

# **Complex analysis for mathematics and engineering**

Mathews, John H.

## **Chapter 1- Complex Numbers**

- 1.1 The Origin of Complex Numbers
- 1.2 The Algebra of Complex Numbers
- 1.3 The Geometry of Complex Numbers
- 1.4 The Geometry of Complex Numbers, Continued
- 1.5 The Algebra of Complex Numbers, Revised
- 1.6 The Topology of Complex Numbers

## **Chapter 2- Complex Functions**

- 2.1 Functions of a Complex Variable
- 2.2 Transformations and Linear Mappings
- 2.3 The Mappings  $w=z^n$  and  $w = z^{1/n}$
- 2.4 Limits and Continuity
- 2.5 Branches and Functions
- 2.6 The Reciprocal Transformation  $w=1/z$

## **Chapter 3- Analytic and Harmonic Functions**

- 3.1 Differentiable and Analytic Functions
- 3.2 The Cauchy-Riemann Equations
- 3.3 Harmonic Functions

## **Chapter 4- Sequences, Julia and Mandelbrot Sets, and Power Series**

- 4.1 Sequences and Series
- 4.2 Julia and Mandelbrot Sets
- 4.3 Geometric Series and Convergence Theorems
- 4.4 Power Series Functions

## **Chapter 5- Elementary Functions**

- 5.1 The Complex Exponential Function
- 5.2 The Complex Logarithm
- 5.3 Complex Exponents
- 5.4 Trigonometric and Hyperbolic Functions
- 5.5 Inverse Trigonometric and Hyperbolic Functions

## **Chapter 6- Complex Integration**

- 6.1 Complex Integrals
- 6.2 Contours and Contour Integrals
- 6.3 The Cauchy-Goursat Theorem
- 6.4 The Fundamental Theorems of Integration

6.5 Integral Representations for Analytic Functions

6.6 The Theorems of Morera and Liouville and Some Applications

### **Chapter 7- Taylor and Laurent Series**

7.1 Uniform Convergence

7.2 Taylor Series Representations

7.3 Laurent Series Representations

7.4 Singularities, Zeros, and Poles

7.5 Applications of Taylor and Laurent Series

### **Chapter 8- Residue Theory**

8.1 The Residue Theorem

8.2 Calculation of Residues

8.3 Trigonometric Integrals

8.4 Improper Integrals of Rational Functions

8.5 Improper Integrals Involving Trigonometric Functions

8.6 Indented Contour Integrals

8.7 Integrands with Branch Points

8.8 The Argument Principle and Rouché's Theorem

### **Chapter 9- Z-Transforms**

The topic in my new section is z-transforms and applications to: finite difference equations, recurrence equations, digital filter design, signal processing

### **Chapter 10- Conformal Mapping**

10.1 Basic Properties of Conformal Mappings

10.2 Bilinear Transformations

10.2.1 Lines of Flux

10.3 Mappings Involving Elementary Functions

10.3.1 The Mapping  $w = (z^2 - 1)^{1/2}$

10.3.2 The Riemann Surface for  $w = (z^2 - 1)^{1/2}$

10.4 Mapping by Trigonometric Functions

10.4.1 The Complex Arcsine function

### **Chapter 11- Applications of Harmonic Functions**

11.1 Preliminaries

11.2 Invariance of Laplace's Equation and the Dirichlet Problem

11.3 Poisson's Integral Formula for the Upper Half Plane

11.4 Two-Dimensional Mathematical Models

11.5 Steady State Temperatures

11.5.1 An Insulated Segment on the Boundary

11.6 Two-Dimensional Electrostatics

- 11.7 Two-Dimensional Fluid Flow
- 11.8 The Joukowski Airfoil
  - 11.8.1 Flow with Circulation
- 11.9 The Schwarz-Christoffel Transformation
- 11.10 Image of a Fluid Flow
- 11.11 Sources and Sinks

## **Chapter 12- Fourier Series and the Laplace Transform**

- 12.1 Fourier Series
  - 12.1.1 Proof of Euler's Formulae
- 12.2 The Dirichlet Problem for the Unit Disk
- 12.3 Vibrations in Mechanical Systems
  - 12.3.1 Damped Systems
  - 12.3.2 Forced Vibrations
- 12.4 The Fourier Transform
- 12.5 The Laplace Transform
  - 12.5.1 From Fourier Transforms to Laplace Transforms
  - 12.5.2 Properties of the Laplace Transform
- 12.6 Laplace Transforms of Derivatives and Integrals
- 12.7 Shifting Theorems and the Step Function
- 12.8 Multiplication and Division by  $t$
- 12.9 Inverting the Laplace Transform
- 12.10 Convolution

Answers

Index