MAE 101B
Advanced 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, Wiley, (8^{th} edition)

Catalog Description: Laminar and turbulent flow. Pipe flow including friction factor. Boundary layers, separation, drag, and lift. Compressible flow including shock waves.

Prerequisites: MAE 101A or CENG 101A, and MAE 11 or MAE 110A or CENG 102, or consent of instructor.

Course Type: Required

Course Objectives and Performance Criteria:

1. Understanding the Principles of Viscous and Compressible Flow
    - Demonstrate an understanding of physics underlying internal and external viscous flow.
    - Demonstrate an understanding of the physics underlying compressible flow.
    - Demonstrate an understanding of the physical laws governing compressible flow and their implications.

2. Apply Engineering Analysis to Internal, External, and Compressible Flows
    - Identify forces acting on a control volume in viscous flow and calculate velocity profiles and volume fluxes.
    - Solve problems related to flow in rough pipes, considering fittings and minor losses.
    - Calculate properties of laminar and turbulent boundary layers.
    - Compute drag and lift forces on objects in external flows.
    - Analyze generalized one-dimensional compressible flow, accounting for heating, frictional forces, area changes, and normal shocks.
    - Apply and integrate fundamental principles of viscous and compressible flow to solve engineering problems.

Course Topics:

1. Laminar internal flow: Poiseuille and Couette flow
2. Turbulent internal flow
3. Internal flow energy equation: major and minor losses, friction factor
4. Solution of pipe flow problems
5. Boundary layer flow physics: laminar and turbulent flows
6. Boundary layer analysis: Blasius solution and momentum integral
7. Drag and lift
8. Thermodynamics of compressible flow, stagnation state properties
9. Speed of Sand, Mach Number
10. Compressible flow with area changes, converging - diverging nozzles
11. Compressible flow with heat transfer: Rayleigh line
12. Compressible flow with friction: Fanno line
13. Shock waves

Last Updated: March 2025