St. Xavier's College (Autonomous), Ahmedabad

Syllabus of Semester – I of the following departments under Faculty of Data Science based on Undergraduate Curriculum Framework to be implemented from the Academic Year 2025-26.

DEPARTMENT OF DATA SCIENCE

BSc. Artificial Intelligence and Machine Learning (Hons.)

Minor Course: Calculus-I

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title & Code	Credit Distribution of The Course			Eligibility Criteria	Prerequisite(s) of the Course (if any)
	Lecture	Tutorial	Practical / Practice		
Calculus-1	4	0	0	10 + 2 from a recognized board in any stream	Nil

Course Objectives:

By the end of this course, students will be able to:

1. Understand and apply fundamental concepts of sets, relations, and functions to model and solve problems relevant to artificial intelligence and machine learning.
2. Analyze the behavior of mathematical functions using limits and continuity, and appreciate their significance in optimization and learning algorithms.
3. Apply rules of differentiation, including higher-order and implicit differentiation, to assess function behavior and prepare for gradient-based learning methods.
4. Utilize curve tracing techniques to interpret and visualize mathematical models, especially in understanding optimization landscapes in AI applications.
5. Develop the ability to connect core calculus and algebraic concepts to real-world AI/ML problems, fostering analytical thinking and mathematical intuition.

Learning Outcomes:

After completing this course, students will be able to:

CO – 1 Apply set theory, relations, and functions to model and analyze structured data in AI and ML contexts.
CO – 2 Evaluate limits and continuity to understand and ensure stability in mathematical models.
CO – 3 Use differentiation techniques to analyze and interpret function behavior in optimization problems.
CO – 4 Trace curves and interpret graphical behavior to support decision-making in AI model design.

UNIT	TOPICS / SUBTOPICS	Hours
1	**Sets, Relations, and Functions:** Definition of sets, types of sets, set operations, Venn diagrams Cartesian product of sets, relations, properties of relations, Functions: Types, composition of functions, inverse functions, Applications of sets, relations, and functions in AI and ML	**15**
2	**Limits and Continuity:** Concept of limits, left-hand and right-hand limits, Techniques for evaluating limits, L'Hospital's Rule, Continuity of a function, properties of continuous functions, Intermediate value theorem, applications in calculus, Limits involving infinity and their significance in calculus.	**15**
3	**Basic Differentiation:** Definition and geometric interpretation of derivative Rules of differentiation (sum, product, quotient, chain rule), Higher-order derivatives, implicit differentiation, Logarithmic differentiation and its applications	**15**
4	**Curve Tracing and Applications:** Concept of increasing and decreasing functions, Concavity and convexity, points of inflection, Asymptotes and their types, Steps to trace curves in Cartesian and parametric forms, Applications of curve tracing in optimization and AI.	**15**

Essential / Recommended Readings:

The topics are roughly covered in

1. Calculus: Early Transcendentals (8th Edition) by James Stewart, Cengage Learning. https://dzackgarza.com/assets/books/Stewart.pdf
2. Calculus – Vol I, one variable calculus, with an introduction to linear algebra, (2nd Edition), by Tom Apostol https://simeioseismathimatikwn.wordpress.com/wp-content/uploads/2013/03/apostol-calculusi.pdf
3. Basics of Mathematics (8th Edition), B. S. Shah Prakashan

Suggestive Readings:

1. "Mathematics for Computer Science" by Eric Lehman, F. Thomson Leighton, and Albert R. Meyer
2. "Krishna's B.C.A. Mathematics – I" by J. P. Chauhan and Sharad Kumar. https://archive.org/download/books_202307/BCA%20MATHEMATICS%20VOL-1.pdf
3. "Calculus of One Variable" by M. Thamban Nair https://www.anebooks.com/Rajesh/Maths.pdf
4. NCERT Mathematics Textbooks (Class 11 & 12) https://ncert.nic.in/textbook/pdf/kemh102.pdf