*San Francisco State University*
*Department of Mathematics*
*Course Syllabus*

# MATH 380
# Introduction to Functions of a Complex Variable

## Prerequisites

MATH 228 with a grade of C or better; MATH 325 with a grade of C or better.

## Bulletin Description

Complex values functions of a complex variable. Analytic functions, Cauchy Riemann Equations, Cauchy's Theorem, power series, Laurent series, singularities, Residue Theorem with applications to definite integrals; Conformal mappings with applications to heat conduction and fluid flow.

## Course Objectives

The principal aim of Introduction to Functions of a Complex Variables is to introduce students to the field of complex numbers and to the algebra of complex valued functions of a complex variable. While this course does not emphasize rigorous proofs students are expected to solve a variety of problems involving complex differentiation, complex path integration, infinite series and conformal mapping.

Students who successfully complete this course should be capable of:

- Determining whether complex-valued functions are analytic.
- Applying the Cauchy-Riemann Equations, Cauchy's Theorem, Cauchy's Integral Formula, Cauchy's Inequality, Liouville's Theorem and the Maximum Modulus Principle to complex valued functions.
- Applying Taylor's Theorem, Laurent's Theorem and the Residue Theorem. Students should be able to apply the Residue Theorem to evaluate improper integrals.
- Demonstrating the relationship between analytic functions and conformal mapping and use conformal mapping to determine heat conduction and fluid flow in various bounded regions.

## Evaluation of Students

Students will be graded o their ability to devise, organize and present in correct mathematical English solutions to problems. While instructors may design their own methods of evaluating student performance, these methods must include in-class examination, graded homework assignments and a final exam.

## Course Outline

| Topics | Number of Weeks |
|---|---|
| The Field of Complex Numbers ($\mathbb{C}$). | 2 |
| Analytic Functions: properties of analytic functions, Cauchy-Riemann equations. | 2 |
| Elementary Functions: algebraic, trigonometric and logarithmic functions. | 2 |
| Contour Integrals of Complex Functions: Cauchy' Theorem, Cauchy's Integral Formula, Cauchy's Inequalities, Liouville' Theorem, Morera's Theorem, Maximum Modulus Theorem and elementary properties of harmonic functions | 4 |
| Complex Series: power series, Taylor's Theorem, Laurent's Theorem and Laurent series, residues. | 3 |
| Conformal mapping with applications chosen from: Dirichlet and Neumann problems, heat conduction, fluid flow and electric potential. | 2 |

## Textbooks and Software

*Fundamentals of Complex Analysis,* 2nd Edition by Saff & Snider.
*Complex Variable and Applications*, 6th Edition by Brown and Churchill.

Submitted by: David Ellis Date: 31 Jan 2003