**A.C.-03.08.2022**
**Appendix-80**

# UNIVERSITY OF DELHI

## DEPARTMENT: MATHEMATICS

### COURSE NAME: Bachelor with 2 core Disciplines

**(SEMESTER - I)**
based on

Undergraduate Curriculum Framework 2022 (UGCF)

(Effective from Academic Year 2022-23)

University of Delhi

Course name: **Bachelor with 2 core Disciplines**

| Course Title | Nature of the Course | Total Credits | Components | | | Eligibility Criteria/ Prerequisite | **Contents of the course and reference is in** |
|---|---|---|---|---|---|---|---|
| | | | Lecture | Tutorial | Practical | | |
| Elements of Discrete Mathematics | DSC | 4 | 3 | 1 | 0 | **12th** | **Annexure-I** |
| Topics in Calculus | Discipline-1 | 4 | 3 | 1 | 0 | **12th** | **Annexure-II** |

# Mathematics Bachelor with 2 Core Disciplines (Sem I)
# DSC-I: Elements of Discrete Mathematics

**Total Marks: 100** (Theory: 75, Internal Assessment: 25) **Examination:** 3 Hrs.
**Workload:** 3 Lectures, 1 Tutorial (per week) **Credits:** 4

**Course Objectives:** Students are introduced to the important concept of order (or partial order) and related properties. The course includes the notion of a lattice which is also a step towards abstract algebra. Students are taught the concept of Boolean algebra and its applications to minimizing a Boolean polynomial and switching circuits, which has further applications in computer science.

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

i) Understand the basic concepts of sets, relations, functions, and induction.
ii) Understand mathematical logic and logical operations to various fields.
iii) Understand the notion of order and maps between partially ordered sets.
iv) Minimize a Boolean polynomial and apply Boolean algebra techniques to decode switching circuits.

**Unit 1: Sets, Relations and Functions**

Sets, Propositions and logical operations, Conditional statements, Mathematical induction, Relations and equivalence relation, Equivalence classes, Partial order relation, Partially ordered set, Hasse diagrams, Chain, Maximal and minimal elements, least and greatest elements, Least upper bound, Greatest lower bound, Zorn's lemma, Functions and bijective functions, Functions between POSETS, Order isomorphism.

**Unit 2: Lattices**

Lattice as a POSET, Lattice as an algebra and their equivalence, Bounded lattices, Sublattices, Interval in a lattice, Products and homomorphism of lattices, Isomorphism of lattices; Distributive, Complemented, Partition and pentagonal lattices.

**Unit 3: Boolean Algebra and Switching Circuits**

Boolean algebra, De Morgan's laws, Boolean expressions, Truth tables, Logic diagrams, Boolean functions, Disjunctive normal forms (as join of meets), Minimal forms of Boolean polynomials, Quine Mc-Cluskey method, Karnaugh maps, Switching circuits, Applications of switching circuits.

**References**:

1. Rudolf Lidl, & Gunter Pilz (2004). *Applied Abstract Algebra* (2nd ed.). Undergraduate text in Mathematics, Springer (SIE), Indian Reprint.
2. Bernard Kolman, Robert C. Busby, & Sharon Cutler Ross (2009). *Discrete Mathematical Structures* ($6^{th}$ ed.). Pearson education Inc., Indian reprint.

**Additional Reading**:

i. Rosen, Kenneth H. (2017). *Discrete Mathematics and its applications with combinatorics and Graph Theory* (7th ed.). McGraw Hill Education.

# Bachelor with 2 Core Disciplines (Sem I)
# Discipline A-1: Topics in Calculus

**Total Marks: 100** (Theory: 75, Internal Assessment: 25) **Examination:** 3 Hrs.
**Workload:** 3 Lectures, 1 Tutorial (per week) **Credits:** 4

**Course 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. Students will be able to understand/create various mathematical models in everyday life.

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

i) Understand continuity and differentiability in terms of limits and graphs of certain functions.
ii) Describe asymptotic behaviour in terms of limits involving infinity.
iii) Use of derivatives to explore the behaviour of a given function locating and classify its extrema and graphing the function.
iv) Apply the concepts of asymptotes, and inflexion points in tracing of cartesian curves.
v) Compute the reduction formulae of standard transcendental functions with applications.

**Unit 1: 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 *n*th derivatives, Leibnitz theorem; Partial differentiation, Euler's theorem on homogeneous functions.

**Unit 2: 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: 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.

**References:**

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

**Additional Readings:**

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