MATH 2111
Matrix Algebra and Applications
2024-25 Fall

Midterm Exam date: 6:00 pm—7:30 pm, Oct. 20, 2024

Lecture

Time	Monday and Wednesday: 9:00 AM-10:20 AM
Venue	LTE
Instructor	**Dr. Guibo YE**
E-mail	magbye@ust.hk
Office	Room 3419, Department of Mathematics

Tutorial

session	T1A
Time	Tuesday 09:30-10:20
Venue	Room 6580
Teaching Assistant	**LIANG Shixin Phyllis**
E-mail	masxliang@ust.hk
session	T1B
Time	Friday 13:00-13:50
Venue	Room 1409
Teaching Assistant	**Kong Hoi Sang**
E-mail	mahsk@connect.ust.hk
session	T1C
Time	Monday 16:00-16:50
Venue	Room 1104
Teaching Assistant	**LIANG Shixin Phyllis**
E-mail	masxliang@ust.hk

Course Description

Course outline: This course covers the basic concepts and computation techniques of linear algebra that are essential for various applications in science and engineering subjects.

Credits: 3

Prerequisites: A passing grade in AL Pure Mathematics / AL Applied Mathematics; OR MATH 1014; OR MATH 1018; OR MATH 1020; OR MATH 1024

Exclusion: MATH 2121, MATH 2131, MATH 2350

Intended Learning Outcomes (ILOs)

Upon completion of this course, students are expected to be able to:

(1) Explain the core theories and concepts of a system of linear equations.
(2) Manipulate the basic algebra and computation techniques of matrices and determinants.
(3) Describe the basic terminologies that appeared in vector spaces and inner product spaces.
(4) Formulate the concept and properties of eigenvalues and eigenvectors of a matrix.
(5) Operate the diagonalization process and the Gram-Schmidt process, and recognize their applications

Assessment and Grading

Homework: There will be 9 or 10 problem sets. The homework is assigned in webwork. Students should submit the homework online before the deadline. The website for webwork is: https://webwork.math.ust.hk.

Examinations: There will be a 1.5-hour midterm exam on Oct. 20 6:00pm–7:30pm, and a 3-hour final exam arranged by ARO.

Make-up midterm policy:

- Under any circumstance, students who are unable to attend the midterm exam will **not** be offered a make-up midterm that takes place after the regular exam session.
- For students who have valid reasons for missing the midterm (such as time crash with another midterm), the instructor may approve an early midterm, or assign the midterm marks according to the final exam performance.
- On other hand, for students who miss the midterm without a valid reason, the midterm score will be regarded as 0. This includes self-claimed sickness without any medical statement.

The course will follow the make-up exam policy set by ARO for the final exam. Approval from the instructor, the dean, and ARO will be needed for applying for a make-up final exam.

Grading Scheme:

This course will be assessed using **criterion-referencing**, and grades will **not** be assigned using a curve (nor a surface). Your course total will be calculated by taking the following scheme:

	Scheme	Address ILOs
Homework	10%	1, 2, 3, 4, 5
Midterm	30%	1, 2
Final	60%	1, 2, 3, 4, 5
Course Total	100%	

Letter Grades: Students should aim at getting a course total of 85% or above for A-/A/A+ and about a course total of 40% or above to get a pass grade.

Grade Descriptors:

Grades	Short Description A	Elaboration on subject grading description
A	Excellent Performance	The student has mastered almost all concepts and techniques of linear algebra taught in the course, has excellent understanding of the deepest content of the subject, and acquired workable knowledge for further studies of system of linear equations, vectors, matrices, eigenvalues and eigenvectors of a matrix and their applications.
B	Good Performance	The student has mastered most computational techniques of system of linear equations, vectors, matrices, eigenvalues and eigenvectors taught in the course, yet the understanding of some challenging concepts may not be deep enough for further studies on related advanced subjects.
C	Satisfactory Performance	The student meets the minimum expectation of the instructor, has acquired some basic computational techniques of the subject, yet some concepts were not clearly understood.
D	Marginal Pass	The student is only able to recall some fragments of topics and is able to complete some of the easiest computations.
F	Fail	The student does not have sufficient understanding of even some fragments of topics, and is not even able to complete some of the easiest computations.

TEXTBOOKS AND OTHER RESOURCES

(1) Textbook: David C. Lay et al., Linear Algebra and its Applications, Fifth Edition, Pearson.
(2) other resources:
The MATH Support Center (Rm 3010-3013)
Check more information from the website: http://www.math.ust.hk/ support

COURSE SCHEDULE (ABOUT 32 HOURS)

Chap 1 Systems of Linear Equations (about 9 hours)

(i) Systems of Linear Equations;
(ii) Row Reduction and Echelon Forms;
(iii) Vector Equations;
(iv) The Matrix Equation Ax=b;
(v) Solution Sets of Linear Systems;
(vi) Linear Independence;
(vii) Linear Transformations;
(viii) The Matrix of a Linear Transformation.

Chaps 2 and 3 Matrix Algebra and Determinants (about 7 hours)

(i) Matrix Operations;
(ii) Matrix Inverse;
(iii) Characterizations of Invertible Matrices;
(iv) Introduction to Determinants;
(v) Properties of Determinants;
(vi) Cramer's Rule, Volume, and Linear Transformations

Chap 4 Vector Spaces (about 5 hours)

(i) Vector Spaces and Subspaces;
(ii) Null Spaces, Column Spaces, and Linear Transformations;
(iii) Linearly Independent Sets and Bases;
(iv) Coordinate Systems;
(v) Dimension of a Vector Space and Rank of a Matrix.

Chap 5 Eigenvalues and Eigenvectors (about 4 hours)

(i) Eigenvectors and Eigenvalues;
(ii) The Characteristic Equation;
(iii) Diagonalization;
(iv) Applications to Dynamical Systems and Differential Equations.

Chap 6 Inner Product Spaces (about 5 hours)

(i) Inner Product, Length, and Orthogonality;
(ii) Orthogonal Sets;
(iii) Orthogonal Projections;
(iv) The Gram-Schmidt Process;
(v) Least-Squares Problems;
(vi) Applications to Linear Models.

Chap 7 Symmetric Matrices and Quadratic Forms (about 2 hours)

(i) Diagonalization of Symmetric Matrices;
(ii) Quadratic Forms and the Principal Axes Theorem.

ACADEMIC INTEGRITY

Students are expected to adhere to the university's academic integrity policy. Students are expected to uphold HKUST's Academic Honor Code and to maintain the highest standards of academic integrity. The University has zero tolerance of academic misconduct.