UG MA S3-01
(DSE)

FOUR YEAR DEGREE COURSE

(CBCS in Accordance with NEP 2020)

SEMESTER - III

DIFFERENTIAL CALCULUS

MATHEMATICS

Hiranya Chandra Bhuyan School of Science and Technology

KRISHNA KANTA HANDIQUI STATE OPEN UNIVERSITY

Subject Experts

Professor Bipan Hazarika, Dept. of Mathematics, Gauhati University

Dr. Dilip Kumar Sarma, Former Head, Dept. of Mathematics, Cotton College

Course Co-ordinator : Harekrishna Deka, KKHSOU

SLM Preparation Team

UNITS	CONTRIBUTORS
1, 2, 3, 5, 6, 7, 8, 9 & 10	S. K. Jha, Lumding College, Lumding
11, 12, 13 & 14	Harekrishna Deka, KKHSOU

Editorial Team

Content : Dr. Dilip Kumar Sarma, Dept. of Mathematics, Cotton College

Structure, Format : Harekrishna Deka, KKHSOU

First Edition : September, 2024 ISBN: .....

© Krishna Kanta Handiqui State Open University

This Self Learning Material (SLM) of the Krishna Kanta Handiqui State Open University is made available under a Creative Commons Attribution-Non Commercial-Share Alike 4.0 License (international): http://creativecommons.org/licenses/by-nc-sa/4.0/

Printed and published by Registrar on behalf of the Krishna Kanta Handiqui State Open University.

The University acknowledges with thanks the financial support provided by the **Distance Education Bureau, UGC** for the preparation of this study material.

Headquarters: Patgaon, Rani Gate, Guwahati-781017
City Office: NH 37, Resham Nagar, Khanapara, Guwahati 781022; Web: www.kkhsou.in

CONTENTS

UNIT 1: Functions **Pages: 7-19**

Function: Domain and Range of a Function; Classification of a Function: Some Important Functions

UNIT 2: Limit of a Function **Pages: 20-36**

Limit of a Function: Methods of Evaluation Limits of Functions, Some Important Limits, Right Hand and Left Hand Limits

UNIT 3: Continuity of a Function **Pages: 37-46**

Definition, Examples, Continuity of a Function at a Point

UNIT 4: Differentiability of a Function **Pages: 47-60**

Concept of Derivative: Derivative of a Function, Left and Right Hand Derivatives

UNIT 5: Derivatives of Functions **Pages: 61-87**

Geometrical Interpretation of Derivative of a Function; Derivative of Various Standard Functions; Derivative of Sum and Difference of Functions; Derivative of Product of Functions and Quotient Rule

UNIT 6: Derivatives of Special Function **Pages: 88-108**

Derivative of Composite Functions; Derivative of Logarithm Functions and Implicit Functions

UNIT 7: Indeterminate Form **Pages: 111-125**

Indeterminate Form, Various Types of Indereminate Form L' Hospitals Rule

UNIT 8: Successive Differentiation **Pages: 126-151**

The n^{th} Derivatives of Some Standard Functions; Leibnitz's Theorem for the n^{th} Derivative of the Product of two Functions

UNIT 9: Application of Derivatives **Pages: 152-213**

Increasing and Decreasing Function; Derivative as a Rate Measurer; Maximum and Minimum of a Function: Methods for finding Maximum and Minimum; Application of Maxima and Minima; Curvature: Definition, Radius of Curvature, Radius of Curvature for Cartesian Curves, Radius of Curvature in Polar Form; Tangents and Normals: Equations of Tangent and Normal

UNIT 10: Mean Value Theorems **Pages: 214-241**

Rolle's Theorem: Geometrical Interpretation of Rolle's Theorem; Lagrange's Mean Value Theorem: Geometrical Meaning of Lagrange's Mean Value Theorem, Another form of Lagrange's Mean Value Theorem; Cauchy's Mean Value Theorem: Geometrical Meaning of Cauchy's Mean Value Theorem

UNIT 11: Partial Differentiation **Pages: 242-284**

Function of Several Variables; Partial Derivatives; Chain Rule for Partial Differentiation; Homogeneous Function; Euler's Theorem on Homogeneous Function

UNIT 12: Extreme Value of a Function of Several Variables **Pages: 285-304**

Taylor's Theorem for a Function of Two Variables; Maximum and Minimum of a Function of two Variables: Necessary Conditions for the Existence of a Maximum or a Minimum of a Function of two Variables, Stationary and Extreme Points, Sufficient Condition for Maxima or Minima of a Function of two Variables, Working rule for Finding Maxima or Minima of a Function of two Variables; Lagrange's Method of Undetermined Multipliers

UNIT 13: Jacobians **Pages: 305-321**

Definitions, Properties of Jacobians

UNIT 14: Lagrange Method of Undetermined Multipliers **Pages: 322-333**

Statement, Examples

COURSE INTRODUCTION

'Differential Calculus' is the third discipline specific elective course in Mathmatics for B. A programme.

The course consists of fourteen units.

In Unit 1, We will discuss about function and various types of function.

In Unit 2, We will introduce you to the concept of limit of a function.

In Unit 3, The concept of continuity of a function will be introduced.

In Unit 4, We will discuss the differentiability of a function.

In Unit 5, deals with the concept of derivatives.

In Unit 6, We will discuss the derivatives of various types functions.

In Unit 7, deals with limit of functions of indeterminate forms.

In Unit 8, we will discuss successive differentiation of various functions. Leibnitz's theorem on successive differentiation has also been included in this unit.

In Unit 9, we deals with application of derivatives such as finding equations of tangent and normal, curvature, maxima and minima of functions. We will also discuss increasing and decreasing function in this unit.

In Unit 10, we will discuss mean value theorems. Rolle's theorem, Lagrange's and Cauchy's mean value theorems have been included in this unit.

In Unit 11, we deals with the partial differentiation of homogeneous function. The concept of total differentiation is discussed in this unit. We also discuss about Euler's theorem in this unit.

In Unit 12, Taylor's theorem on expansion of series have been discussed in this unit. Maxima and minima of function of two or more variables are discussed in this unit with the help of simple geometrical examples.

In Unit 13, we will discuss the concept of Jacobian and its properties.

In Unit 14, we will discuss Lagrange's Method of undetermined multipliers.

While going through a unit, you will notice some along-side boxes, which have been included to help you know some of the difficult, unseen terms. Again, we have included some relevant concepts in ''LET US KNOW'' along with the text. And, at the end of each section, you will get "CHECK YOUR PROGRESS" questions. These have been designed to self-check your progress of study. It will be better if you solve the problems put in these boxes immediately after you go through the sections of the units and then match your answers with "ANSWERS TO CHECK YOUR PPROGRESS" given at the end of each unit.