

Course Outline for MATH 3301, Complex Analysis

MATH 3301 Complex Analysis (3 units)

Prerequisite: Junior standing or Mathematics major; completion of GE Area 1 with grades of C- or better; and completion of GE Area 2 with a grade of C- or better; and MATH 241 or [MATH 2263](#); and one of the following: MATH 242, MATH 244, [MATH 2341](#), or [MATH 2343](#).

Elementary analytic functions and mappings. Cauchy-Riemann equations. Cauchy's Integral Theorem. Taylor and Laurent series. Theory of residues and evaluation of integrals. Winding number, the argument principle, and Rouché's theorem. 3 lectures. Fulfills GE Areas Upper-Division 2 or Upper-Division 5.

Course Learning Objectives	
1	Describe analytic functions and their properties.
2	Perform complex arithmetic and interpret multi-valued functions.
3	Use the Cauchy-Riemann equations to determine domains of analyticity for complex valued functions.
4	Evaluate contour integrals of functions and describe their connections with analytic functions.
5	State and apply Cauchy's Integral Formula, the Maximum Modulus Principle, Gauss's Mean Value Property, the Argument Principle, and Rouché's Theorem.
6	Compute Taylor and Laurent expansions of functions that arise in the study of mathematics, science, or engineering and describe their basic properties.
7	Identify and classify singularities of complex valued functions and compute the residues at those points.
8	Use winding numbers and the Residue Theorem to evaluate the definite integrals of real and complex valued functions that arise in the study of mathematics, science, or engineering.

Expanded Course Content

Textbooks, materials, and/or other resources
Marsden, J. and Hoffman, M. Basic Complex Analysis, Third Edition

Week	Readings	Topics of Discussion
1	Sections 1.1 - 1.3	Complex numbers and their properties
2	Sections 1.4 - 1.5	Continuous and analytic functions, Cauchy-Riemann equations
3	Section 1.6	Complex differentiation, holomorphic functions, analytic implies holomorphic

Week	Readings	Topics of Discussion
4	Sections 2.1 - 2.2	Contour integrals, parametrization, Cauchy's theorem
5	Sections 2.3 - 2.4	Implications of Cauchy's theorem, the Cauchy Integral Formula, the Cauchy Integral Formula for derivatives
6	Section 2.5	The maximum modulus principle, Gauss's Mean Value Theorem, harmonic functions
7	Section 3.1	Series of analytic functions, uniform convergence, Weierstrass M-test
8	Section 3.2	Power series, nature of convergence of power series, differentiation of power series, Taylor's theorem
9	Sections 3.2 - 3.3	Isolated zeros, isolated singularities, Laurent series
10	Section 3.3	Classification of isolated singularities, zeros and poles, essential singularities, Casorati-Weierstrass theorem (Picard's theorem)
11	Section 4.1	Residues, calculation of residues
12	Section 4.2	Residue Theorem, residues at infinity, examples of integrals computed by residues
13	Section 4.3	Calculus of residues, definite integrals, Cauchy principal value, branch points
14	Section 6.2	Root and pole counting, principle of the argument, logarithmic differentiation, Rouché's theorem
15	Section 6.2 and instructor supplement	Winding number, Fundamental Theorem of Algebra

Method of Assessment

The possible methods of assessment are written individual examinations, quizzes, in-class worksheets or presentations, projects, and homework. One or more midterms and a cumulative final exam are required.

Instructional Mode

The instructional mode for this class is face-to-face. This designation means that the essential academic standards of the course require in-class student engagement, and thus remote instruction is not appropriate.