Version No:
Approval Date:

Multivariate Calculus and Vector Calculus

Programme(s) in which it is offered: B.Sc.B.Ed. Mathematics

Course Category: Core	**Schedule of Offering**: Even
Course Credit Structure: 4	**Course Code:** MTH1212
Total Number of Hours: 5	**Contact Hours Per Week:** 5
Lecture: 3, 3	**Tutorial:** 1, 2
Practical: 0, 0	**Medium of Instruction:** English
Date of Revision:	**Skill Focus:** Others
Short Name of the Course: Multivariate Calculus & Vector Calculus	**Course Stream** ***(Only for Minor Courses)*****:**
Grading Method: Regular	**Repeatable:** Credit
Course Level: Intermediate	

Course Description

This is a core course offered to students of B.Sc.B.Ed. Mathematics students. This course discusses calculus of functions of two or more variables, multiple integration and vector calculus.

Course Introduction

This course introduces the learners to calculus of functions of two or more variables, and vector calculus. The course discusses various concepts such as partial differentiation, line integrals, double and triple integrals, improper integrals and their convergence, vector differentiation and vector integration, and their theory and applications.

Course Objective

The objectives of this course are:

1. To develop understanding of differential calculus of two variables
2. To develop understanding of integral calculus of two variables
3. To discuss the importance of calculus of several variables
4. To discuss the application of double and triple integration
5. To develop understanding of improper integrals and their convergence
6. To develop understanding of vector calculus

7. To discuss the application of double and triple integration

Course Outcome

At the end of the course students will be able to:

1. Apply the theory and techniques of differential calculus of functions of two variables
2. Evaluate double and triple integrals
3. Evaluate surface areas and volumes as applications of multiple integrals
4. Apply appropriate results in solving problems related to vector calculus
5. Appreciate the theory and applications of vector calculus

PO-CO Mapping

<This should explain how the Course Outcomes (CO) are mapped with the Programme Outcomes (PO). All programmes to have two generic POs which can map to all minors/proficiency courses and foundation/self-immersion courses. Please tick the respective cells only; leave the other cells blank.>

PO-CO Mapping Matrix

CO/PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6
CO1						
CO2						
CO3						
CO4						
CO5						

Prerequisites and other constraints

This course is offered to the students of B.Sc.B.Ed. Mathematics programme. This course does not require any pre-requisite course.

Pedagogy

The teaching-learning of the course is organized through lectures, problem-solving sessions and student presentations. ICT based sessions will be used in helping the learners visualize certain concepts and theory. Guided discovery approach and problem posing/solving approaches are the key strategies to be employed.

Suggested Reading:

1. Lang (1998). First Course in Calculus. Addison-Wiley
2. Thomas and Finney (2010). Calculus and Analytic Geometry. Pearson Education India.
3. Widder (1989). Advanced Calculus. Dover Publications.
4. Hallet, Gleason, et al. (2012). Calculus, Single and Multivariable. Wiley.
5. Narayan, S. and Mittal (2005). Integral Calculus. S Chand and Co Ltd.
6. Kreyszig (2015), Advanced Engineering Mathematics, Wiley Eastern Ltd.

Evaluation Pattern

Evaluation Matrix

	Component Type	Weightage Percentage	Total Marks	Tentative Dates	Course Outcome Mapping
Continuous Internal Assessment (CIA) Components*	Mid-semester exam	33% of CIA	50	Around 9th week	1, 2,
	Assignment	67% of CIA	30	End of each module	1, 2, 3, 4, 5
	Quizzes/ Problem Solving		10	Every two weeks	1, 2, 3, 4
	Presentations		10	End of two modules	1, 2, 3, 4, 5
	CIA Marks	30%	**100**		
ESE		70%	**100**	End of the semester	1, 2, 3, 4, 5

Module Sessions

Module 1: Differential Calculus of Functions of Two Variables (18 Hours)

Functions of two or more variables, Domain and range of functions of two variables;

Limits and Continuity functions of two variables; Partial derivatives of first and second order; Higher Order Partial Derivatives; Distinction between derivatives and differential coefficients, Equality of mixed order partial derivatives of second order; Euler's theorem on homogenous functions; Mean value theorem for functions of two variables; Taylor's theorem for functions of two variables.

Reading:

1. Hallet
2. Thomas
3. Lang

Activities:

a. Quiz
b. Assignment

Module 2: Integral Calculus of Functions of Two Variables (20 Hours)

Definition of a line integral and basic properties, Evaluation of line integrals, Definition of double integral, Conversion to iterated integrals, Evaluation of Double integral, change of variables, Surface areas. Definition of a triple integral, Evaluation, Volume as a triple integral.

Reading:

1. Hallet
2. Narayan
3. Widder

Activities:

a. Quiz
b. Assignment
c. Assignments

Module 3: Improper Integrals and Their Convergence (20 Hours)

Improper integrals of the first and second kinds, Convergence, Gamma and Beta functions, Connection between Beta and Gamma functions, Application to evaluation of Integrals, Duplication formula, Sterling formula (Statement only).

Reading:

1. Narayan
2. Widder
3. Thomas

Activities:

a. Quiz

b. Assignment

Module 4: Vector Calculus **(17 Hours)**

Vectors, Scalars, Vector field, Scalar field, Vector differentiation, Vector differential operator Del, Gradient, Curl, Vector integration, The divergence theorem of Gauss, Stoke's theorem, Green's theorem in plane.

Reading:

1. Kreyszig
2. Thomas

Activities:

a. Quiz
b. Assignment
c. Presentation