Math 309 (C1) Spring - Summer 2018

Mathematical Methods for Electrical Engineers

Department of Mathematical and Statistical Sciences
University of Alberta

Lecture Topics Selected From:

1. Complex Numbers

- 1.1 The Algebra of Complex Numbers
- 1.2 Point Representation of Complex Numbers
- 1.3 Vectors and Polar Forms
- 1.4 The Complex Exponential
- 1.5 Powers and Roots
- 1.6 Planar Sets
- 1.7 The Riemann Sphere and Stereographic Projection

2. Analytic Functions

- 2.1 Functions of a Complex Variable
- 2.2 Limits and Continuity
- 2.3 Analyticity
- 2.4 The Cauchy-Riemann Equations
- 2.5 Harmonic Functions
- 2.6 Steady-State Temperature as a Harmonic Function

3. Elementary Functions

- 3.1 Polynomials and Rational Functions
- 3.2 The Exponential, Trigonometric, and Hyperbolic Functions
- 3.3 The Logarithmic Function
- 3.4 Washers, Wedges, and Walls
- 3.5 Complex Powers and Inverse Trigonometric Functions
- 3.6 Application to Oscillating Systems

4. Complex Integration

- 4.1 Contours
- 4.2 Contour Integrals
- 4.3 Independence of Path
- 4.4 Cauchy's Integral Theorem
  - 4.4a Deformation of Contours Approach
  - 4.4b Vector Analysis Approach
- 4.5 Cauchy's Integral Formula and Its Consequences
- 4.6 Bounds for Analytic Functions
- 4.7 Applications to Harmonic Functions

5. Series Representations for Analytic Functions

- ▶ 5.1 Sequences and Series
- ▶ 5.2 Taylor Series
- ▶ 5.3 Power Series
- ▶ 5.4 Mathematical Theory of Convergence
- ▶ 5.5 Laurent Series
- ▶ 5.6 Zeros and Singularities
- ▶ 5.7 The Point at Infinity
- 5.8 Analytic Continuation

6. Residue Theory

- ▶ 6.1 The Residue Theorem
- ▶ 6.2 Trigonometric Integrals over $[0, 2\pi]$
- ▶ 6.3 Improper Integrals of Certain Functions over $(-\infty, \infty)$
- ▶ 6.4 Improper Integrals Involving Trigonometric Functions
- ▶ 6.5 Indented Contours
- ▶ 6.6 Integrals Involving Multiple-Valued Functions
- ▶ 6.7 The Argument Principle and Rouché's Theorem

7. Conformal Mapping

- ▶ 7.1 Invariance of Laplace's Equation
- ▶ 7.2 Geometric Considerations
- ▶ 7.3 Möbius Transformations
- ▶ 7.4 Möbius Transformations, Continued
- 7.5 The Schwarz-Christoffel Transformation
- 7.6 Applications in Electrostatics, Heat Flow, and Fluid Mechanics
- 7.7 Further Physical Applications of Conformal Mapping

8. The Transforms of Applied Mathematics

- ▶ 8.1 Fourier Series (The Finite Fourier Transform)
- ▶ 8.2 The Fourier Transform
- ▶ 8.3 The Laplace Transform
- 8.4 The z-Transform
- 8.5 Cauchy Integrals and the Hilbert Transform

The sections listed above are from the text by Saff and Snider.

The sections marked with an arrow (▶) are required reading, and we will try to cover all of them in class.