

Discipline Specific Elective (DSE) Courses

Discipline Specific Elective (DSE) Courses 1a: Analysis

| Course Title and Code | Credits | Credit Distribution of Course | | | Eligibility Criteria | Prerequisite of the course (if any) |
|-----------------------|---------|-------------------------------|---------------------|----------------------|----------------------|-------------------------------------|
| | | Lecture (45 Hours) | Tutorial (15 Hours) | Practical (00 Hours) | | |
| DSE 1a: Analysis | 4 | 3 | 1 | 0 | NIL | NIL |

Course Objectives:

- To introduce students the knowledge of real field and complex field with their properties and relativity between complex plane and real line.
- To provide students grounds for Probability Theory and help in theoretical research in Statistics.

Course Learning Outcomes: After successful completion of this course, student will be able to:

- Understand existence of integral and their evaluation.
- Apply convergence theorems of sequence and series of real valued function and complex valued functions.
- Understand change of multiple integrals into line integral.
- Learn how apply real and complex-analytic methods to problems in probability theory.
- Understand complex region and relativity between complex plane and real line.
- Analyze power series, Laurent series, and residue calculus.
- Solve contour integrals.
- Gain exposure to challenging exercises that deepen theoretical understanding.

Unit I (10 Hours)

Functions of bounded variation, Riemann integration and Riemann-Stieltjes integration, Statement of the standard property and problem based on them, Multiple integrals, repeated integrals, Change of variables in multiple integration.

Unit II (11 Hours)

Differentiation under integral sign, Leibnitz rule, Dirichlet integral, Liouville's extension, Uniform convergence of sequence of functions and series of functions, Cauchy's criteria and Weirstrass M-test, Maxima-minima of functions of several variables.

Unit III (12 Hours)

Properties of complex numbers, Region in complex plane, Limit, continuity and differentiability of function of complex variables, Analytic function, Contour integration, Cauchy integral formula, Liouville's theorem, Fundamental theorem of Algebra.

Unit IV (12 Hours)

Power series and radius of convergence, Taylor's and Laurent's series, Singular points and their types, Residue at singular point and residue at infinity, Cauchy residue theorem, Evaluation of real integrals involving sine and cosine using residue.

Tutorial:

Tutorial sessions will include at least one activity such as group discussion/presentation/problem solving exercise based on the material covered in the lectures along with scholastic work related to the conceptual understanding of the subject.

Essential Readings:

1. Brown, J.W. and Churchill, R.V. (2009). *Complex variables and Applications*, McGraw Hill.
2. Rudin, W. (1985). *Principles of Mathematical Analysis*, McGraw Hill.

Suggested Readings:

1. Bak, J. and Newman, D. J. (1997). *Complex Analysis*, Springer.
2. Bartle, R.G. (1976). *Elements of Analysis*, John Wiley & Sons.
3. Rose, K.A. (2004). *Elementary Analysis: The Theory of Calculus*, Springer.