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This is a first course in real analysis. The objective is to establish the ground work upon which great part of modern mathematics is based. The main topics to be covered are: 1) the basics of the real number system and metric spaces; 2) ordinary differential equations; 3) calculus on several dimensions and inverse and implicit function theorems and 4) measure theory. 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.

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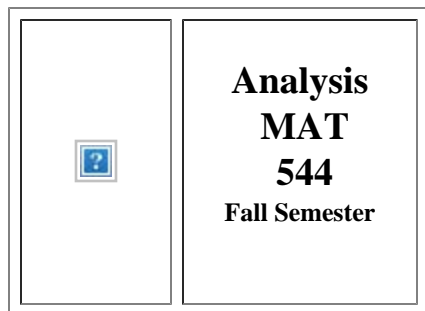
### **Course Syllabus**

**Homework:** Homework will be assigned approximately weekly and collected one week after having been assigned. Click [here](#) for the assignment. 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, October 12th, in class, including all the material we manage to cover until then.

**Final Exam: The final exam is Friday, Dec. 14th, 12am - 3pm in P-131.**

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



1. Advanced Calculus and Ordinary Differential Equations (ODE)

- Review of the real number system
- Metric spaces, continuity, uniform convergence
- Contraction mapping principle
- Existence and uniqueness theorems for ODE
- Global existence theorem for linear ODE
- Linear transformations, orthogonal projections and matrix exponential
- Linear systems of ODE with constant coefficients
- Derivatives in  $\mathbb{R}^n$  and in Banach spaces
- Newton's method and the inverse function theorem
- The implicit function theorem

2. Measure Theory

- Riemann integral in  $\mathbb{R}^n$
- Cantor-type sets, dyadic decompositions in  $\mathbb{R}^n$
- Measures arising from volume functions on open sets
- Basic properties of the Lebesgue measure
- Measurable and integrable functions
- Convergence theorems for Lebesgue integrals: monotone and dominated convergence theorems and Fatou's lemma
- Criterion for Riemann integrability

3. Additional Topics

- Iterated integrals; Tonelli's and Fubini's Theorems
- Riesz Representation Theorem
- Radon-Nikodym Theorem

The main reference is Geller's book. A rough timetable of the pace to cover the book is:

Ch. 1	2½ weeks
Ch. 2	2 weeks
Ch. 3	3½ weeks
Ch. 4	2½ weeks
Ch. 5	2½ weeks
Ch. 6	Homework
Ch. 7 & 8	2½ weeks

**References:**

- Daryl Geller, *A first graduate course in real analysis. Part I,*

Solutions Custom Publishing (to be distributed in class)

- Walter Rudin, *Principles of mathematical analysis*,  
3<sup>rd</sup> ed., McGraw-Hill, New York 1976
- Walter Rudin, *Real and complex analysis*,  
3<sup>rd</sup> ed., McGraw-Hill, New York 1987



**MAT 544  
Analysis I**

**Fall 2001**

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## **Homework Sets:**

**1) Chapter 1 - Due Friday, Sept. 7th.**

Section 1) 3, 7, 9, 10, 11

Section 2) 1, 5, 6, 7

**2) Chapter 1 - Due Friday, Sept. 14th.**

Section 3) 1, 3, 7, 8

Section 4) 2, 4

Section 5) 3, 4, 7

**3) Chapter 2 - Due Friday, Sept. 28th.**

Section 1) 3, 5, 6

Section 2) 2, 4, 7, 10

Section 3) 1, 3

**4) Chapter 2 - Due Friday, Oct. 5th.**

Section 3) 4, 6, 7, 9

**5) Chapter 3 - Due Friday, Oct. 12th.**

Section 1) 2, 6

Section 2) 1, 3

Section 3) 4, 5, 6, 7

**6) Chapter 3 - Due Friday, Oct. 26th.**

Section 5) 2

Section 6) 3, 7, 9

Section 8) 2, 8

**7) Chapter 4 - Due Monday, Nov. 12th.**

Section 1) 1, 3

Section 2) 1, 2,

Section 3) 2, 3, 4, 5

Section 4) 2

Section 5) 3, 4, 5

Section 6) 1, 3, 5

Section 7) 1, 2, 3

**8) Chapter 5 - Due Monday, Nov. 26th.**

Section 2) 1, 2, 3, 4, 7, 8

Section 3) 3, 4, 5

Section 5) 2, 3, 4

**9) Review Problems - Due Wednesday, Dec. 12th. to Yasuhiro Tanaka.**