinction: This course differs substantially from the non-Honors version. First, the writing component of the course will be much more demanding, and will prepare students for upper-division college writing and for work on the **Honors Thesis**. Students will be exposed to vocabulary of a specifically theoretical nature, and will be expected to comprehend these new concepts and to deploy these new terms in their own critical thinking and writing. In addition, we will begin professionalizing our own readings and analyses of these texts. Students will be expected to familiarize themselves with the history and the ongoing critical and scholarly conversation about these works, and will give in-class presentations about critical history and about the living scholars in the field as it now stands. Students will also engage with the theoretical tools used by today's reading community to study literature. Most importantly, this course will reflect the interdisciplinary nature of Honors education and will inculcate critical attitudes and skills that will teach you how to learn for yourself.

Goals. There are really two sets of goals for this course. The first set of goals involves mastering the mathematical content of a second semester real analysis course and developing mathematical reasoning and writing abilities. In particular, in this course, students should come to

◊ understand and appreciate general metric and normed spaces;
◊ be able to give examples of and prove basic facts about these spaces;
◊
◊ Gain a understanding of how algebra, topology, and analysis relate to each other.

The second set of goals involves broader issues of learning. More general goals include developing students' abilities to

◊ improve logical thinking and problem-solving skills;
◊ communicate mathematics effectively, both in oral and written formats;
◊ work effectively in heterogeneous teams;
◊ use technological tools such as a computer algebra system in an appropriate manner; and

◊ engage in life-long learning.

Materials. The textbook is N. L. Carothers, *Real Analysis,* Cambridge University press, 2000

Homework and Quizzes. There will be weekly homework assignments, announced in class. Homework assignments should be written on loose leaf paper, and must be organized and legible. *Late homework may be accepted for reduced credit until I have graded the homework set, provided arrangements have been made in advance. Late homework that is received after I have graded the homework set or when no arrangements have been made in advance, may receive no credit.* We may have short quizzes if I deem them necessary.

Tests. There will be three tests in this course and a comprehensive final exam. No make-ups will be given for tests. In the case of a documented emergency, one test score may be replaced by half the final exam score. Midterm tests may be given in two parts, a take-home portion and an in-class portion.

Grading. Your semester grade will be based on the total number of points accumulated from different course activities. In the table below, I have estimated the number of points for the semester, and the corresponding percentages that will come from each component of the course.

	Points	**Percentage**
Homework & Quizzes	150	21 %
Projects & Activities	50	7 %
Mid Terms (100 points each)	300	43 %
Final Exam	200	29 %

Classroom Etiquette Policy:
In order to enhance and maintain a productive atmosphere for education, personal communication devices, such as cellular telephones and pagers, are to be disabled in class sessions.

Policy on Accommodations:
In compliance with the Americans with Disabilities Act (ADA), students who require reasonable accommodations due to a disability to properly execute coursework must register with the Office for Students with Disabilities (OSD) -- in Boca Raton, SU 133 (561-297-3880); in Davie, LA 240 (954-236-1222); or in Jupiter, SR 110 (561-799-8010); – and follow all OSD procedures.

Academic Integrity Policy:
Students at Florida Atlantic University are expected to maintain the highest ethical standards. Academic dishonesty is considered a serious breach of these ethical standards, because it interferes with the university mission to provide a high quality education in which no student enjoys an unfair advantage over any other. Academic dishonesty is also destructive of the university community, which is grounded in a system of mutual trust and places high value on personal integrity and individual responsibility. Harsh penalties are associated with academic dishonesty. For more information, see University Regulation 4.001.

All students agree to adhere to the honor code, available online at:
http://www.fau.edu/divdept/honcol/academics_honor_code.htm

While you are encouraged to discuss the course material with each other, all assignments must be entirely your own work. If you have any doubts about what constitutes plagiarism or a violation of the honor code, consult with me beforehand.

I assume that you're here to learn. If you talk to each other, you'll learn from each other, perhaps more than you'll learn from me. I encourage you to talk to each other while you are thinking about how to do a problem or assignment. When working homework problems, you can examine each others' solutions, since examining the solution of a fellow student may help you understand the problem and how to solve it. However, you may not copy someone else's solution, nor refer repeatedly to someone else's solution while you develop your own. That doesn't mean that you can't use the ideas of another student, but you must give credit for the idea and understand the idea yourself.

The basic rule is simple: discussion and even completion of problems with your peers is acceptable, but after you have discussed a problem, you should throw away any notes you made, go somewhere by yourself and write up the problem entirely on your own, without consulting others.

Assistance. Please ask questions and seek assistance as needed. You may email me at any time, and I encourage you to make use of my office hours.

Brief Course Outline.

Week 1	Chapters 1, 2	**Calculus Review:** The real numbers; Limits and continuity Countable and Uncountable sets
Week 2	Chapter 3	**Metrics and Norms:** Metric spaces, normed vector spaces, inequalities, limits
Week 3	Chapters 4, 5	**Open Sets and Closed Sets, Continuity:** Relative metric, homeomorphisms, the space of continuous functions
Week 4	Chapters 6, 7	**Connectedness and Completeness:** Connected sets, totally bounded sets, complete metric spaces, fixed points
Week 5	Chapter 8	**Compactness:** Compact metric spaces, uniform continuity, equivalent metrics
		TEST 1
Week 6	Chapter 10	**Sequences of Functions:** Pointwise and uniform convergence, limits, the space of bounded functions
Week 7	Chapter 11	**The Space of Continuous Functions:** The Weierstrass theorem, equicontinuity, trigonometric polynomials, infinitely differentiable functions
Week 8	Chapters 12, 13	**The Stone-Weierstrass Theorem, Functions of Bounded Variation**
Week 9	Chapter 14	**The Riemann-Stieltjes Integral:** Measure, the space of integrable functions, Riemann integral, the Riesz representation theorem
Week 10		**Review, TEST 2**
Week 11	Chapter 16	**Lebesgue measure:** Outer measure, inner measure, measurable sets, non-measurable sets
Week 12	Chapter 17	**Measurable Functions:** Sequences of measurable functions, approximations of measurable functions
Week 13	Chapter 18	**The Lebesgue Integral:** Simple functions, non-negative functions, Lebesgue's dominated convergence theorem, approximation of integrable functions
Week 14	Chapter 19	**Additional topics, Presentation of projects**
Week 15		**Review, TEST 3**
		FINAL EXAM

Bibliography:

N. L. Carothers, *Real Analysis,* Cambridge University press, 2000
Kenneth Ross, *Elementary Analysis: The Theory of Calculus,* Springer, 1980
Walter Rudin, *Principles of Mathematical Analysis, 3rd edition*, McGraw Hill, 1976
Daniel Solow, *How to Read and Do Proofs, 4th edition*, Wiley, 2005.

Using History to Teach Mathematics. Mathematical Association of America Note #51, MAA, 2000.
William Wade, *An Introduction to Analysis (4th ed),* Pearson, 2009
H. L. Royden, *Real Analysis (3rd Edition)*, Pearson, 1988
Terrence Tao, *An Introduction to Measure Theory*, AMS, 2011