MATH2350 Applied Linear Algebra and Differential Equations
L2 (Fall 2023) Course Outline

1. Instructor

Name: Dr. CHENG Kam Hang Henry
Office: Room 3486 (L25–26)
Email: keroc@ust.hk
Office hours: (Tentative) Mon 15:30 – 17:30; you may also just drop in my office any time or make an email appointment beforehand to ensure I am there.

2. Teaching assistants

(T2A)
Name: Mr. HUANG Haohan
Email: hhuangbu@connect.ust.hk

(T2B, T2C)
Name: Mr. LAI Yanming
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3. Meeting time and venue

Lectures:	(L2)	Tue & Thu 10:30 – 11:50	2407 (L17–18)	
Tutorials:	(T2A)	Thu 18:00 – 18:50	2407 (L17–18)	(Starting on **Sep 14**)
	(T2B)	Wed 11:00 – 11:50	CYT G009B	(Starting on **Sep 13**)
	(T2C)	Tue 9:30 – 10:20	4504 (L25–26)	(Starting on **Sep 12**)

4. Course description

This course provides a concise introduction to **linear algebra** and **differential equations**. Major topics include: systems of linear equations, matrix algebra, determinants, vector spaces, eigenvalues and eigenvectors, first order ODEs, linear second order ODEs and mechanical vibrations, homogeneous systems of first order ODEs with constant coefficients.

Credit points: 3
Exclusions: MATH2111/2121/2131; MATH2351/2352; PHYS2124
Prerequisite: **Calculus II** (MATH1014/1020/1024)

5. Intended learning outcomes (ILOs)

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

1. do computations regarding linear algebra and ordinary differential equations, and explain the logical reasoning behind the computations;
2. apply rigorous analytical and numerical approach to analyze and solve problems using concepts of linear algebra and differential equations;
3. demonstrate skills in reading, interpreting and communicating mathematical content which are integrated into other disciplines or appear in everyday life; and
4. develop mathematical maturity to undertake higher level studies in mathematically related fields.

6. Assessment scheme

- **Assignments (10%)**: Assessing ILOs 1, 2, 3 and 4
  Homework will be assigned from time to time. You are allowed to have peer discussion on the solutions, but you need to submit work that is individually written **on your own**. The use of ChatGPT or other generative AI tools are not allowed.
  You should submit each homework in the form of a clearly written and scanned **PDF file** on the **Canvas** system before the deadline. The due time of Canvas is sharp; late submission can still be marked but the score will not be counted to your final grade. To accommodate unforeseeable incidents such as sickness and emergency, the lowest homework score will be dropped from the calculation of your course total.

- **Midterm Test (40%)**: Assessing ILOs 1, 2, 3 and 4
  The mid-term test will be tentatively scheduled on **Friday, October 20 from 19:00 to 21:00**. It will cover all materials about **linear algebra** taught in this course.

- **Final Exam (50%)**: Assessing ILOs 1, 2, 3 and 4
  The final exam will take 3 hours, and the exact schedule will be announced in due course. It will mainly focus on materials about **differential equations** taught in this course, but some relevant topics about linear algebra will also be lightly touched on.

The mid-term test and the final exam will normally be **closed-book written tests**, and the usage of **HKEAA-approved calculators** will be allowed during the tests. The exact exam arrangements may be modified in the event of unexpected emergencies.

If you obtain a total score of at least $\begin{Bmatrix}90\%\\80\%\\70\%\end{Bmatrix}$, then you will get a letter grade of **at least** $\begin{Bmatrix}\text{A}-\\\text{B}-\\\text{C}-\end{Bmatrix}$.

7. Student learning resources

- Main reference: Lecture note by the instructor
  (Accessible via our course website https://canvas.ust.hk/courses/52917)

- Other references:
  J. R. Chasnov, *Matrix Algebra for Engineers* and *Differential Equations for Engineers*, Lecture Notes on Coursera.
  D. C. Lay, S. R. Lay and J. J. McDonald, *Linear Algebra and its Applications* (5th ed.), Pearson.
  W. E. Boyce, R. C. DiPrima and D. B. Meade, *Elementary Differential Equations and Boundary Value Problems* (12th ed.), Wiley.

8. Tentative course schedule

Week	Lecture dates	Topics
1	Sep 5, Sep 7	Complex number arithmetics
		Systems of linear (algebraic) equations
2	Sep 12, Sep 14	Gaussian elimination, Row echelon forms
		Matrix algebra, Inverse of a matrix
3	Sep 19, Sep 21	Vector spaces, bases and dimension
		Column space and null space of a matrix
4	Sep 26, Sep 28	Inner product spaces
		Orthogonal projection, Gram-Schmidt process
5	Oct 3, Oct 5	Determinants
		Eigenvalues and eigenvectors
6	Oct 10, Oct 12	Diagonalization of a square matrix
		Introduction to ordinary differential equations (ODEs)
7	Oct 17, Oct 19	First-order ODEs
8	Oct 24, Oct 26	Homogeneous linear second-order ODEs
9	Oct 31, Nov 2	Non-homogeneous linear second-order ODEs
		Mechanical vibrations
10	Nov 7, Nov 9	Laplace transform
11	Nov 14, Nov 16	Series solutions to a linear ODE
		Numerical methods for ODEs
12	Nov 21, Nov 23	Systems of linear first-order ODEs
13	Nov 28, Nov 30	Any other selected topic(s) and/or Final review