

MAE 101B
Advanced Fluid Mechanics (4 units)

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

Course Coordinator(s): Keiko Nomura, David Miller

Textbooks/Materials: Frank White, Fluid Mechanics, Wiley

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

Prerequisites: Grades of C- or better in MAE 101A and MAE 110A.

- Required Course
- Technical Elective Course
- Other: _____

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 calculate generalized one-dimensional 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

Objective 3

- 3.1 Students will engage in consideration of engineering ethics and professional responsibility

Course Objectives:

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

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

Objective 2: To train students to identify, formulate and solve engineering problems concerning internal, external and compressible flows (1a, 5e, AE12).

Course Topics:

1. Laminar internal flow: Poiseuille and Couette flow
2. Turbulent internal flow
3. Internal flow with losses: major and minor losses, friction factor
4. Solution of pipe flow problems
5. Boundary layer thickness
6. Boundary layer for zero pressure gradient: Blasius solution and momentum integral
7. Drag and lift
8. Thermodynamics of compressible flow, stagnation enthalpy
9. Compressible flow with area changes
10. Compressible flow with heat loss: Rayleigh line
11. Compressible flow with friction: Fanno line
12. Shock waves

Prepared By: K. Vecchio, March 2000

Revised: Prab bandaru & Joanna McKittrick, April 2008, via Teaching Work Group Meeting

Reviewed and Revised: TWG, June 2010; June 2011

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