

Department: MATHEMATICAL SCIENCES

Semester Hours: 3

Course Title and Number: MATH 440 - Elements of Complex Analysis

Course Description: A beginning course in complex analysis emphasizing the applications of complex function theory.

PRQ: MATH 232 and MATH 240, or MATH 334, or equivalent.

Course Objectives: To gain a basic understanding of functions of a single complex variable and develop higher mathematical skills, including

- mathematically rigorous reasoning,
- clear and concise communication of mathematics (proofs),
- creative and abstract thinking,
- sharing, empathy and a general joie de vivre.

Syllabus:

- Complex numbers: algebraic properties; complex plane and Riemann sphere; representations of complex numbers; elementary topology of the plane.
- Complex functions: functions of a complex variable; continuous functions, sequences of functions, exponential and trigonometric functions, argument and logarithm, Möbius transformations.
- Differentiation: derivative of a complex function; Cauchy-Riemann equations; analytic functions; harmonic functions.
- Integration: contours and contour integrals; Cauchy-Goursat theorem and applications.
- Series representations: series and sequences of complex numbers and convergence; Taylor series; Laurent series; singularities, zeros and poles.
- Residue theory: the residue theorem; calculations of residues and applications to integration.

Selective Bibliography:

Mathews, **Complex Variables for Mathematics and Engineering** 2nd ed., W. C. Brown (1988)  
Saff, **Fundamentals of Complex Analysis for Mathematics, Science and Engineering**, 2nd ed., Prentice-Hall (1993)

Brown and Churchill, **Complex Variables and Applications** 9th ed., McGraw-Hill (2009)