MAE 101A
Introductory Fluid Mechanics

Designation: Required course for ME and AE.

Catalog Data:
MAE 101A Introductory Fluid Mechanics (4)

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

Prerequisites: Admission to the engineering major and grades of C- or better in Phys. 2A and Math 20D (or 21D) and 20E or concurrent enrollment.

Prerequisites by Topic: Integral and differential calculus, differential equations, Newton's laws.

Textbook and Required Materials: Frank White, Fluid Mechanics, Sixth Edition, John Wiley and Sons, 2008.

Class/Laboratory Schedule: 4 lecture hours per week

Course Topics:
1. Definition of a fluid
2. Control volume and differential analysis
3. Kinematics of fluid motion
4. Stress and strain rate; Newtonian fluid
5. Fluid statics
6. Conservation of mass and momentum in control volume form
7. First law of thermodynamics
8. Differential analysis of fluid motion
9. Streamfunction for two-dimensional incompressible flow
10. Incompressible inviscid flow
11. Bernoulli's equation
12. Irrotational flow and the velocity potential
13. Dimensional analysis and Similitude

Course Objectives:
(Numbers in parenthesis refer to MAE Program Outcomes)

Objective 1: To teach students the basic principles underlying the statics and dynamics of a fluid (1a, AE 12, ME 12)

Objective 2: To train students to identify, formulate and solve engineering problems in fluid statics and dynamics (5e, AE 12)

Objective 3: To introduce students to the concepts of dimensional analysis (1a, ME 12)

Methods of Evaluation:
1. Homework will be regularly collected and graded.
2. Exams

Performance Criteria:
(Numbers in parentheses refer to the methods of evaluation used to assess student performance.)

Objective 1
1.1 Students will demonstrate an understanding of the physics and basic equations underlying the kinematics and dynamics of Newtonian fluids. (1,2)

Objective 2
2.1 Students will demonstrate the ability to perform control volume analysis of fluid motion (1, 2).
2.2 Students will demonstrate an ability to calculate static forces on bodies submerged within a fluid (1, 2).
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 (1, 2).
2.4 Students will demonstrate that they can apply and combine the appropriate principles referred to in Objective 1 to the solution of problems (1, 2).

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 (1, 2).
3.2 Students will be able to determine the appropriate use of the stream function and velocity potential (1, 2).
3.3 Students will demonstrate an understanding of conservation laws for mass, momentum and energy (1, 2).
3.4 Students will demonstrate an ability to apply dimensional analysis to fluid mechanics(1, 2, 3).

Contribution of Course to Professional Component:
Engineering Science

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Revised: S.G. Llewellyn-Smith, April 2008 via Teaching Work Group meeting.