Math 2350 Applied Linear Algebra and Differential Equations

Course Outline – Spring 2025

Instructor

Prof. Lixin Wu
Rm. 3427; Phone 2358 7435; malwu@ust.hk
Office hours: drop by or by appointment

Lectures

L1: Tue, Thu 1200 -1320 LG3008

Teaching Assistants and Tutorials

T1a: WANG, Kaibo/kwangbi	Wed 06:00PM - 06:50PM, Rm 6602, Lift 31-32
T1B: SHI, Xiao/xshiau	Thur 02:00PM - 02:50PM, Rm 2463, Lift 25-26

Course Description

This course provides a concise introduction to linear algebra and differential equations, with exposure to the use of numerical computing software like MATLAB. Topics include systems of linear equations, matrix algebra and determinants, language of vector spaces and inner product spaces, eigenvalue and eigenvector, first order ODEs, linear second order ODEs and oscillations, and homogeneous system of first order ODEs with constant coefficients.

Credits: 3 units;

Prerequisites: AL Pure Mathematics/AL Applied Mathematics; or MATH 1014; or MATH 1018; or MATH 1020; or MATH 1024

Exclusions: MATH 2111, MATH 2121, MATH 2131, MATH 2351, MATH 2352

Student Learning Resources

Textbooks: Linear Algebra and its Applications by Lay, Lay and McDonald; Elementary Differential Equations and Boundary Value Problems by Boyce, DiPrima and Meade.
Reference Notes: https://www.math.hkust.edu.hk/~machas/applied-linear-algebra-and-differential-equations.pdf

Intended Learning Outcomes

Upon successful completion of this course, students should

1. Develop an understanding of the core ideas and concepts of linear algebra and ordinary differential equations;
2. Recognize the power of abstraction and generalization, carry out mathematical work with independent judgement;
3. Apply rigorous, analytical and numeric approach to analyze and solve problems using concepts of linear algebra and differential equations;
4. Demonstrate skills in reading, interpreting and communicating mathematical content which are integrated into other disciplines or appear in everyday life;
5. Develop the mathematical maturity to undertake higher level studies in mathematically related fields.

Assessment and Grading

*Homework***:** There will be 6 or 7 problem sets. Students should submit each homework in form of a clearly written and scanned or a LaTeX-typed PDF on the Canvas system before the deadline. Sufficient justifications should be provided for late submission.

Examinations: There will be a 1 and 1/2-hour midterm exam during Week 6-8, and a 3-hour final exam arranged by ARO.

Policy for Make-up Midterm Exam:

A make-up exam is offered only to students who are unable to make to the exam with justifiable causes which, in particular, exclude self-claimed discomfort or miner illness. And those students can also opt to reallocate the weight for midterm to final exam.

Policy for Make-up Final Exam:

The course will follow the make-up exam policy set by ARRO. Approval from the instructor, the dean, and ARO will be needed for applying for a make-up final exam. Students must take the make-up exam before the deadline set by ARRO. The problem set of the make-up exam will be different from that of the regular exam with however the level of difficulty.

Grading Scheme

This course will be assessed using criterion-referencing, and grades will not be assigned using a curve. The course total will be calculated by taking schemes:

		Assessing Course ILOs
Homework:	20%	1, 2, 3, 4, 5
Midterm:	30%	1, 2, 3, 4, 5
Final:	50%	1, 2, 3, 4, 5

Letter Grades: Students should aim at getting a course total of 85% or above for A-/A/A+, and about 60% or above for B-/B/B+.

Grade Descriptors:

Grades	Description	Elaborations
A	Excellent Performance	A solid grasp of all major concepts and techniques, analytical or numerical, of linear algebra and differential equations that are introduced in the course.
B	Good Performance	Comprehensive understanding of all major concepts and techniques, with however some weakness.
C	Satisfactory Performance	Mediocre overall performance in homework, midterm and final exam that shows a student has many weaknesses in understanding of course contents
D	Marginal Pass	A disappointing performance that shows a student has crossed only the very basic hurdle of the course.
F	Fail	A disaster performance that shows a student has learned almost nothing from the course.

Course AI Policy

Students are free to utilize AI in learning, but are barred from accessing AI during exams.

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.

Syllabus

Week 1:

1.1-1.5 Systems of linear (algebraic) equations, Row reduction, Gaussian elimination,

Week 2:

2.1, 2.2, 2.5, 3.1-3.3 Matrix algebra, Inverse of a matrix, determinant, Cramer's rule
Week 3:
4.1-4.3 Vector spaces, bases and dimension, Column space and null space of a matrix
Week 4:
5.1-5.5 Eigenvalues and eigenvectors, diagonalization of a square matrix
Week 5:
6.1-6.4 Inner product spaces, orthogonal projection, Gram-Schmidt process
Week 6:
6.5 Linear least-square problems
Week 7:
1.1-1.2, 2.1-2.3 First-order ordinary differential equations (ODEs)
Week 8
3.1-3.4 Homogeneous linear second-order ODEs
Week 9
3.5-3.7 Non-homogeneous linear second-order ODEs, Mechanical vibrations
Week 10
5.1-5.4 Series solutions to a linear ODE, Numerical methods for ODEs
Week 11
6.1-6.9 Systems of linear first-order ODEs
Week 12
7.1--7.6 Laplace transform and its applications to ODE
Week 13
8.1-8.3 Numerical methods and final review