MA2001: MULTI-VARIABLE CALCULUS AND LINEAR ALGEBRA

Effective Term
Semester A 2024/25

Part I Course Overview

Course Title
Multi-variable Calculus and Linear Algebra

Subject Code
MA - Mathematics
Course Number
2001

Academic Unit
Mathematics (MA)

College/School
College of Science (SI)

Course Duration
One Semester

Credit Units
3

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

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
MA1201 Calculus and Basic Linear Algebra II / MA1301 Enhanced Calculus and Linear Algebra II; or equivalent

Precursors
Nil

Equivalent Courses
Nil

Exclusive Courses
MA2158 Linear Algebra and Calculus

Part II Course Details

Abstract

This course aims to introduce important ideas in Linear Algebra and Advanced Calculus necessary for an understanding of their application to Science and Engineering. It will help students develop the ability to think quantitatively and analyse problems critically.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	explain clearly mathematical concepts from linear algebra, and advanced calculus.	10	x	x	
2	compute eigenvalues and eigenvectors of matrices and implement eigenvalue decompositions.	20	x	x	
3	evaluate partial derivatives, local extrema and Taylor series of multivariate functions.	30	x	x	x
4	evaluate multiple integrals, line and surface integrals, and perform the theorems of Green, Divergence and Stokes.	30	x	x	x
5	apply mathematical and computational methods to a range of applications involving linear algebra and multi-variable calculus.	10	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	Students will engage in formal lectures to gain knowledge of topics in multi-variable calculus and linear algebra.	1, 2, 3, 4, 5	Min 39 hours to a max of 52 hours in total
2	Tutorials	Students will engage in tutorial activities to consolidate their learning through interactive problem solving and receiving instant feedback.	2	2 hours in total

3	Tutorials	Students will engage in tutorial activities to consolidate their learning through interactive problem solving and receiving instant feedback.	3	4 hours in total
4	Tutorials	Students will engage in tutorial activities to consolidate their learning through interactive problem solving and receiving instant feedback.	4	5 hours in total
5	Tutorials	Students will engage in tutorial activities to consolidate their learning through interactive problem solving and receiving instant feedback.	1, 5	2 hours in total
6	Practice exercises	Students will engage with a series of practice exercises posted on the course website in advance to deepen their knowledge and skills.	1, 2, 3, 4, 5	after-class
7	Online applications	Students will engage with online examples for applications to deepen and expand their knowledge and skills for applying mathematical and computational methods to solve problems.	5	after-class
8	Math Help Centre	Students will receive extra help through learning activities in Math Help Centre.	1, 2, 3, 4, 5	after-class

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Test/Midterm	1, 2, 3, 4	20	Questions are designed for the first part of the course to see how well the students have learned concepts and techniques of linear algebra and multi-variable calculus.

2	Hand-in assignments (Quizzes +WeBWorK)	1, 2, 3, 4, 5	4	These are skills based assessment to help students demonstrate advanced concepts and techniques of linear algebra, multi-variable calculus and some applications in science and engineering.
3	Formative take-home assignments	1, 2, 3, 4, 5	6	The assignments provide students' chances to demonstrate their achievements on linear algebra and multi-variable calculus learned in this course.

Continuous Assessment (%)

30

Examination (%)

70

Examination Duration (Hours)

2

Additional Information for ATs

30% Coursework
70% Examination (Duration: 2 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. Test/Midterm

Criterion

Intermediate stage: ability to understand the concepts and techniques of linear algebra and multi-variable calculus

Excellent (A+, A, A-)

Demonstrates a thorough understanding of the concepts and techniques in multi-variable calculus and linear algebra, and can always apply this understanding to solve a range of mathematical problems

Good (B+, B, B-)

Demonstrate a substantial understanding of the concepts and techniques in multi-variable calculus and linear algebra, and can usually apply this understanding to solve some mathematical problems

Fair (C+, C, C-)

Demonstrate a general understanding of the concepts and techniques in multi-variable calculus and linear algebra, and can sometimes apply this understanding to solve some mathematical problems

Marginal (D)

Demonstrate a partial understanding of the concepts and techniques in multi-variable calculus and linear algebra, and can rarely apply this understanding

Failure (F)

Demonstrate a little understanding or some misunderstanding of the concepts and techniques in multi-variable calculus and linear algebra, and can rarely or almost never apply this understanding

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Assessment Task

2. Hand-in assignments (Quizzes +WeBWorK)

Criterion

Carefully selected fundamental problems to test students' ability to demonstrate advanced concepts and apply analysis techniques to science and Engineering

Excellent (A+, A, A-)

Demonstrates a thorough understanding of the concepts and techniques in multi-variable calculus and linear algebra, and can always apply this understanding to solve a range of mathematical problems

Good (B+, B, B-)

Demonstrate a substantial understanding of the concepts and techniques in multi-variable calculus and linear algebra, and can usually apply this understanding to solve some mathematical problems

Fair (C+, C, C-)

Demonstrate a general understanding of the concepts and techniques in multi-variable calculus and linear algebra, and can sometimes apply this understanding to solve some mathematical problems

Marginal (D)

Demonstrate a partial understanding of the concepts and techniques in multi-variable calculus and linear algebra, and can rarely apply this understanding

Failure (F)

Demonstrate a little understanding or some misunderstanding of the concepts and techniques in multi-variable calculus and linear algebra, and can rarely or almost never apply this understanding

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Assessment Task

3. Formative take-home assignments

Criterion

Exercises and practices to demonstrate students' achievements on linear algebra and multi-variable calculus learned in this course

Excellent (A+, A, A-)

Demonstrates a thorough understanding of the concepts and techniques in multi-variable calculus and linear algebra, and can always apply this understanding to solve a range of mathematical problems

Good (B+, B, B-)

Demonstrate a substantial understanding of the concepts and techniques in multi-variable calculus and linear algebra, and can usually apply this understanding to solve some mathematical problems

Fair (C+, C, C-)

Demonstrate a general understanding of the concepts and techniques in multi-variable calculus and linear algebra, and can sometimes apply this understanding to solve some mathematical problems

Marginal (D)

Demonstrate a partial understanding of the concepts and techniques in multi-variable calculus and linear algebra, and can rarely apply this understanding

Failure (F)

Demonstrate a little understanding or some misunderstanding of the concepts and techniques in multi-variable calculus and linear algebra, and can rarely or almost never apply this understanding

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Assessment Task

4. Examination

Criterion

Ability to demonstrate their versatility in linear algebra and multi-variable calculus

Excellent (A+, A, A-)

Demonstrates a thorough understanding of the concepts and techniques in multi-variable calculus and linear algebra, and can always apply this understanding to solve a range of mathematical problems

Good (B+, B, B-)

Demonstrate a substantial understanding of the concepts and techniques in multi-variable calculus and linear algebra, and can usually apply this understanding to solve some mathematical problems

Fair (C+, C, C-)

Demonstrate a general understanding of the concepts and techniques in multi-variable calculus and linear algebra, and can sometimes apply this understanding to solve some mathematical problems

Marginal (D)

Demonstrate a partial understanding of the concepts and techniques in multi-variable calculus and linear algebra, and can rarely apply this understanding

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Demonstrate a little understanding or some misunderstanding of the concepts and techniques in multi-variable calculus and linear algebra, and can rarely or almost never apply this understanding

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Part III Other Information

Keyword Syllabus

Linear Algebra (3 weeks): Orthogonality; Eigenvalues and eigenvectors; Eigenvalue decompositions.

Multi-variable Calculus (10 weeks): Functions of several variables; Partial differentiation; Multi-variable Taylor series; Multiple integration; Gradient, divergence and curl; Line and surface integrals; Theorems of Gauss, Stokes and Green.

Reading List

Compulsory Readings

	Title
1	https://www.cityu.edu.hk/ma/programmes/undergraduate/non-BSCM-students/topics-recommended-readings-servicing-courses#heading6

Additional Readings

	Title
1	Elements of Advanced Engineering Mathematics by Peter V. O'Neil, Cengage Learning, 2011
2	Linear Algebra and Its Applications, 4/E, by David C. Lay, Pearson, 2011

3	Thomas' Calculus, Multivariable (12th Edition) by George B. Thomas Jr. , Maurice D. Weir, Joel R. Hass, 2009
4	Multivariable Calculus with Matrices (6th ed.) by C. Henry Edwards and David E. Penney, Prentice Hall, 2002