DISCIPLINE SPECIFIC CORE COURSE – 2: TOPICS IN 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		
Topics in Calculus	4	3	1	0	Class XII pass with Mathematics	Nil

Learning Objectives

The primary objective of this course is to:

- Introduce the basic tools of calculus which are helpful in understanding their applications in many real-world problems.
- Understand/create various mathematical models in everyday life.

Learning Outcomes

This course will enable the students to:

- Understand continuity and differentiability in terms of limits and graphs of certain functions.
- Describe asymptotic behaviour in terms of limits involving infinity.
- Use of derivatives to explore the behaviour of a given function locating and classify its

extrema and graphing the function.

- Apply the concepts of asymptotes, and inflexion points in tracing of cartesian curves.
- Compute the reduction formulae of standard transcendental functions with applications.

SYLLABUS OF DSC - 2

Theory

Unit – 1 **(20 hours)**

Limits, Continuity and Differentiability

Limit of a function, $\varepsilon-\delta$ definition of a limit, Infinite limits, Continuity and types of discontinuities; Differentiability of a function, Successive differentiation: Calculation of the nth derivatives, Leibnitz theorem; Partial differentiation, Euler's theorem on homogeneous functions.

Unit – 2 **(20 hours)**

Mean Value Theorems and its Applications

Rolle's theorem, Mean value theorems and applications to monotonic functions and inequalities; Taylor's theorem, Taylor's series, Maclaurin's series expansions of e^x, $\sin x$, $\cos x$, $\log(1+x)$ and $(1+x)^m$; Indeterminate forms.

Unit – 3 **(20 hours)**

Tracing of Curves and Reduction Formulae

Asymptotes (parallel to axes and oblique), Concavity and inflexion points, Singular points, Tangents at the origin and nature of singular points, Curve tracing (cartesian and polar equations). Reduction formulae for $\int \sin^n x\,dx, \int \cos^n x\,dx,$ and $\int \sin^m x \cos^n x\,dx$ and their applications.

Practical component (if any) – NIL

Essential Readings

- Prasad, Gorakh (2016). Differential Calculus (19th ed.). Pothishala Pvt. Ltd. Allahabad.
- Prasad, Gorakh (2015). Integral Calculus. Pothishala Pvt. Ltd. Allahabad.

Suggestive Readings

- Apostol, T. M. (2007). Calculus: One-Variable Calculus with An Introduction to Linear Algebra (2nd ed.). Vol. 1. Wiley India Pvt. Ltd.
- Ross, Kenneth. A. (2013). Elementary Analysis: The Theory of Calculus (2nd ed.). Undergraduate Texts in Mathematics, Springer. Indian reprint.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

B.A/ B.Sc. (Prog.) with Mathematics as Non-Major (Sem I)

Teaching Plan (DSC: Topics in Calculus):

Weeks 1 and 2: Limit of a function, definition of a limit, Infinite limits, Continuity and types of discontinuities.
[1] Chapter 2.

Weeks 3 and 4: Differentiability of a function, Successive differentiation: Calculation of the *n*th derivatives, Leibnitz theorem.
[1] Chapter 3 (Sections 3.1, and 3.2), and Chapter 5.

Week 5: Partial differentiation, Euler's theorem on homogeneous functions.
[1] Chapter 12 [Section 12.2 (12.21 without proof, exclude 12.22 and 12.23), and Section 12.3].

Weeks 6 and 7: Rolle's theorem, Mean value theorems and applications to monotonic functions and inequalities.
[1] Chapter 7 (Sections 7.4 to 7.6).

Weeks 8 and 9: Taylor's theorem with Lagrange's and Cauchy's form of remainders, Definition and examples of convergent sequences and series, Taylor's, Maclaurin's series expansions of e^x, $\sin x$, $\cos x$, $\log(1+x)$ and $(1+x)^m$.
[1] Chapter 6 (Brief introduction of convergence from the Sections 6.1 and 6.2).
[1] Chapter 7 (Sections 7.7, and 7.8).

Week 10: Indeterminate forms.
[1] Chapter 16.

Week 11: Asymptotes (parallel to axes and oblique).
[1] Chapter 9 (Sections 9.1 to 9.4).

Weeks 12 and 13: Concavity and inflexion points, Singular points (cusp, node and conjugate), Tangents at the origin and nature of singular points, Curve tracing (cartesian and polar equations).
[1] Chapter 10 (Section 10.7).
[1] Chapter 11. Use only statement for nature of double points in the Section 11.4.

Weeks 14 and 15: Reduction formulae for $\int \sin^n x\,dx, \int \cos^n x\,dx,$ and $\int \sin^m x \cos^n x\,dx$ and their applications. [2] Chapter 4 (Sections 4.1, 4.11, 4.12, and 4.13).