MAT 402
Real Analysis II
(Spring, 2009)

Classes: Monday and Wednesday, 11.50 am to 1.05 pm (Fanning 310)

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Office Hours: Mondays 1.15 to 2.30 pm, and Wednesdays 9.00 to 11.00 am

Textbooks (Required): (i) *Understanding Analysis*, by Stephen Abbott (Springer, 2000), (ii) *The Elements of Integration*, by Robert Bartle (Wiley, 1966)

General Principles: This course, as a follow-up course to Real Analysis I (MAT 301), will be run quite differently from lower-level courses. A typical fortnight (4 classes) will have the following structure, which is subject to change. The instructor will "lecture" only one of these classes. For two of these classes, readings will be assigned from the textbook before each class, and students are expected to come to class prepared to discuss the sections. The remaining class will be consist of students presenting solutions to assigned exercises on the board. There will also be regular (fortnightly) homework which will be collected and graded.

Graded Homework (Problem Sets): Problem Sets will be assigned every fortnight, typically due in class on Wednesdays. You are encouraged to work with others, *but the final written solutions must be your own, and you are not allowed to see anyone else's written solutions.*

In-Class Homework Presentations: On the Wednesdays on which Problem Sets are not due, the typical class will consist of students presenting solutions to exercises on the board. Students will be chosen at random to do this.

Student-Run Class: Towards the end of the semester, each student will choose a topic of interest to them, and will run a class on it.

Mid-Semester Meeting: Each student will have a mandatory meeting with the instructor in Week 7 (mid-semester). Students should come to this meeting with ideas on their proposed student-run class, for discussion with the instructor. This is also an opportunity to discuss one's progress in the course.

Final Grades: Your final grade will be based on the following weighting.

Graded Problem Sets:	35 %
In-Class Homework Presentations:	25 %
Student-Run Class	25 %
Class Contribution (Instructor Grade)	5 %
Class Contribution (Peer/Self Grade):	10 %

Attendance Policy: Attendance is expected for all classes. In particular, attendance is mandatory on the dates of in-class homework presentations. Unexcused absences will result in a lowering of your grade.

Late Assignment Policy: Late assignments will *not* be accepted. Any assignment not submitted by the due time will earn an automatic zero.

Honor Code: The Connecticut College Honor Code will apply. Its impact on individual assessment tasks will be made specific when those tasks are handed out. *Any violations will result in referrals to the Judiciary Board.*

Special Accommodations: If you have a hidden or visible disability which may require classroom, test-taking or other reasonable modifications, please register with the Office of Student Disability Services at 439-5428 as soon as possible. Please also speak to your instructor immediately to plan suitable arrangements for the semester.

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Course Summary

This is a follow-up course to MAT 301 (Real Analysis I). It can be thought of as a"topics" course in Real Analysis. This semester, after covering topics from Abbott's textbook which completes the strengthening of the foundations associated with calculus (notably, the Riemann integral and Taylor's Theorem), we will venture into several areas which are probably new to you. We will define *metric spaces*, in which our familiar notion of distance is generalized. This includes spaces of functions on the real line, and thus we will be venturing into the realm of *functional analysis.* We will address an important example of this – *Fourier series.* We will then move on to Bartle's textbook, and consider the idea of defining integration on non-continuous functions, such as the Dirichlet function. The method we will build up to is called *Lebesgue integration*, and in building up a theory for this, we will touch on a variety of interesting real analysis topics. This will include (i) *measure theory* (a generalization of the notion of intervals filling up space), (ii) interchanging limits (Monotone Convergence Theorem, Dominated Convergence Theorem), (iii) the L_p-function spaces, (iv) important inequalities (Schwarz, Hölder, Minkowski), and (v) types of convergence.

Tentative Outline

We will cover the following topics. This outline is subject to change, and may vary depending on time constraints and student interests.

- Sequences and Series of Functions (*Abbott, Chapter 6*)
- The Riemann Integral (*Abbott, Chapter 7*)
- Metric Spaces (*Abbott, Section 8.2*)
- Fourier Series (*Abbott, Section 8.3*)
- Measures (*Bartle, Chapters 2 and 3*)
- The Lebesgue Integral (*Bartle, Chapters 4 and 5*)
- The Lebesgue (L_p) Spaces (*Bartle, Chapter 6*)
- Modes of Convergence (*Bartle, Chapter 7*)