

**MATH 444: Elementary Real Analysis (3 credits)****Course Description**

This course is an introduction to ε - δ analysis on real numbers, which makes what the students have learned from calculus courses rigorous. This course is for students who do not plan graduate study (those students should take Math 447). Topics covered by Math 444 include the real number system, limits, continuity, derivatives, the Darboux integral, the Riemann integral, and sequences of functions.

Prerequisite: MATH 241; MATH 347 or MATH 348, or equivalent.

Course Objectives

Students should leave the course not only with a basic understanding of the fundamental concepts of real analysis, but also an improved ability at reading and writing mathematical arguments. Regular homework is an important aspect of the course.

Course Content

1. Preliminaries Sets and functions. Well-Ordering Property of Natural Numbers. Mathematical Induction. Cardinality.
2. The Real Numbers Basic Properties of Real Numbers. Infimum and Supremum. Completeness of the Real Numbers. Archimedean Property. Density of Rationals. Intervals.
3. Sequences Sequences and Limits. Limit Theorems. Monotone Sequences. Bolzano-Weierstrass Theorem. Cauchy Criterion. Infinite Series.
4. Limits Limits of Functions. Sequential Criterion for Limits. Limit Theorems.
5. Continuous Functions Continuous Functions. Sequential Criterion for Continuity. Combinations of Continuous Functions. Properties of Continuous Functions on Intervals. Uniform Continuity Theorem. Lipschitz Functions. Continuous Extension Theorem.
6. Differentiation The Derivative. Caratheodory's Theorem and Chain Rule. Interior Extremum Theorem. Mean Value Theorem and Applications.
7. The Riemann Integral Riemann Integral (equivalently the Darboux Integral). Cauchy Criterion for Integrability. Classes of Integrable Functions. Fundamental Theorem of Calculus.
8. Sequences of Functions. Pointwise and Uniform Convergence. Cauchy Criterion for Uniform Convergence. Interchange of Limits.

Format

- This is an online course featuring video lectures from the UIUC Summer 2016 course taught by Professor Joe Miles.
- Text: R.B. Bartle and D. R. Sherbert, Introduction to Real Analysis, 4th Edition, John Wiley & Sons.
- Students must be able to print out assignments, write out solutions, then scan their written work and upload it to Moodle to meet set deadlines.
- This course requires multiple paper-based exams that must be taken with an approved proctor. Exams may be taken on campus with NetMath proctoring; for off-campus options see <https://netmath.illinois.edu/offcampus>. Off-campus proctors must be able to scan completed exams and email them to NetMath for grading, as well as mailing the paper exam back for archival purposes.