

## DISCIPLINE SPECIFIC CORE COURSE – 5: CALCULUS

### 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		
Calculus	4	3	1	0	Class XII pass with Mathematics	DSC-2: Elementary Real Analysis

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

- To introduce the basic tools of calculus, also known as ‘science of variation’.
- To provide a way of viewing and analyzing the real-world.

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

- The notion of limits, continuity and uniform continuity of functions.
- Geometrical properties of continuous functions on closed and bounded intervals.
- Applications of derivative, relative extrema and mean value theorems.
- Higher order derivatives, Taylor’s theorem, indeterminate forms and tracing of curves.

### SYLLABUS OF DSC-5

#### UNIT – I: Limits and Continuity (15 hours)

Limits of functions ( $\varepsilon - \delta$  and sequential approach), Algebra of limits, Squeeze theorem, One-sided limits, Infinite limits and limits at infinity; Continuous functions and its properties on closed and bounded intervals; Uniform continuity.

#### UNIT – II: Differentiability and Mean Value Theorems (15 hours)

Differentiability of a real-valued function, Algebra of differentiable functions, Chain rule, Relative extrema, Interior extremum theorem, Rolle’s theorem, Mean-value theorem and its applications, Intermediate value theorem for derivatives.

#### UNIT – III: (15 hours)

##### Successive Differentiation, Taylor’s Theorem and Tracing of Plane Curves

Higher order derivatives and calculation of the  $n$ th derivative, Leibnitz’s theorem; Taylor’s theorem, Taylor’s series expansions of  $e^x$ ,  $\sin x$ ,  $\cos x$ . Indeterminate forms, L’Hôpital’s rule; Concavity and inflexion points; Singular points, Asymptotes, Tracing graphs of rational functions and polar equations.

#### Essential Readings

1. Anton, Howard, Bivens, Irl, & Davis, Stephen (2013). *Calculus* (10th ed.). John Wiley & Sons Singapore Pvt. Ltd. Reprint (2016) by Wiley India Pvt. Ltd. Delhi.
2. Bartle, Robert G., & Sherbert, Donald R. (2011). *Introduction to Real Analysis* (4th ed.). John Wiley & Sons. Wiley India edition reprint.

3. Prasad, Gorakh (2016). *Differential Calculus* (19th ed.). Pothishala Pvt. Ltd. Allahabad.
4. Ross, Kenneth A. (2013). *Elementary Analysis: The Theory of Calculus* (2nd ed.). Undergraduate Texts in Mathematics, Springer. Indian reprint.

### Suggestive Readings

- Apostol, T. M. (2007). *Calculus: One-Variable Calculus with an Introduction to Linear Algebra* (2nd ed.). Vol. 1. Wiley India Pvt. Ltd.
- Ghorpade, Sudhir R. & Limaye, B. V. (2006). *A Course in Calculus and Real Analysis*. Undergraduate Texts in Mathematics, Springer (SIE). Indian reprint.

## DISCIPLINE SPECIFIC CORE COURSE – 6: ORDINARY DIFFERENTIAL EQUATIONS

### 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		
Ordinary Differential Equations	4	3	0	1	Class XII pass with Mathematics	NIL

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

- The exciting world of differential equations.
- Their applications and mathematical modeling.

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

- Learn the basics of differential equations and compartmental models.
- Formulate differential equations for various mathematical models.
- Solve first order non-linear differential equations, linear differential equations of higher order and system of linear differential equations using various techniques.
- Apply these techniques to solve and analyze various mathematical models.

### SYLLABUS OF DSC-6

#### UNIT – I: First-Order Differential Equations (12 hours)

Concept of implicit, general and singular solutions for the first order ordinary differential equation; Bernoulli's equation, Exact equations, Integrating factors, Initial value problems, Reducible second order differential equations; Applications of first order differential equations to Newton's law of cooling, exponential growth and decay problems.

#### UNIT – II: Second and Higher-Order Differential Equations (18 hours)