ENG BE 436 – Fundamentals of Fluid Mechanics

Spring 2018 Course Overview

Course Description	Introductory course emphasizing the application of the principles of conservation of mass, momentum, and energy to fluid systems. Lecture: 4 credits
Prerequisites	• CAS MA 226 – Differential Equations • ENG EK 301 – Engineering Mechanics
Textbook	Munson, Young, Okiishi, and Huebsch (2008) *Fundamentals of Fluid Mechanics*, Sixth Edition, John Wiley.
Instructor	Dr. Edward R. Damiano ERB 701B 44 Cummington Mall 617-353-9493 edamiano@bu.edu Office hours: T 3–4 pm, F 2–3 pm
Teaching Fellows	Sanaya Shroff sshroff@bu.edu Office: CILSE 106B usually, except: Feb 15th and Apr 26th in CILSE 609 Office hours: Th 12:30–1:30 pm Raj Setty rajsetty@bu.edu Office: ERA B11 Office hours: W 6:30–7:30 pm
Grading	• (10%) 10-minute discussion quizzes. Highest quiz grade counted twice. • (25%) Exam 1 (March 23rd, 3:30 pm, CAS 313) • (25%) Exam 2 (April 27th, 3:30 pm, TBD) • (40%) Cumulative final exam (TBD, TBD, TBD)
Academic Integrity	If you are found in violation of BU's Academic Conduct Code on any quiz or exam, your written material will be immediately voided and you may, at the discretion of the teaching fellows and Dr. Damiano, be given the opportunity to take an oral test with Dr. Damiano. Looking at other students' papers during quizzes or exams is a violation of BU's Academic Conduct Code.

- Fluid statics
  - The hydrostatic equation (§§2.1–2.5)
  - Manometry (§2.6)
  - Pressure distributions in fluids undergoing rigid body motion (§2.12)
- The Bernoulli equation (§§3.1–3.6)
- Integral relations for a control volume
  - Reynolds transport theorem (§§4.3–4.4)
  - Conservation of mass (§5.1)
  - Conservation of linear momentum (§5.2)
  - Conservation of energy (§5.3)
- Fluid kinematics
  - Lagrangian and Eulerian reference frames (§4.1)
  - The material derivative (§4.2)
  - Vorticity (§6.2)
- Differential relations for a fluid particle
  - Continuity equation (conservation of mass) (§6.2)
  - Conservation of linear momentum (differential form) (§6.3)
  - Constitutive relation for a Newtonian fluid (§6.8.1)
  - The Navier-Stokes equations (§6.8.2)
- Examples of incompressible viscous flows
  - Non-dimensionalization of equations of motion (§6.2)
  - Couette flow (§6.2)
  - Start-up transient for Couette flow (§6.2)
  - Poiseuille flow in a channel and a tube (§6.2)
  - Oscillatory flow in a channel and a tube (§6.2)
- Dimensional analysis
  - Buckingham pi theorem (§§7.1–7.6)
  - Model similarity (§§7.8–7.9)
- Potential flow
  - Velocity potential and stream function (§§6.2.3, 6.4)
  - Two-dimensional plane flows (§6.5)
  - Superposition of plane flows (§6.6)
  - Laplace's equation
- External flow
  - Prandtl's boundary layer equations (§§9.1–9.2)
  - Blasius' solution for laminar flow over a flat plate (§9.2)
  - von Kármán's momentum-integral analysis (§9.2)
  - Lift and drag (§§9.3–9.4)