MA1503: LINEAR ALGEBRA WITH APPLICATIONS

Effective Term
Semester A 2022/23

Part I Course Overview

Course Title
Linear Algebra with Applications

Subject Code
MA - Mathematics
Course Number
1503

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
(i) HKDSE Mathematics Compulsory Part, or
(ii) HKDSE Mathematics Compulsory Part and Extended Part Module 1, or
(iii) HKDSE Mathematics Compulsory Part and Extended Part Module 2 (Levels 1 – 3); or equivalent

Precursors
Nil

Equivalent Courses
Nil

Exclusive Courses
MA2503 Linear Algebra

Part II Course Details

Abstract

This course introduces the theory and applications of linear algebra and matrices. It will help students to develop a logical and systematic understanding of the core material of linear algebra, and apply linear algebra methods to create and formulate mathematical models in science and related fields.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Explain clearly concepts from vector and matrix algebra	10	x		
2	Perform basic operations and solve equations involving complex numbers	10	x		
3	Evaluate mathematical quantities of matrices and vector spaces by Gaussian elimination, diagonalization, and other algorithms	25		x	
4	Develop a logical and systematic understanding of the structure of the Euclidean vector spaces, and demonstrate this in some practical problems	15	x	x	
5	Apply linear algebra methods to various subjects, and create and formulate mathematical models to a range of problems in science and engineering involving linear structures	15	x	x	x
6	The combination of CILOs 1 – 5	25	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.

Teaching and Learning Activities (TLAs)

	TLAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lectures	Learning through teaching is primarily based on lectures.	1, 2, 3, 4, 5, 6	39 hours in total
2	Tutorials	Learning through tutorials is primarily based on interactive problem solving allowing instant feedback.	2	4 hours

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

Assessment Tasks / Activities (ATs)

	ATs	**CILO No.**	**Weighting (%)**	**Remarks (e.g. Parameter for GenAI use)**
1	Quizzes/Test(s)	1, 2, 3, 4, 5, 6	25	Questions are designed for the first part of the course to see how well the students have learned the basic concepts and fundamental theory of linear algebra, and have developed the ability of proving mathematical statements rigorously.

2	Formative take-home assignments	1, 2, 3, 4, 5, 6	5	The assignments provide students chances to demonstrate their achievements on linear algebra 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

Test

Criterion

UNDERSTANDING of the basic concepts and theory of linear algebraABILITY to PROVE mathematical statements rigorously

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

Hand-in Assignments

Criterion

DEMONSTRATION of the understanding of the basic materials

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
Formative take-home assignments

Criterion
DEMONSTRATION of the understanding of the basic materials

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
Examination

Criterion
DEMONSTRATION of skills and versatility in linear algebra

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

A) Vectors in R^2 and R^3; Scalar (dot) products, cross products, triple scalar products; Linear (in)dependence
B) Matrices; Determinants, cofactor expansion; Systems of linear equations, Gaussian elimination, Cramer's rule; Matrix inverses, Gauss-Jordan elimination method
C) Eigenvalues and Eigenvectors. Similarity and Diagonalization
D) Vector spaces, subspace, rank; Fundamental theorems of linear algebra
E) Linear Transformations; Quadratic Form and Positive Definite Matrices; Orthogonal and Unitary Transformation

Reading List

Compulsory Readings

	Title
1	(Lay 2012) Linear Algebra and Its Applications, by David, C. Lay, Pearson 2012.
2	(Meyer 2000) Matrix Analysis and Applied Linear Algebra, by C. D. Meyer, SIAM 2000.

Additional Readings

	Title
1	(Nicholson, 2018) Linear Algebra with Applications, by W. Keith Nicholson, Open Edition, 2018
2	(Trefethen and Bau 1997) Numerical Linear Algebra, by L. N. Trefethen and D. Bau III, SIAM 1997. (nice introduction to numerical linear algebra, suitable for beginners)
3	(Axler 2004) Linear Algebra Done Right (2nd edition), by S. Axler, Springer 2004. (advanced text suitable for math majors and graduates, very well written and unique in its determinant-free approach)