

Course code	:	DSE – F11
Title of course	:	Complex Analysis
Theory	:	32 Hrs. (40 lecturers of 48 min.)
Marks	:	50 (Credit: 02)

Course Learning Outcomes: This course will enable the students to:

- CO1: understand the fundamental concepts in linear algebra, enabling them to analyze and manipulate vector spaces, linear transformations.
- CO2: relate matrices and linear transformations
- CO3: acquire skills to perform computations related to inner product and orthogonalization techniques.
- CO4: compute Eigen values and Eigen vectors of a linear transformations.

Unit 1: Analytic Functions and Integrals

(20 Lect.)

- 1.1 Complex numbers: Sum and products, Basic algebraic properties of complex numbers , Further properties, Vectors and Moduli, Complex conjugates, Exponential form, Regions in the complex plane.
- 1.2 Analytic functions: Function of complex variable, Limits, Theorems on limits (Theorems without proof), Continuity (Theorems without proof), Derivatives, Differentiation formulas, Cauchy-Riemann equations, Sufficient conditions for differentiability, Polar Coordinates: Derivation of Cauchy-Riemann equations in polar form and examples, Analytic functions (Theorem without proof), Examples, Harmonic functions.
- 1.3 Integrals: Derivative of functions $w(t)$, Definite integrals of functions, Contours, Contour integrals, Some examples, Cauchy-Goursat theorem (Theorem without proof), Simply connected domains, Multiply connected domains, Cauchy Integral formula, An extension of the Cauchy Integral formula, Some consequences of the extension, Liouville's theorem and The fundamental theorem of algebra.

Unit 2: Sequences, Series and Residue Calculus

(20 Lect.)

- 2.1 Convergence of sequence, Convergence of series, Taylor series (Theorem without proof), Examples on Taylors and Maclaurin's series, Laurent's Theorem (Theorem without proof), Examples on Laurent's series.
- 2.2 Residues and Poles : Isolated singular points, Residues, Cauchy Residue theorem, Residue at infinity, The three type of isolated singular points, Residue at poles, Examples, Zeros of analytic functions, Zeros and poles.
- 2.3 Application of residues : Evaluation of improper integrals, Examples, Definite integrals involving sines and cosines.

Recommended book:

- 1. James Ward Brown and Ruel V. Churchill, Complex Variables and Applications, 8th Ed., McGraw – Hill Education (India) Edition, 2014. Eleventh reprint 2018.

Scope of Syllabus:

Unit 1: Chapter1 : 1, 2, 3, 4, 5, 6, 11, Chapter 2 : 12, 15,16, 18, 19, 20, 21, 22, 23, 24, 25, 26, Chapter 4: 37, 38, 39, 40, 41, 46, 48, 49, 50, 51, 52, 53.

Unit II: Chapter 5: 55, 56, 57, 59, 60, 62. Chapter 6: 68, 69, 70, 71, 72, 73, 74, 75, 76, Chapter 7: 78, 79, 85.

Reference books:

1. S. Ponnusamy, Foundations of Complex Analysis, Narosa Publishing House, Second Edition , 2005, Ninth reprint 2013.
2. Lars V Ahlfors, Complex Analysis, McGraw-Hill Education; 3 edition (January 1, 1979).
3. S. B. Joshi, T. Bulboaca and P. Goswamy, Complex Analysis, Theory and Applications, DeGruyter, Germany(2019).
4. Shanti Narayan, Dr. P. K. Mittal, Theory of functions of a complex variable, S. Chand, second edition, 2005.