ES 3003 Introduction to Fluid Mechanics

(Required course for ChE, ME and PE programs)

Current Catalog Description: Basic principles of fluid mechanics. Properties of fluids, fluid statics, concepts of control volume and transport theorem, equations of continuity and motion, Bernoulli's equation, incompressible flow in pipes and around solid bodies, fluid measurements.

Prerequisites: Math 2073, Phys 2053.

Corequisites: ES 3053

Prerequisites by Topic: Newtonian Mechanics, Partial Derivatives, Vector Calculus, Energy Balances

Recent Textbook: Fluid Mechanics: Fundamentals and Applications, Y.A. Çengel and J.M. Cimbala, 2006, McGraw-Hill. Crane's Flow of Fluids, Technical Paper No. 410 (English Units) is recommended.

Other Required Material: None

Course Objectives: By the end of the course the student should be able to demonstrate that they can

1. apply fluid statics including manometers, Archimedes principle, and hydrostatic forces on bodies.
2. solve problems using the conservation of mass, momentum and energy including Bernoulli's equation
3. use basic dimensionless groups in modeling
4. analyze piping systems for viscous flow which may include measurement devices and branching
5. apply a basic understanding of drag and lift forces
6. Solve a design problem that includes appropriate computer usage, economics, safety, and environmental aspects, and a design report.
7. work effectively in multi-disciplinary groups

Major Topics Covered in the Course: Fluid Properties, Fluid Statics, Bernoulli Equation, Reynolds Transport Theorem, Equations of Continuity and Motion, Dimensional Analysis, Pipe Flow, Lift and Drag

Class/Laboratory Schedule: Lecture meets for two 75-minute sessions each week for 14 weeks.

Professional Component Contribution: This course applies mathematics and basic chemistry and physics to engineering applications of fluid mechanics. A minimum of one design project is assigned in this course.

Relationship to Student Outcomes	
outcome:	**Description of related course content:**
(a) an ability to apply knowledge of mathematics, science and engineering	Problems in this course build on a background of chemistry, physics, and thermodynamics.
(b) an ability to design and conduct experiments, as well as to analyze and interpret data	Occasional homework problems require analysis and interpretation of experimental data.
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	Students design a fluid system in this course to satisfy a specific set of constraints. Problems relating to health and safety may be assigned as homework.
(d) an ability to function on multi-disciplinary teams	The design project and most homework problems are done in teams. Every effort is made to ensure a mix of two or more majors on each team.
(e) an ability to identify, formulate, and solve engineering problems	A variety of homework problems are assigned each week so that students will develop the necessary problem solving skills.
(f) an understanding of professional and ethical responsibility	FE style questions are included on exams to encourage students to become licensed engineers. Ethical behavior is required in the course.
(g) an ability to communicate effectively	In addition to the communication skills required to function on a team and successfully write an exam, students are required to write a paper summarizing their design project.
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	The economic trade-offs in selecting pipe size are discussed. The design project often has an economic or environmental component.
(i) a recognition of the need for, and an ability to engage in life-long learning	Students are reminded throughout the course that this is simply an introductory course and that there is more to learn in this field.
(j) a knowledge of contemporary issues	Current events relating to the course are introduced as appropriate.
(k) an ability to use the techniques, skills and modern engineering tools necessary for engineering practice	Students are required to use computers to solve problems throughout the course. Excel is required.

Prepared by: Laura P. Ford (May 27, 2005)
Modified January 8, 2007 Laura P. Ford , objective 7 was changed from *designing* piping systems to *analyzing* piping systems, and Objective 11 was added.
Modified April 26, 2007 Laura P. Ford, The objectives were reworded to be active voice and include appropriate terms from Bloom's taxonomy.
Modified January 15, 2008 Laura P. Ford, During the Faculty Meeting on Friday, January 11, 2008, the following three changes to old Objectives 2, 3, 4, and 9 were made: "They can perform manometer calculations" and "They can apply hydrostatic forces, Pascal's law and Archimedes' principle" were combined into "They can apply fluid statics." "They can apply Bernoulli's equation (with and without mechanical energy effects) to flow problems" was changed to "They

can apply Bernoulli's equation (with and without losses) to flow problems." "They can incorporate writing skills, computer skills and a knowledge of safety and ethical concerns" was changed to "They can write a design report, use computers to solve course problems, and apply safety and ethics as appropriate." In the Catalog Description, "over submerged bodies" was changed to "around solid bodies." Vector Calculus was added to the prerequisites by topic, since partial derivatives is not all that they need to remember from multivariate calculus.
Modified May 7, 2008 Francis S. Manning, P.E., Changed Crane TN 410 from required to recommended. Completed "Relation to Program Outcomes" section.
Modified Course objectives from Spring 2009 added by G. L. Price
Modified 3/20/2012 to remove old ChE criteria - GLP