MAE 101A
Introductory Fluid Mechanics (4 units)

Class/Laboratory Schedule: four hours of lecture, eight hours of outside preparation.
12 hours/week total

Course Coordinator(s): Keiko Nomura

Textbooks/Materials:

1. Fundamentals of Fluid Mechanics, Munson, Young & Okiishi (8^{th} edition)

Catalog Description: Fluid statics; fluid kinematics; integral and differential forms of the conservation laws for mass, momentum, and energy; Bernoulli equation; potential flows; dimensional analysis and similitude.

Prerequisites: PHYS 2A or 4A and MATH 20D and MATH 20E or MATH 31CH, or consent of instructor. Enrollment restricted to MC 25, MC 27, MC 29, MC 30–34, and MC 35–37 majors only.

Course Type: Required

Course Objectives and Performance Criteria:

1. Understand the Principles of Fluid Statics and Dynamics
    - Demonstrate an understanding of the physics and fundamental equations governing the kinematics and dynamics of Newtonian fluids.
    - Calculate static forces on bodies submerged in a fluid.
    - Understand the relationship between pressure and velocity in a flow, including applications of Bernoulli's equation.

2. Apply Engineering Analysis to Fluid Mechanics Problems
    - Perform control volume analysis of fluid motion.
    - Relate control volume conservation principles to differential equations for fluid motion and apply appropriate boundary conditions.

3. Develop Advanced Analytical Skills in Fluid Mechanics
    - Utilize the stream function and velocity potential appropriately.
    - Demonstrate an understanding of conservation laws for mass, momentum, and energy.
    - Apply dimensional analysis to fluid mechanics problems.

Course Topics:

1. Definition of a fluid
2. Stress and strain rate; Newtonian fluid
3. Fluid statics
4. Kinematics of fluid motion
5. Conservation of mass and momentum in control volume form
6. First law of thermodynamics
7. Conservation of mass and momentum in differential form
8. Viscous Flow: Naver-Stokes Equation, Simple solutions
9. Inviscid flow: Euler's Equation, Bernoulli's equation
10. Irrotational flow and the Velocity Potential, Potential Flow
11. Dimensional analysis and Similitude

Last updated: March 2025