	MAT 550 **Real Analysis I** **Spring 2002**

This is a second course in real analysis which builds upon the groundwork set in MAT 544. The prerequisites consist essentially of a working knowledge of Lebesgue measure theory and someone with such knowledge should have no difficulty following the course. A detailed syllabus can be seen following the link below.

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Office hours: Wed 3:30-4:30pm, Thu 11am-12pm or by appointment.

Course Syllabus

Homework: Homework will be assigned approximately weekly and collected one week after having been assigned. Click here for the assignement. Doing the homework is *fundamental* part of the course work. In particular, it will count for 30% of the overall course grade.

Midterm Exam: Friday, March 8th, in class, including all the material we manage to cover until then.

Final Exam: The final exam is on Monday, May 13th, 8am - 10:30am, in the usual room, P-124.

Final Grade: 30% MT + 30% HW + 40% Final

Real Analysis I
MAT 550
Spring Semester

1. Brief discussion of the measure theory
    - Riesz Representation Theorem
    - Tonelli's and Fubini's Theorems
    - The dual of L^1
    - Radon-Nykodim Theorem
    - Lebesgue's Theorem
    - Hahn Decomposition Theorem
2. L^p spaces, convergence in measure, the dual of L^p
3. Fourier series
    - Riemann-Lebesgue lemma
    - Convergence of Fourier series for differentiable functions
    - Parseval's formula
4. Functional analysis
    - Open mapping and closed graph theorems
    - Uniform boundedness principle
    - Hahn-Banach theorem
    - Existence of orthonormal bases for Hilbert spaces
    - Maximal operator controlling sequences of operators between Banach spaces
5. More measure theory
    - Maximal operators controlling almost everywhere convergence
    - The fundamental theorems of calculus for the Lebesgue integral
    - Change of variables of integration
    - Polar coordinates
6. Partial Differential Equations
    - Separation of variables
    - The heat equation
    - Laplace's equation, the fundamental solution
    - The strong maximum principle and the Liouville theorem
    - The mean-value theorem
    - The Poisson kernel
    - Approximate identities and the Weierstrass theorem on approximation by polynomials
    - The wave equation, d'Alembert's solution
7. Additional Topics
    - Introduction to ergodic theory
    - Birkhoff's Ergodic Theorem

References:

- Daryl Geller, *A first graduate course in real analysis. Part II,*
  Solutions Custom Publishing (can be ordered from the campus bookstore);
- Walter Rudin, *Principles of mathematical analysis,*
  3rd ed., McGraw-Hill, New York 1976;
- Walter Rudin, *Real and complex analysis,*
  3rd ed., McGraw-Hill, New York 1987;

- Michael Taylor, *Partial differential equations*,
  Springer Verlag, 1996.

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Homework Sets:

1) Chapters 1 and 2 of *Rudin* - Due Friday, Feb. 8th.

Chapter 1: 7, 8

Chapter 2: 8, 10, 11, 15, 17, 25

2) Chapters 3 and 4 of *Rudin* - Due Friday, Mar. 1st.

Chapter 3: 4, 5, 10, 14, 17, 20

Chapter 4: 2, 3, 6, 9, 10, 13, 14

3) Chapter 5 of *Rudin* - Due Friday, Apr. 5th.

Chapter 5: 3, 6, 8, 9, 12, 22

4) Chapters 6 and 7 of *Rudin* - Due, Friday, May 3rd.

Chapter 6: 3, 4, 7, 9

Chapter 7: 2, 5, 7, 14, 22