

**B.Sc. (Physical Sciences/Mathematical Sciences) Sem-V**  
**with Mathematics as one of the Core Discipline**

**Category-III**

**DISCIPLINE SPECIFIC CORE COURSE – 5 (Discipline A-5): ELEMENTS OF REAL ANALYSIS**

**CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE**

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Elements of Real Analysis	4	3	1	0	Class XII pass with Mathematics	NIL

**Learning Objectives:** The primary objective of this course is to introduce:

- The real line with algebraic, order and completeness properties.
- Convergence and divergence of sequences and series of real numbers with applications.

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

- Understand the basic properties of the set of real numbers, including completeness and Archimedean with some consequences.
- Recognize bounded, convergent, monotonic and Cauchy sequences
- Learn to apply various tests such as limit comparison, ratio, root, and alternating series tests for convergence and absolute convergence of infinite series of real numbers.

**SYLLABUS OF DISCIPLINE A-5**

**UNIT-I: Basic Properties of the Set of Real Numbers (12 hours)**

Field and order properties of  $\mathbb{R}$ , basic properties and inequalities of the absolute value of a real number, bounded above and bounded below sets, Suprema and infima, The completeness axiom and the Archimedean property of  $\mathbb{R}$ .

**UNIT-II: Real Sequences (18 hours)**

Convergence of a real sequence, Algebra of limits, The squeeze principle and applications, Monotone sequences, Monotone convergence theorem and applications, Cauchy sequences, Cauchy criterion for convergence and applications.

**UNIT-III: Infinite Series of Real Numbers (15 hours)**

Convergence and divergence of infinite series of real numbers, Necessary condition for convergence, Cauchy criterion for convergence of series, Tests for convergence of positive term series, Applications of the integral test, Comparison tests, D’Alembert’s ratio test, Cauchy’s  $n$ th root test, Raabe’s test; Alternating series, Leibniz alternating series test, Absolute and conditional convergence.

### Essential Reading

1. Denlinger, Charles G. (2011). Elements of Real Analysis. Jones & Bartlett India Pvt. Ltd. Student Edition. Reprinted 2015.

### Suggestive Readings

- Bartle, Robert G., & Sherbert, Donald R. (2011). Introduction to Real Analysis (4th ed.). John Wiley & Sons. Wiley India Edition 2015.
- Bilodeau, Gerald G., Thie, Paul R., & Keough, G. E. (2010). An Introduction to Analysis (2nd ed.). Jones & Bartlett India Pvt. Ltd. Student Edition. Reprinted 2015.

## DSE Courses of B.Sc. (Physical Sciences/Mathematical Sciences) Semester-V Category-III

### DISCIPLINE SPECIFIC ELECTIVE COURSE – 3(i): BIOMATHEMATICS

#### CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Biomathematics	4	3	1	0	Class XII pass with Mathematics	Discipline A-3: Differential Equations

**Learning Objectives:** The main objective of this course is to:

- Develop and analyse the models of the biological phenomenon with emphasis on population growth and predator-prey models.
- Interpret first-order autonomous systems of nonlinear differential equations using the Poincaré phase plane.
- Apply the basic concepts of probability to understand molecular evolution and genetics.

**Learning Outcomes:** The course will enable the students to:

- Get a better comprehension of mathematical models, utilised in biology.
- To identify and explain the findings from models of population studies, species' communication, adaptation, and dynamics of disorder.
- Create a basic model of molecular evolution by making use of probability and matrices.

### SYLLABUS OF DSE-3(i)

#### UNIT – I: Mathematical Modeling for Biological Processes (15 hours)

Formulation a model through data, A continuous population growth model, Long-term behavior and equilibrium states, The Verhulst model for discrete population growth,