

FLUID MECHANICS

<http://www.icaen.uiowa.edu/~fluids/lecture.htm>

Chapter 1: Introduction and Basic Concepts

- 1.1 Fluid and no-slip Condition
- 1.2 Continuum Hypothesis
- 1.3 Properties of Fluids
- 1.4 Basic units
- 1.5 System; Extensive and Intensive Properties
- 1.6 Properties Involving the Mass or Weight of the Fluid
- 1.7 Vapor Pressure and Cavitation
- 1.8 Properties Involving the Flow of Heat
- 1.9 Elasticity (i.e., compressibility)
- 1.10 Viscosity
- 1.11 Surface Tension and Capillary Effects
- 1.12 Fluid Mechanics and Flow Classification

Chapter 2: Pressure and Fluid Statics

- 2.1 Pressure
- 2.2 Pressure Variation with Elevation
- 2.3 Pressure Measurements
- 2.4 Hydrostatic Forces on Plane Surfaces
- 2.5 Hydrostatic Forces on Curved Surfaces
- 2.6 Buoyancy
- 2.7 Stability of Immersed and Floating Bodies
- 2.8 Fluids in Rigid-Body Motion

Chapter 3: Bernoulli Equation

- 3.1 Derivation of Bernoulli Equation
- 3.2 Applications of Bernoulli Equation
- 3.3 Energy grade line (EGL) and hydraulic grade line (HGL)
- 3.4 Limitations of Bernoulli Equation

Chapter 4: Fluid Kinematics

- 4.1 Velocity and Description Methods
- 4.2 Acceleration Field and Material Derivative
- 4.3 Separation, Vortices, Turbulence, and Flow Classification
- 4.4 Basic Control-Volume Approach and RTT

Chapter 5: Mass, Momentum, and Energy Equations

- 5.1 Flow Rate and Conservation of Mass
- 5.2 Momentum Equation
- 5.3 Energy Equations
- 5.4 Simplified Forms of the Energy Equation

Chapter 6: Differential Analysis of Fluid Flow

- 6.1 Fluid Element Kinematics
- 6.2 The Continuity Equation in Differential Form
- 6.3 Navier-Stokes Equations
- 6.4 Inviscid flow: Euler's equations of motion
- 6.5 Differential Analysis of Fluid Flow

Chapter 7: Dimensional Analysis and Modeling

- 7.1 The Need for Dimensional Analysis
- 7.2 Dimensions and Equations
- 7.3 Buckingham II Theorems
- 7.4 Dimensional Analysis
- 7.5 Common Dimensionless Parameters for Fluid Flow Problems
- 7.6 Similarity and Model Testing

Chapter 8: Flow in Conduits

- 8.1 Shear-Stress Distribution Across a Pipe Section
- 8.2 Laminar Flow in Pipes
- 8.3 Criterion for Laminar or Turbulent Flow in a Pipe
- 8.4 Turbulent Flow in Pipes
- 8.5 Flows at Pipe Inlets and Losses From Fittings

Chapter 9: Flow over Immersed Bodies

- 9.1 Basic Considerations
- 9.2 Qualitative Description of the Boundary Layer
- 9.3 Quantitative Relations for the Laminar Boundary Layer
- 9.4 Quantitative Relations for the Turbulent Boundary Layer
- 9.5 Drag of 2-D Bodies
- 9.6 Effect of Compressibility on Drag: $C_D = C_D(\text{Re}, \text{Ma})$