

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 (8th 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 and Math 20D (or 21D) and 20E or concurrent enrollment

Course Type: Required

Performance Criteria:

Objective 1

1.1 Students will demonstrate an understanding of the physics and basic equations underlying the kinematics and dynamics of Newtonian fluids.

Objective 2

2.1 Students will demonstrate the ability to perform control volume analysis of fluid motion

2.2 Students will demonstrate an ability to calculate static forces on bodies submerged within a fluid

2.3 Students will demonstrate an ability to relate control volume conservation principles to differential equations for fluid motion and apply the appropriate boundary conditions

2.4 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 demonstrate an understanding of the relation between pressure and velocity in a flow as expressed by Bernoulli's equation

3.2 Students will be able to determine the appropriate use of the stream function and velocity potential

3.3 Students will demonstrate an understanding of conservation laws for mass, momentum and energy

3.4 Students will demonstrate an ability to apply dimensional analysis to fluid mechanics

Course Objectives:

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

1. To teach students the basic principles underlying the statics and dynamics of a fluid (1, ME9, ME10, AE12)
2. To train students to identify, formulate and solve engineering problems in fluid statics and dynamics (1, ME9, AE12)
3. To introduce students to the concepts of dimensional analysis (1, ME9, ME10)

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: Navier-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: 18th July 2019