

MATHEMATICS 352
COMPLEX ANALYSIS

I. Introduction

A. Catalog Description

The calculus of functions with complex numbers as inputs and outputs has surprising depth and richness. The basic theory of these functions is developed in this course. Students will explore the standard topics of calculus (function, limit, continuity, derivative, integral, series) in this new context of complex numbers leading to some powerful and beautiful results. Applications include using conformal mappings to solve boundary-value problems for Laplace's equation.

Prerequisites: Math 221 and Math 232 or permission of the instructor. Satisfies the proof-based requirement in major contracts.

B. Objectives

1. General understanding of analytic functions including the exponential and logarithm functions.
2. General understanding of limit, continuity, and derivative.
3. General understanding of line integrals, Cauchy's theorem, and Cauchy's integral formula.
3. Ability to manipulate power series.
4. Ability to evaluate definite integrals with the residue theorem.
5. Ability to solve boundary-value problems using conformal mapping.

C. Prerequisites

Math 221 and Math 232 or permission of the instructor.

II. Required Topics

A. Complex numbers

Algebra and elementary topology.

B. Differentiation

Cauchy-Riemann equations, analytic functions, harmonic functions.

C. Integration

Line integrals, Cauchy Integral Theorem, Cauchy Integral Formula, theoretical consequences.

D. Series

Taylor and Laurent series, local properties of analytic functions.

E. Poles and residues

Residue theorem, evaluation of definite integrals.

F. Conformal mapping

Theory and examples. Boundary-value problems.

II. Required Topics (cont.)

G. Special functions

Exponential, logarithm, fractional linear.

H. Optional topics

Further treatment of conformal mapping, Poisson integral formula, Riemann surfaces.

III. Bibliography

- Ahlfors Complex Analysis
Churchill/Brown Complex Variables & Applications
Dettman Applied Complex Variables
Henrici Applied & Computational Complex Analysis
Hille Analytic Function Theory
Kyrala Applied Functions of a Complex Variable
Marsden/Hoffman, Basic Complex Analysis
Wunsch Complex Variables with Applications