City University of Hong Kong
Course Syllabus

offered by College/School/Department of Mathematics
with effect from Semester A 20 20 / 21

Part I Course Overview

Course Title:	**Linear Algebra with Applications**
Course Code:	**MA1503**
Course Duration:	**1 Semester**
Credit Units:	**4**
Level:	**B1**
Proposed Area: *(for GE courses only)*	☐ Arts and Humanities ☐ Study of Societies, Social and Business Organisations ☐ Science and Technology
Medium of Instruction:	**English**
Medium of Assessment:	**English**
Prerequisites: *(Course Code and Title)*	**(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: *(Course Code and Title)*	**Nil**
Equivalent Courses: *(Course Code and Title)*	**Nil**
Exclusive Courses: *(Course Code and Title)*	**MA2503 Linear Algebra**

Part II Course Details

1. Abstract

(A 150-word description about the course)

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.

2. Course Intended Learning Outcomes (CILOs)

(CILOs state what the student is expected to be able to do at the end of the course according to a given standard of performance.)

No.	CILOs[#]	Weighting* (if applicable)	Discovery-enriched curriculum related learning outcomes (please tick where appropriate)		
			A1	*A2*	*A3*
1.	Explain clearly concepts from vector and matrix algebra	10%	√		
2.	Perform basic operations and solve equations involving complex numbers	10%	√		
3.	Evaluate mathematical quantities of matrices and vector spaces by Gaussian elimination, diagonalization, and other algorithms	25%		√	
4.	Develop a logical and systematic understanding of the structure of the Euclidean vector spaces, and demonstrate this in some practical problems	15%	√	√	
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%	√	√	√
6.	The combination of CILOs 1 – 5	25%	√	√	√
		100%			

** If weighting is assigned to CILOs, they should add up to 100%.*

[#] Please specify the alignment of CILOs to the Gateway Education Programme Intended Learning outcomes (PILOs) in Section A of Annex.

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 self-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.

3. Teaching and Learning Activities (TLAs)

(TLAs designed to facilitate students' achievement of the CILOs.)

Indicative of likely activities and tasks students will undertake to learn in this course. Final details will be provided to students in their first week of attendance in this course.

TLA	Brief Description	CILO No.						Hours/week (if applicable)
		1	2	3	4	5	6	
Lectures	Learning through **teaching** is primarily based on lectures.	✓	✓	✓	✓	✓	✓	39 hours in total
Tutorials	Learning through **tutorials** is primarily based on interactive problem solving allowing instant feedback.		✓					4 hours
				✓				4 hours
					✓			2 hours
		✓				✓	✓	2 hours
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.	✓	✓	✓	✓	✓	✓	after-class
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.				✓	✓	✓	after-class
Math Help Centre	Learning activities in **Math Help Centre** provides students extra help.	✓	✓	✓	✓	✓	✓	after-class

4. Assessment Tasks/Activities (ATs)

(ATs are designed to assess how well the students achieve the CILOs.)

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 Tasks/Activities	CILO No.						Weighting*	Remarks
	1	2	3	4	5	6		
Continuous Assessment: __30__%								
Quizzes/Test(s)	✓	✓	✓	✓	✓	✓	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.

Assessment Tasks/Activities	CILO No.						Weighting*	Remarks
	1	2	3	4	5	6		
Formative take-home assignments	✓	✓	✓	✓	✓	✓	5%	The assignments provide students chances to demonstrate their achievements on linear algebra learned in this course.
Examination: (duration: 3 hrs)	✓	✓	✓	✓	✓	✓	70%	Examination questions are designed to see how far students have achieved their intended learning outcomes. Questions will primarily be skills and understanding based to assess the student's versatility in linear algebra.
** The weightings should add up to 100%.*							100%	

5. Assessment Rubrics

(Grading of student achievements is based on student performance in assessment tasks/activities with the following rubrics.)

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Fair (C+, C, C-)	Marginal (D)	Failure (F)
1. Test	1.1 UNDERSTANDING of the basic concepts and theory of linear algebra 1.2 ABILITY to PROVE mathematical statements rigorously	High	Significant	Moderate	Basic	Not even reaching marginal levels
2. Hand-in Assignments	2.1 DEMONSTRATION of the understanding of the basic materials	High	Significant	Moderate	Basic	Not even reaching marginal levels
3. Formative take-home assignments	3.1 DEMONSTRATION of the understanding of the basic materials	High	Significant	Moderate	Basic	Not even reaching marginal levels
4. Examination	4.1 DEMONSTRATION of skills and versatility in linear algebra	High	Significant	Moderate	Basic	Not even reaching marginal levels

Part III Other Information (more details can be provided separately in the teaching plan)

1. Keyword Syllabus

(An indication of the key topics of the course.)

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

2. Reading List

2.1 Compulsory Readings

(Compulsory readings can include books, book chapters, or journal/magazine articles. There are also collections of e-books, e-journals available from the CityU Library.)

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.

2.2 Additional Readings

(Additional references for students to learn to expand their knowledge about the subject.)

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)