

MECH 2210-L1 FLUID MECHANICS
(Spring 2022/2023)

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: 3:00-4:00pm Monday and Wednesday or by appointment

Teaching Assistants: Mr. Dachuang Shi dshiab@connect.ust.hk room 4222
Mr. Le Zhou lzhouaz@connect.ust.hk room 4222

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%
Final exam	50%