Course Title: Complex Analysis

Course Code: MATH-301

Course Type: Major Math

Prerequisites: Real Analysis

Credit Hours: 3 (3 + 0)

Course Objectives: After successful completion of the course, students will be able to:

- Represent complex numbers algebraically and geometrically
- Understand Cauchy-Riemann equations, analytic functions and various properties of analytic functions.
- Understand Cauchy theorem and Cauchy integral formulas and apply these to evaluate complex contour integrals.
- Represent functions as Taylor and Laurent series, classify singularities and poles, find residues and evaluate complex integrals using the residue theorem.

Course Contents:

Introduction to Complex Numbers: Algebra of complex numbers, Geometric representation of complex numbers, Conjugate and modulus of complex numbers, Polar form of complex numbers, Argument function, Roots of complex numbers.

Functions of Complex Variables: Definition of functions of a complex variable, Limit and continuity, Branches of functions, Differentiable. Analytic functions, The Cauchy-Riemann equations, Entire functions, Harmonic functions. Elementary functions: Exponential, Trigonometric, Hyperbolic, Logarithmic and Inverse elementary functions. Definitions of Conformal mapping and Möbius transformation.

Complex Integrals: Contours and contour integrals, Upper bounds for Moduli of contour integrals, Cauchy-Goursat theorem, Cauchy integral formula, Liovilles theorem, Morereas theorem, Fundamental theorem of algebra.

Series: Power series, Radius of convergence and analyticity, Taylors and Laurents series.

Residues and Poles: Isolated singular points, Residues, Cauchys Residue Theorem, Types of singular points, Calculus of residues, Contour integration, Cauchys residue theorem with applications in computing real integrals.

Recommended Books:

1. Brown, J. W. and Churchill, R. V., *Complex Variables and Applications*, McGraw Hill, 9th edition, 2013.
2. Kasana, H. S., *Complex Variables: Theory and Applications*, Prentice-Hall of India Pvt.Ltd, 2nd edition, 2005.

3. Pennisi, L., *Elements of Complex Variables*, Holt, Rinehart and Winston, 2nd edition, 1976.

4. Spiegel, M. R., *Complex Variables*, McGraw-Hill Education-Europe, 1980.

5. Zill, D. G. and Shanahan, P. D., *Complex Analysis: A First Course with Applications*, Jones & Bartlett Learning, 3rd edition, 2013.

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