Math 2121 Linear Algebra
Course Syllabus - 2025-2026 Fall

Course

Title: Linear algebra
Code: Math 2121
Credit Points: 4

Pre-requisite: A passing grade in AL Pure Mathematics / AL Applied Mathematics; OR MATH 1014 OR MATH 1020 OR MATH 1024
Exclusion: MATH 2111, MATH 2131, MATH 2350

Instructor

Name: Min YAN
Contact: mamyan@ust.hk, room 3487, phone 23587442

Lecture: L1
Date/Time: Monday 15:00 - 16:20, Friday 10:30 - 11:50
Venue: LTA

Lecture: L2
Date/Time: Monday 16:30 - 17:50, Friday 12:00 - 13:20
Venue: Room 4620

Tutorial

T01: Wednesday 12:00 - 12:50, room 4579
Changlin HE, cheaq@connect.ust.hk
T02: Wednesday 11:00 - 11:50, CYTG009B,
Jiacheng WU, jwudt@connect.ust.hk
T03: Monday 11:30 - 12:20, room 1527,
Zijun XIE, zxieam@connect.ust.hk
T04: Monday 18:00 - 18:50, room 2304,
Yingze YU, yyucc@connect.ust.hk
T05: Tuesday 18:00 - 18:50, room 4508,
Wenkai Fan, wfanai@connect.ust.hk,
T06: Tuesday 12:30 - 13:20, LSK1107,
Zhihan LI, zlihq@connect.ust.hk,
T07: Friday 13:30 - 14:20, room 2406,
Fengkai LIU, fliuar@connect.ust.hk,
T08: Thursday 14:00 - 14:50, room 5583,
Xiaoheng MA, xmabs@connect.ust.hk

Course Description

Content/Schedule

1. Three equivalent fundamental concepts (6 weeks):
   i. System of linear equations: row (and column) operations, existence and uniqueness, rank.

ii. Euclidean vector: linear combination, linear independence, subspace, basis, coordinate, dimension.
iii. Linear transformation: matrix of linear transformation, operations of matrix and linear transformation, onto, one-to-one, inverse.

2. Vector space (2 weeks): general vector space, isomorphism, basis, coordinate, matrix of linear transformation, change of basis, direct sum.

3. Topics in linear algebra (5 weeks):
   i. Orthogonality: orthogonal projection, orthogonalisation, orthogonal matrix, QR-decomposition, least square method, inner product, positive definite matrix, adjoint.
   ii. Determinant: geometric approach, algebraic approach.
   iii. Diagonalisation: eigenspace, diagonalisability, complex eigenvalue, orthogonal diagonalisation of symmetric matrix, singular value decomposition.

Teaching and learning method

1. Lecture: The lecture note is Linear Algebra by the instructor. Learn the concepts through definitions, examples, and discussions. Lecture videos will be provided.

2. Tutorial: Learn how to solve problems. Instructor my provide additional material not covered in the lecture.

3. Online: The course is managed through Canvas. Moreover, a WeChat group is set up, where the students, the instructor, and the TA can discuss and communicate all things about the course.

Intended Learning Outcomes

By the end of this course, students should be able to:

1. Master the foundational linear algebra calculation of row/column operations, and conceptually interpret the result of the calculation.
2. Master the special linear algebra calculations such as orthogonalisation, least square method, determinant, diagonalisation.
3. Understand the core concepts of linear algebra. Apply the concepts to many practical problems, and solve these problems.
4. Practise on logical reasoning and critical thinking, through more conceptual mathematics.

Assessment

Homework: about 10 assignments, 20% of course grade
Midterm exam: 3 hours, 20% of course grade
Final exam: 3 hours, 50% of course grade

Mapping of Course ILOs to Assessment Tasks

Homework: ILO 1, 2, 3, 4
The assigned homework is the minimum. You should do as many exercises as possible. The exercises are integrated parts of my lecture note. You *must* use the method from the examples and discussions right before the exercises. The goal of the exercises is to master the concept and method. You get no credit if you use the wrong method, even if you get the correct answer. I provide answers to almost all the exercises, and the official answers are the only correct way of doing exercises.

Midterm exam: ILO 1, 2, 3, 4

The midterm will test the first four chapters. These are the foundations of linear algebra. The test will emphasis the correct understanding of concepts, and the right way to do the problems. You cannot use the methods outside the four chapters to do the midterm.

Final exam: ILO 1, 2, 3, 4

The final will test the last three chapters. These are the most important special topics of linear algebra. The test will emphasis the correct understanding of concepts, and the right way to do the problems.

Grading

A: 85 points, the student has fully mastered all the theories and concepts, and can do all the corresponding calculations.

B: 60 points, the student has mastered enough theories and concepts, but may have missed some more advanced parts, and can do most of the corresponding calculations.

C: 35 points, the student has mastered the minimum theories and concepts, and can do minimum of the corresponding calculations.

D and F: the student does not understand some major parts, and cannot do most calculations. The line between D and F is whether the student shows enough effort. If the gap in grade from C is too much, or the student did not submit most of the homework, then he/she gets F. Otherwise the student gets D.