

Mathematics 4361 - Complex Variables

Student Learning Outcomes

- 1. The students will demonstrate factual knowledge including mathematical notation and terminology used in this course.** Students will read, interpret, and use the vocabulary, symbolism and basic definitions used in complex analysis.
- 2. The students will describe the fundamental principles including the laws and theorems arising from the concepts covered in this course.** Students will develop and apply the theorems about and the characteristics of complex numbers and functions defined on the complex numbers.
- 3. The students will apply course material along with techniques and procedures covered in this course to solve problems.** Students will apply theorems and results from this class to solve complex variable problems as well as related problems in other areas of mathematics including analysis and topology.
- 4. The students will develop specific skills, competencies and thought processes sufficient to support further study or work in this or related fields.** Students will acquire the skills related to the study of complex variables including integration and differentiation techniques and the results associated to these ideas.

Course Content

Textbook: *Complex Variables and Applications*, by Ruel V. Churchill and James Ward Brown, McGraw Hill

- 1. Complex Numbers:** definition and properties, geometric interpretation, polar form, powers and roots, regions in the complex plane
- 2. Analytic Functions:** functions, mappings, limits, derivatives, Cauchy-Riemann equations, analytic Functions, harmonic Functions
- 3. Elementary Functions:** exponential functions, complex exponents, trigonometric functions, hyperbolic functions, logarithmic function and branches
- 4. Integrals:** antiderivatives, contours and contour integrals, Cauchy integral formula, simply and multiply connected domains, derivatives of analytic functions, The Fundamental Theorem of Algebra, Maximum Modulus Principle
- 5. Series:** Taylor and Laurent series, general properties of infinite series
- 6. Residues and Poles:** residue theorem, zeros and poles of order m , singularities
- 7. Applications of Residues:** evaluation of improper integrals, branch points and branch cuts
- 8. Mappings:** linear transformations, linear fractional transformations, mappings of the upper half-plane