42048 Introduction to Complex Variables (3)

Knowledge

Complex number system and polar form. Analytic functions and the Cauchy-Riemann equations. Harmonic functions and conjugates. Elementary complex functions: exponential, logarithm, powers, roots, trigonometric, hyperbolic. Complex contour integral. Simply connected domains. Big-3 results of complex integration theory: Cauchy Integral Theorem, Cauchy Integral Formula, Cauchy Residue Theorem. Complex power series and Laurent series.

Comprehension

Connection between complex functions and mappings. Connection between complex contour integrals and line integrals of advanced calculus. Understand the connections among independence of path, vanishing loop integrals, exact differentials, Green's theorem, and potential fields.

Application

Basic algebra of complex numbers and variables and functions. Logarithmic potential of electrostatics. Orthogonal trajectories. Complex partial fraction expansion of rational functions. Evaluation of complex contour integrals by parametrization. Evaluation of complex contour integrals by residues.

Analysis

Be able to show that the real and imaginary parts of an analytic function are harmonic. Be able to show that the level curves of the real and imaginary parts of an analytic function are orthogonal trajectories. Use the Cauchy-Riemann equations to prove that the real and imaginary parts of the contour integral of an analytic function are independent of path.

Synthesis

Know how to use deformation of contour to transform complex contour integrals into simpler forms.

Evaluation

Be able to explain why there is no Mean Value Theorem for complex functions.

Class Activities

Lectures: development, exposition, examples, and illustrations. Mid-term and final exams.

Out of Class Activities

Written homework.