

CAAM 401/501: Analysis I (Fall 2011)

Time and Location: T Th: 10:50am -12:05 pm, DCH 1046.

Website: <http://www.caam.rice.edu/~caam401>

Instructor: Liliana Borcea

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Office Hours: M: 10:00-12:00 or by appointment.

Textbooks: Serge Lang, “Undergraduate Analysis”.

Michael Spivak, “Calculus on manifolds” will be used very little. You will need it for 402/502.

Course Description: CAAM401/501 is an introduction to mathematical analysis. CAAM 401 welcomes CAAM majors and other undergraduate students, and graduate students from other departments. CAAM 501 covers extra topics and involve additional homework. It is intended to provide an analytical foundation for graduate study in CAAM and to assist the students in preparing for the qualifying exam.

Problem sessions: Attendance is optional for CAAM 401 but mandatory for CAAM 501.

Grade: Homework assignments will be given weekly. They will be generally due in one week. Three assignments will be pledged and together will count as 0.45 of the grade (0.15 each). The other homework assignments will count for 0.55 of the grade. There are no exams.

- **Homeworks and solutions will be posted on the course website. Hard copies will not be handed out.**
- All homeworks must be completed in order to pass this course.
- Homeworks are due in class, on the due date. No late homework will be accepted, except by previous, explicit arrangement.
- For the pledged assignments, the CAAM 401 (but not 501) students can use the textbook. No other printed or electronic resources are allowed. Also no collaboration or assistance from others is allowed.

Any student with a documented disability needing academic adjustments or accommodations is requested to speak with me during the first two weeks of class. All discussions will remain confidential. Students with disabilities will need to also contact Disability Support Services in the Ley Student Center.

Topics listed in order: In parenthesis the section in Lang’s book listed as “chapter.section”.

- Sets and maps. Injective, surjective and bijective maps. The inverse map. Composition of maps. (0.1-2).
- Natural numbers. Well ordering axiom. Induction. (0.3)

- Countability (0.4).
- Equivalence relations (0.5).
- The real numbers. Algebraic and ordering axioms. Archimedean property. The completeness axiom (I.1-4).
- Sequences of numbers. Convergence. Cauchy sequences. Accumulation points. Bolzano - Weierstrass theorem. (II.1).
- Limits of functions (on the real line) (II.2-3).
- Continuous functions (on the real line). Maxima/minima, intermediate function theorem, uniform continuity. (II.4).
- Vector spaces (VI.1). Spanning sets, basis, dimension.
- Norms, inner products, norm equivalence (VI.2-3).
- Limits in normed vector spaces, Cauchy sequences, completeness. (VI.4).
- Open and closed sets (VI.5).
- Limits in normed vector spaces (VII.1).
- Continuous maps (VII.2).
- Limits in function spaces. Pointwise and uniform convergence. Completeness of the normed vector space of bounded and continuous functions (VII.3).
- **501 topic:** Approximation by polynomials (Weierstrass theorem).
- **501 topic:** Completion of normed vector spaces (VII.4).
- Compact sets (VIII.1).
- Continuous maps on compact sets (VIII.2).
- **501 topic:** Compactness and open covers (VIII.3).
- **501 topic:** Ascoli's theorem.
- Differentiation on the real line (III.1). Mean value theorem (III.2) and inverse functions (III.3).
- The integral in one variable. (X.1-3 and Spivak chapter 3).
- **Possible 501 topic:** The Lebesgue integral (X.4).
- **If time permits:** Series (IX.1-7).