

# MATH 2131 – Honors in Linear and Abstract Algebra I

Fall 2023 Course Outline

## Lecture

**Instructor:** Prof. IP, Ivan Chi-Ho  
**Office:** Room 3470 (Lift 25-26)  
**Office Hour:** By appointment  
**E-mail:** ivan.ip@ust.hk

## Tutorial

**TA:** WEN, Jiayi  
**Office:** Room 4381 (Lift 17-18)  
**Office Hours:** TBA  
**E-mail:** jiayi.wen@connect.ust.hk

## Meeting Time and Venue

**Lecture:** Monday, Wednesday 12:00 – 13:20 Room 5583 (Lift 29-30)  
**Session T1A:** Tuesday 18:00 – 18:50 Rm 1010, LSK Bldg  
**Session T1B:** Tuesday 15:00 – 15:50 Rm 6591, Lift 31-32

## Course Description

This is the first in the sequence MATH 2131 – MATH 3131 of honors courses in linear algebra and abstract algebra, with particular emphasis on rigorous mathematical reasoning.

This course will cover the basics of linear algebra over any field in the finite-dimensional setting. .

Topics include: abstract vector space, linear transformation and matrix, determinant, inner product space, spectral theory, positive definiteness, complex matrix, invariant subspace, canonical forms, quotient and dual spaces.

**Prerequisite:** Grade A in AL Pure Mathematics;  
or grade A- or above in MATH 1014/MATH 1020/MATH 1024  
**Exclusion:** MATH 2111, MATH 2121, MATH 2350  
**Credits:** 4

## Intended Learning Outcomes

Upon completion of this course, students are expected:

1. Develop an understanding of the core ideas and concepts of Linear Algebra in the abstract setting
2. Be able to recognize the power of abstraction and generalization, and to carry out mathematical work with independent judgment.
3. Be able to apply rigorous, analytic, and numeric approach to analyze and solve problems.
4. Be able to explain clearly concepts and calculations from Linear Algebra.

## Assessment Scheme

	Weight	Assessment ILOs
Homework	30%	1,2,3,4
Midterm Examination	30%	1,2,3,4
Final Examination	40%	1,2,3,4

## Grading Scheme

Letter grades will be assigned depending on overall performance.

Obtaining a total point of 90% or above, or top 10% will guarantee an A+.

Obtaining a total point of 70% or above, or top 40% will guarantee an A-range.

Obtaining a total point of 30% or above will guarantee a passing grade.

## Teaching and Learning Activities

Aside from lectures, to master this course students are required to do as many exercises as they can to get familiar with the subject. A lot of the exercises are available in the references.

- There are 6 Homework Sets throughout the semester, including both computation and proof-based problems.
- We will work through problems provided in Worksheet format during every lecture, part of them are Examples from the lecture notes.
- Tutorial Problem Sets will be discussed during the Tutorial Session. Solutions are available after each tutorial.

## Student Learning Resources

**Lecture Notes** written by the instructor.

**Lecture Slides** and **Lecture Videos** will also be available on canvas after class.

### References:

1. *Linear Algebra Done Right*, by S. Axler
2. *Linear Algebra Done Wrong*, by S. Treil
3. *Linear Algebra*, by J. Liesen and V. Mehrmann
4. *Linear Algebra*, Lecture Notes by M. Yan

## Tentative Schedule

Week 1	Abstract Vector Spaces
Week 2	Abstract Vector Spaces (cont'd)
Week 3	Linear Transformations
Week 4	Linear Transformations (cont'd)
Week 5	Determinant
Week 6	Inner Product Space
Week 7	Inner Product Space (cont'd)
Week 8	Spectral Theory
Week 9	Positive Definite Matrix
Week 10	Complex Matrices
Week 11	Invariant Subspaces
Week 12	Canonical Forms
Week 13	Quotient and Dual Spaces