**Math 555 Applied Complex Analysis** Fall 2013

**Instructor.** Professor J. Rauch

Office: 4034 East Hall

Email: rauch@umich.edu

Home page: www.math.lsa.umich.edu/˜rauch

**Prerequsites.** Advanced Calculus (partial derivatives, Green's Theorem, uniform convergence and uniform continuity). It is assumed that students have (briefly) encountered Fourier series and Fourier integrals. Many prerequisite results will be briefly reviewed when used. Math 555 is an opportunity to deepen understanding of earlier material.

**Text.** Richard A. Silverman, *Complex Analysis with Applications*, Dover publishers. This text has the right level, right material, and the right price. We will not follow it closely. Online handouts complement the text, especially for the applications.

**Audience.** Mathematics, science, and engineering undergraduates and graduate students.

**Goals.** This course is an introduction to the theory of functions of a complex variable *with special attention to applications in science and engineering.* In addition to the presentation of the often amazing fundamental principles, the importance and utility of these principles in applications is emphasized. Applications include

- The fundamental theorem of algebra.
- Interactions with Fourier analysis, e.g. Shannon's sampling theorem.
- The evaluation of definite integrals by the method of residues. Including examples of Fourier and Laplace Transforms.
- The solutions of boundary value problems for Laplace's equation arising in fluid mechanics, heat conduction and electrostatics.

Students will be expected to learn to use the methods of complex analysis with facility. Complete proofs will be presented. Students will not be expected to reproduce the harder proofs. That is the province of Math 596. Compared to Math 596, product representations, normal families, and the Riemann Mapping Theorem will not be treated. Elementary conformal mappings are treated and applied extensively.

**Content.** The heart of the course is the derivation of the properties of analytic functions from Cauchy's Integral Theorem. The latter is proved by Green's Theorem assuming continuous differentiability. The proofs are simple compared to the proofs in Advanced Calculus in several variables or to the theory of the Lebesgue Integral. The results are frequently surprising. Some of the applications are astonishingly elegant.

**Grading.** Grades are based on Homework 35%, Midterm Exam 25%, and a Final Exam 40%.