MECH 2210 FLUID MECHANICS
(Spring 2023/2024)

Course Description:

Fundamental concepts; fluid statics; fluid kinematics, integral and differential equations of fluid flows; conservation of mass, momentum and energy; dimensional analysis; pipe flows, external flows, and nanofluidics.

Prerequisites: MATH 2011/2023, MECH 2310

References: *Fundamentals of Fluid Mechanics*, 5th or 6th edition
B.R. Munson, D.F. Young and T.H. Okiishi (Wiley and Sons, 2006/10)

Mechanics of Fluids (Cengage Learning, 2015)
M.C. Potter, D.C. Wiggert, and B.H. Ramadan

Nanofluidics: An Introduction, 1st edition
Zhigang Li (CRC-Taylor & Francis, 2018)

Instructor: Dr. Zhigang Li (Tel: 7186 Email: mezli@ust.hk Room: 2561)

Lecture hours: 2 sessions/week, 80 minutes/session (3 credits)

Office hours: 4:00-5:00pm Tuesday and Thursday or by appointment

Teaching Assistants: Mr. Yixiang Wang ywangiq@connect.ust.hk room 4222
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Detailed Course Outline (times are subject to changes)

Chapter 1. Introduction week 1
- 1.2 Dimensions and units
- 1.4 Measures of fluid mass and weight
- 1.5 Ideal gas law
- 1.6 Viscosity
- 1.7 Compressibility
- 1.8 Vapor pressure
- 1.9 Surface tension

Chapter 2. Fluid Statics weeks 2-3
- 2.1 Pressure at a point
- 2.2 Basic equation for pressure field
- 2.3 Pressure variation in a fluid at rest
- 2.4 Standard atmosphere
- 2.5 Measure of pressure
- 2.6 Manometry
- 2.8 Hydrostatic force on a plane surface
- 2.9 Pressure prism
- 2.10 Hydrostatic force on a curved surface
- 2.11 Buoyancy and stability
- 2.12 Pressure variation in a fluid with rigid-body motion

Chapter 3. Fluids in Motions weeks 3 -4
- 3.1 Newton's second law
- 3.2 F=ma along a streamline

3.3 F=ma normal to a streamline
3.4 Physical interpretation
3.5 Static, stagnation, dynamic, and total pressure
3.6 Application of B.E.

Chapter 4. Kinematics of Fluid Motion — weeks 4-5
4.1 Velocity field
4.2 Acceleration field
4.3 Control volume and system
4.4 The Reynolds transport theorem

Chapter 5. Flow analysis using C.V. — weeks 6-7
5.1 Continuity equation
5.2 Linear momentum equation (5.2.3, 5.2.4 not required)
5.3 Energy equation

Chapter 6. Differential methods — week 7-9
6.1 Fluid element kinematics
6.2 Mass conservation
6.3 Conservation of linear momentum
6.4 Inviscid flow (6.4.2 not required)
6.5 Potential flows
6.8 Viscous flow
6.9 Simple solutions for viscous, incompressible fluids

Mid-term TBD — week 9/10

Chapter 8. Pipe Flows — weeks 10-11
8.1 General characteristics of pipe flow
8.2 Fully developed laminar flow
8.3 Fully developed turbulent flow (discussed but not required)
8.4 Dimensional analysis (8.4.3 not required)

Chapter 9. External Flows — weeks 11-12
9.1 General external flow characteristics
9.2 Boundary layer (briefly discussed but not required)
9.3 Drag
9.4 Lift

Chapter 10. Introduction to Nanofluidics — weeks 13
10.1 Introduction
10.2 Methodologies
10.3 Flow regimes and their implications
10.4 Nanofluidic diodes

Grading Policy (TBD)

Homework	10%
Mid-term exam	40%
Fina exam	50%