ME 3250 – Fluid Dynamics I

Credits and Contact Hours: 3 Credits. Three 50 minute or two 75 minute lectures per week.

Instructors:Baki Cetegen, Wilson Chiu, Tai-Hsi Fan, Tianfeng Lu, Reza Sheikhi, Xinyu Zhao

Textbook: *Fundamentals of Fluid Mechanics,* 8th edition, by B.R. Munson, W.W. Huebsch, and A.P. Rothmayer, Wiley, 2015.

Specific Course Information:

a. Catalog Description: Laws of conservation of mass, momentum, and energy in fluid systems, fluid statics, dimensional analysis, incompressible, inviscid and viscous flows, internal and external flows.

b. Prerequisites: ME 2233, MATH 2110Q, and MATH 2410Q. This course and CE 3120 may not be taken for credit.

c. Required, Elective or Selected Elective: Required

Specific Goals:

a. Course Outcomes:

After completing ME 3250 students should be able to:

1. Understand the basic definition and physical meaning of fluid properties including density, dynamic viscosity, kinematic viscosity, and surface tension.
2. Understand the physical origin of hydrostatic pressure and buoyant force, and be able to apply the Archimedes' principle.
3. Know the relationships between pressure and fluid acceleration in a flowing fluid.
4. Understand the applications and limitations of the Bernoulli equation.
5. Apply Reynolds Transport Theorem for mass, momentum, and moment of momentum for control volume analysis of fluid flow.
6. Understand the physical meaning of the continuity equation, the Navier-Stokes equations, and the stress-strain relationship for incompressible Newtonian fluids.
7. Reduce the Navier-Stokes equations for the differential analysis of simple flows.
8. Understand the basic characteristics of laminar flows.

b. Relationship of Course Outcomes to Criterion 3 Student Outcomes:

1. An ability to identify, formulate, and solve engineering problems by applying principles of engineering, science, and mathematics.
   Students use advanced mathematical concepts and control volume analysis to solve fluid flow problems. Emphasis is placed on the simplification of complex mathematical problems to yield engineering solutions. Students learn to identify the basic principles involved, formulate and solve fluid flow related engineering problems.
2. An ability to apply both analysis and synthesis in the engineering design process, resulting in designs that meet desired needs.

Students acquire the ability to design systems, components or processes to meet desired needs utilizing control volume analysis, dimensional analysis and empirical data on fluid flow induced forces.

3. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
   Not Applicable
4. An ability to communicate effectively with a range of audiences.
   Not Applicable
5. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
   Students are exposed to current issues in engineering through class lectures on state of the art technology.
6. An ability to recognize the ongoing need for additional knowledge and locate, evaluate, integrate, and apply this knowledge appropriately.
   Fluid Dynamics I is an introductory course for a sophisticated and mature field. As such, it highlights the need for additional study and education to master the concepts taught. Students learn to use techniques associated with control volume analysis and computational fluid dynamics to solve real world fluid mechanics problems.
7. An ability to function effectively on teams that establish goals, plan tasks, meet deadlines, and analyze risk and uncertainty.
   Not Applicable

Topics Covered:

- Hydrostatics
- Bernoulli's equation
- Kinematics
- Control volume equations
- Differential equations and dimensional analysis
- External flow
- Potential flow
- Internal flow
- Boundary layers