MATH 4326 Introduction to Fluid Dynamics

Course Outline- Spring 2025

1. Instructor(s)

Name: Kun Xu

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2. Teaching Assistant(s)

Name: Wenpei Long

Contact Details: email: wlongab@connect.ust.hk

3. Meeting Time and Venue

Lectures:

Date/Time: Tuesday & Thursday (10:30am– 11:50am)

Venue: Rm 5583

Tutorials:

Date/Time: Tuesday 6:00pm – 6:50pm

Venue: Rm 2306

4. Course Description

Credit Points: 3

Pre-requisite: MATH 4052; Exclusion: CIVL 2510, CIVL 3520, MECH 2210

Brief Information/synopsis:

This course presents fundamental principles of fluid dynamics through rigorous mathematical analysis. The curriculum covers essential topics in classical applied mathematics, including:

- Fluid properties and continuum mechanics
- Vector and tensor analysis
- Integral theorems and conservation laws
- Thermodynamics and Navier-Stokes equations
- Solutions of Newtonian viscous-flow equations
- Wave phenomena (sound and water waves)
- Nonlinear equations and their applications
- Boundary layer theory and shock structure
- Analytical solution methods

The course emphasizes mathematical derivations to develop a deep theoretical understanding of fluid dynamics principles.

5. Intended Learning Outcomes

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

No.	ILOs
1	Develop an understanding of the core ideas and concepts of Fluid Dynamics.
2	Be able to recognize the power of abstraction and generalization, and to carry out investigative mathematical work with independent judgment
3	Be able to apply rigorous, analytic, highly numerate approach to analyze and solve problems of fluid dynamics using combined physical and mathematical means.
4	Be able to communicate problem solutions using correct fluid dynamic terminology.

6. Grading Scheme

This course will be assessed using criterion-referencing, and grades will not be assigned using a curve. Your course total will be calculated by taking the maximum of two weighting schemes – in order to encourage students to work harder in the final exam in case the midterm result is not desirable:

	Scheme A	Scheme B	Address ILOs
Homework	15%	15%	1,2,3,4
Midterm	35%	0	1,2,3,4
Final	50%	85%	1,2,3,4
Total	100%	100%	

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	Short Description	Elaboration on subject grading description
A	Excellent Performance	The student has mastered almost all concepts and techniques of fluid mechanics taught in the course, has excellent understanding of the deepest content of the subject, and acquired workable knowledge for further studies.
B	Good Performance	The student has mastered most computational techniques of fluid mechanics taught in the course, yet the understanding of some challenging concepts may not be deep enough for further studies.
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.

Course AI Policy

Students are allowed to consult any person (including the instructor, TA, classmates, friends outside HKUST) in any homework for ideas and hints, but are required to write up the solutions by themselves. The use of ChatGPT or other generative AI is allowed, and they are regarded as "persons" you have consulted, and therefore must be listed in your homework.

All midterm and final examinations are closed-book, and the use of artificial intelligence tools or assistants is strictly prohibited.

7. Student Learning Resources

Recommended Reading:

P. Kundu, "Fluid Mechanics", Academic Press 1990.

D.J. Acheson, "Elementary Fluid Dynamics", Oxford 1990

G.K. Batchelor, "An Introduction to Fluid Dynamics", Cambridge University Press 2000.

8. Teaching and Learning Activities

Scheduled activities: 2.5 hrs (lecture) and tutorial

9. Course Schedule

Keyword Syllabus:

1. Fluid and continuum media
2. Vector and tensor
3. Integral theorems and conservation laws
4. Thermodynamics and Navier-Stokes equations
5. Solutions of the Newtonian viscous-flow equations
6. Sound waves
7. Linear water waves
8. Nonlinear equations
9. Boundary layer and shock wave
10. Analytical solutions at low Reynolds number

10. 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.