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 101; MAE 11/110A, Math 20D, Math 20E

Course Type: Required

Performance Criteria:
Objective 1
1.1 Students will demonstrate an understanding of the physics underlying internal and external viscous flow
1.2 Students will demonstrate an understanding of the physics underlying compressible flow

Objective 2
2.1 Students will demonstrate the ability to identify the forces acting on a control volume in viscous flow and calculate velocity profiles and volume fluxes
2.2 Students will demonstrate an ability to solve problems related to flow in rough pipes, taking into account fittings and other minor losses
2.3 Students will demonstrate an ability to calculate properties of laminar and turbulent boundary layers
2.4 Students will demonstrate an ability to calculate the drag and lift forces on objects in external flows
2.5 Students will demonstrate an understanding of the physical laws underlying compressible flow
2.6 Students will demonstrate an ability to analyze generalized one-dimensional compressible flow in the presence of heating, frictional forces and area changes, including normal shocks
2.7 Students will demonstrate that they can apply and combine the appropriate principles referred to in Objective 1 to the solution of problems

Course Objectives:
(Numbers in parentheses refer to the specific MAE Program Outcomes)

1. To teach students the basic principles underlying internal and external flow of viscous fluids and compressible flow. (1, ME9, ME10, AE12)

2. To train students to identify, formulate and solve engineering problems concerning internal, external and compressible flows. (1, ME9, ME10, AE12)

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: 18th July 2019