# Semester - II
## MTS-151:Algebra and Calculus II

**Course type: Theory**                    **No. of Credits: 02**

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**Course Objectives:**

1. To study matrix properties, algebraic properties, and methods for finding the inverse of a matrix.

2. To explore the solution of systems of linear equations and evaluate determinants by row reduction.

3. To learn the properties of determinants and study the applications of matrices and determinants.

4. To learn how to find the derivative of a function using limits, and understand the geometrical and physical significance of derivatives.

5. To explore methods to find the $n^{th}$ derivatives of functions.

6. To generalize the comprehensive study of combined algebra and calculus.

**Course Outcomes:**   The successful completion of these course students will able to:

1. Understand the various types of matrices, their properties, and how to convert matrices to echelon form using elementary row operations.

2. Learn methods to solve systems of linear equations, understand the concept of determinants, evaluate determinants by different methods, and solve problems using properties of determinants.

3. Apply the concept of matrices and determinant to the problems in chemistry, electronics, cryptography, etc.

4. Understand differentiation and fundamental theorem in differentiation.

5. Apply Mean Value Theorems and it's applications

6. Explore the combined application of algebra and calculus to various mathematical problems.

## Course Content

**Unit 1 : Systems of Linear Equations and Matrices:  (08 Hours) Section I: Matrix Algebra**

1.1  Matrices and Matrix Operations.

1.2  Inverses; Algebraic Properties of Matrices

1.3  Elementary Matrices and a Method for Finding $A^{-1}$

1.4  Matrix, Matrix Notation and Size of Matrix.

1.5 Diagonal, Triangular, and Symmetric Matrices [Definitions and examples only]

1.6 More on Linear Systems and Invertible Matrices

1.7 Introduction to Systems of Linear Equations

1.8 Gaussian Elimination Method.
    **Note: Theorems 1.4.1,1.4.3,1.4.8,1.5.3,1.6.1-1.6.4,1.7.1 are without proof.**

## Unit 2: Determinants                                                    (07 Hours)

2.1 Determinants by Cofactor Expansion.

2.2 Evaluating Determinants by Row Reduction.

2.3 Properties of Determinants; Cramer's Rule (Without Proof).

2.4 Applications towards Balancing Chemical Equations.

2.5 Applications in Cryptography.
    **Note: Theorems 2.1.1, 2.1.2, 2.2.3, 2.2.4, 2.3.1, 2.3.6, 2.3.8 are without proof**

## Recommended book:

1. Elementary Linear Algebra by Howard Anton, Chris Rorres, 11th Edition [Applications Version] Unit 1: Section 1.1 to 1.7 , Unit 2: Section 2.1 to 2.3, 2.4 [1.10 Balancing Chemical Equations]

## Reference Books:

1. Matrix and Linear Algebra by K. B. Datta, Prentice Hall India Pvt., Limited, 2004.

2. Fundamentals of Matrix Algebra, (3rd Edition) by G. Hartman

3. Linear Algebra and its Applications, David Lay, Third Edition, Pearson Publications.

## Section II: Calculus
## Unit 3: Differentiation                                                 (06 Hours)

3.1 The Derivative as a Function.

3.2 Differentiation Rules

3.3 The Derivative as a Rate of Change

3.4 Derivatives of Trigonometric Functions

3.5 The Chain Rule

3.6 Applications

## Unit 4: Mean Value Theorems                                             (09 Hours)

4.1 Extreme Values of Functions.

4.2 The Mean Value Theorem

4.3 L′Hospital′s Rule (without proof)

4.4 Cauchy's Mean Value Theorem

**Recommended book:**

1. Applied Finite Mathematics by R. Sekhon and R. Bloom, Libre Texts. Unit 2 (2.5): Section 2.5

2. Thomas Calculus: EARLY TRANSCENDENTALS (12th Edition), Pearson Education Unit 3: Section 3.2 - 3.6 and 3.10 Unit 4: Section 4.1 - 4.2 and 4.5

**Reference Books:**

1. Calculus Volume I (Second Edition) Wiley Student Edition, T. M. Apostol, John Wiley, New Delhi.

2. Elements of Real Analysis, Shanti Narayan, M. D. Raisinghaniya (Revised Edition 2012), S. Chand and Company Ltd.

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# MTS 152 - Practicals based on MTS-151 (Algebra and Calculus II)

**Course type: Practical**                    **No. of Credits: 02**

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