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, Zhuyin Ren, Michael Renfro

Textbook: *Fundamentals of Fluid Mechanics,* 5th edition, by B.R. Munson, D.F. Young, and T.H. Okiishi, Wiley, 2006.

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 2110, MATH 2410. 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:

a) an ability to apply knowledge of mathematics, science, and engineering: *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.*

b) an ability to design and conduct experiments, as well as analyze and interpret data: *not applicable*

c) an ability to design a system, component, or process to 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.*

d) an ability to function on multi-disciplinary teams: *not applicable*

e) an ability to identify, formulate, and solve engineering problems:
Students learn to identify the basic principles involved, formulate and solve fluid flow related engineering problems.

f) an understanding of professional and ethical responsibility: *not applicable*

g) an ability to communicate effectively: *not applicable*

h) the broad education necessary to understand the impact of engineering solutions in a global and societal context: *not applicable*

i) a recognition of the need for, and an ability to engage in life-long learning:
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.

j) a knowledge of contemporary issues:
Students are exposed to current issues in engineering through class lectures on state of the art technology.

k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice:
Students learn to use techniques associated with control volume analysis and computational fluid dynamics to solve fluid mechanics problems.

Topics Covered:

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