MA2508: MULTI-VARIABLE CALCULUS

Effective Term
Semester A 2024/25

Part I Course Overview

Course Title
Multi-variable Calculus

Subject Code
MA - Mathematics
Course Number
2508

Academic Unit
Mathematics (MA)

College/School
College of Science (SI)

Course Duration
One Semester

Credit Units
4

Level
B1, B2, B3, B4 - Bachelor's Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
Grade B or above in MA1201 Calculus & Basic Linear Algebra II and subject to approval from MA must be obtained; or
Grade C- or above in MA1301 Enhanced Calculus & Linear Algebra II; or
Grade C- or above in both MA1508 Calculus and MA1503 Linear Algebra with Applications

Precursors
Nil

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

Abstract

This course introduces fundamental mathematical methods and analysis in advanced calculus. It will help students to understand the basic concepts, fundamental theory and identify the applications of multi-variable calculus. It trains students in the ability to think quantitatively and analyze problems critically.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	evaluate limits, partial derivatives, and multiple integrals for functions of several variables.	30		x	
2	compute line and surface integrals.	20		x	
3	apply integral theorems of vector analysis to describe some physical problems.	10	x		x
4	explain basic concepts of multi-variable calculus, create and construct mathematical models through multi-variable calculus and vector analysis, and properly apply to some problems in science and engineering.	20	x	x	x
5	the combination of CILOs 1-4	20	x	x	x

A1: Attitude
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

A3: Accomplishments
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

Learning and Teaching Activities (LTAs)

	LTAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lectures	Learning through teaching is primarily based on lectures.	1, 2, 3, 4, 5	39 hours in total
2	Tutorials	Learning through tutorials is primarily based on interactive problem solving allowing instant feedback.	1	4 hours
3	Tutorials	Learning through tutorials is primarily based on interactive problem solving allowing instant feedback.	2	4 hours

4	Tutorials	Learning through tutorials is primarily based on interactive problem solving allowing instant feedback.	3	2 hours
5	Tutorials	Learning through tutorials is primarily based on interactive problem solving allowing instant feedback.	4	3 hours
6	Assignments	Learning through take-home assignments helps students understand basic mathematical concepts and fundamental theory of multi-variable calculus, and apply mathematical methods and analysis from advanced calculus to some applications.	1, 2, 3, 4, 5	after-class
7	Online applications	Learning through online examples for applications helps students create and formulate mathematical models and apply to some problems in science and engineering.	4	after-class
8	Math Help Centre	Learning activities in Math Help Centre provides students extra help.	1, 2, 3	after-class

Assessment Tasks / Activities (ATs)

	ATs	**CILO No.**	**Weighting (%)**	**Remarks (e.g. Parameter for GenAI use)**
1	Quizzes/Test/Midterm	1, 2, 3	24	Questions are designed for the first part of the course to see how well the students have learned the basic concepts, fundamental theory and recognized the applications of multi-variable calculus.
2	Hand-in assignments	1, 2, 3, 4	0	These are skills based assessment to enable students to demonstrate the basic concepts and fundamental theory of multi-variable calculus and identify the applications.

3	Formative take-home assignments	1, 2, 3, 4	6	The assignments provide students chances to demonstrate their achievements on multi-variable calculus learned in this course.

Continuous Assessment (%)

30

Examination (%)

70

Examination Duration (Hours)

3

Additional Information for ATs

30% Coursework
70% Examination (Duration: 3 hours, at the end of the semester)

For a student to pass the course, at least 30% of the maximum mark for the examination must be obtained.

Assessment Rubrics (AR)

Assessment Task

1. Quizzes/Test/Midterm

Criterion

ABILITY to APPLY and EXPLAIN the methodology of limits, partial derivatives and multiple integrals for functions of several variables

Excellent (A+, A, A-)

High

Good (B+, B, B-)

Significant

Fair (C+, C, C-)

Moderate

Marginal (D)

Basic

Failure (F)

Not even reaching marginal levels

Assessment Task

2. Hand-in assignments

Criterion

CAPACITY to evaluate limits, partial derivatives and multiple integrals for functions of several variables

Excellent (A+, A, A-)

High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal levels

Assessment Task
3. Formative take-home assignments

Criterion
CAPACITY for SELF-DIRECTED LEARNING to apply principles of multi-variable calculus to some problems in science and engineering

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal levels

Assessment Task
4. Examination

Criterion
ABILITY to DEVELOP mathematical models through multi-variable calculus and SOLVE problems with various methods

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)

Not even reaching marginal levels

Part III Other Information

Keyword Syllabus

- Three-dimensional coordinate systems, equations for lines and planes, quadric surfaces
- Definitions of multi-variable functions, concepts of limit and continuity, partial derivatives of multi-variable functions, calculations of partial derivatives and their applications (e.g., maximum and minimum)
- Definitions of double integrals and triple integrals, evaluations of double and triple integrals in rectangular and other coordinates, applications of double and triple integrals (e.g., mass of a plate)
- Definition of vector fields, curl and divergence, definitions and evaluations of line and surface integrals, Green's theorem, Stokes' theorem and Gauss’ s theorem

Reading List

Compulsory Readings

	Title
1	J. Stewart, “Multivariate Calculus”, fifth ed., Brooks/Cole, 2003.

Additional Readings

	Title
1	W. Rudin, Principles of mathematical analysis, New York: McGraw-Hill, c1976.
2	M.P. do Carmo, Differential geometry of curves and surfaces, Englewood Cliffs, N.J.: Prentice-Hall, c1976.
3	M. Spivak, Calculus on manifolds: a modern approach to classical theorems of advanced calculus, New York: W.A. Benjamin, 1965.