CE 311 FLUID MECHANICS

Required Course

Fall 2008

Instructors:	*Name:*	Cem Avcı	Emre Otay
	Office Hours:	M 34, W 34	M 3 W 3
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Course Data: Hours: MM 12, WW 12
Room: Avcı MM: M2230, WW: M3120, Otay MM: M3120, WW: 2170

Course Description (Catalog):

CE311 Fluid Mechanics **(3+2+0)4**

Fundamental principles of fluid mechanics and their application to engineering problems**.** Fluid statics. Kinematics of fluid flow: continuity equation, stream function, irrotational flow velocity potential. Fluid dynamics: flow of viscous fluids. Newtonian fluids, simple laminar flow systems, turbulence, flow in pipes. Selected topics from compressible flow, open channel flow, boundary layer theory.

Prerequisite: CE 245 Mechanics

Course Objectives (Learning Outcomes):

To establish an understanding of the fundamental concepts of fluid mechanics

To build the necessary theoretical background for advanced fluid dynamics and hydraulics courses.

Textbook:

Munson, B.R., Young, D.F. and Okiishi, T.H., "***Fundamentals of Fluid Mechanics***", 5th edition, John Wiley and Sons.

Reference Books:

White F.M., "***Fluid Mechanics***", 2nd edition, McGraw Hill.

Curricular Context

This required course integrates the fundamental math and science concepts into specific applications within the context of fluid mechanics. It provides the foundation for advanced fluid mechanics and hydrodynamics courses.

Laboratory and Computer Usage:

N/A

Class Policies:

Homework and Quizzes: Homework questions to be assigned from each chapter. Unannounced quizzes to be held almost weekly. Quizzes will be based on homework assignments. 10% of the course grade.
Midterm exams: Two exams, each 30% of the course grade.
Final exam: Comprehensive exam at the end of the semester, 30% of the course grade.

Contribution of the Course to Program Outcomes:

(a) An ability to apply knowledge of mathematics, science and engineering
(c) An ability to design a system, component, or process to meet desired needs such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
(e) An ability to identify, formulate and solve engineering problems
(k) An ability to use the techniques, skills and modern engineering tools necessary for engineering practice

Course Assessment:

Course will be assessed on the basis of the accomplishments regarding the course objectives and the contributions to the program outcomes. The evaluation will consist mainly of the responses from the students, who will provide their comments to various course related questions in the final week of the semester.

WK	Topic	Contents	Reading Assignments	Assigned Problems
1	Introduction, Fluid Properties	Introduction to some characteristics of fluids. Analysis of fluid behaviour. Concepts of viscosity vapour pressure, surface tension.	Chapter 1	Ch.1/ 9,23,42,52,54,61,64,83,84
2	Fluid Statics	Pressure variation in a fluid at rest. Manometry. Hydrostatic forces on surfaces. The concepts of buoyancy, flotation and stability. Pressure variation in a fluid with rigid-body motion.	Chapter 2	Ch.2 / 4,7,11,39,41,42,48, 60,69
3	Bernoulli Equation	Review on Newton's second law along a streamline and normal to a streamline, the concepts of static, stagnation, dynamic and total pressure	Chapter 3	Ch.3/12,14,16,20,51,55,58,66,67,80
4	Fluid Kinematics	Eulerian and Lagrangian flow descriptions. 1,2 3 – dimensional flows. Steady and unsteady flows. Streamlines, streaklines and pathlines. The concept of material derivative.	Chapter 4	Ch.4 / 37,39,40,45,47,55, 61
5	Reynolds Transport Theorem	Control volume and system representations. Derivation of the Reynolds Transport Theorem. Moving control volumes. Selection of a control volume.	Chapter 4	
6	Conservation of Mass	Derivation of the continuity equation. Fixed and moving nondeforming control volume. Deforming control volume.	Chapter 5	Ch.5 / 39,43,45,50,56,62,102,106
7	Conservation of Mass & Momentum	Derivation and application of linear momentum equation. Derivation and application of moment of momentum equation.	Chapter 5	
8	Conservation of Energy, Diff. Analysis : Cons. of Mass	Derivation and application of the energy equation. Implementation of the energy equation for nonuniform flows. Differential form of continuity equation in Cartesian and cylindrical polar coordinates. The concept of stream function.	Chapter 6	Ch.6 / 22,34,47,54,57,60, 66,81,93,99
9	Diff. Analysis : Cons. of Momentum	Description of forces acting on the differential element. Equations of motion.	Chapter 6	
10	Diff. Analysis : Potential Flow	Euler's equation of motion. Irrotational flow and the velocity potential. Some basic, plane potential flows.	Chapter 6	
11	Diff. Analysis :Potential Flow, Diff. Analysis : Viscous Flow	Superposition of basic plane potential flows. Stress-deformation relationships in viscous flow. The Navier-stokes equation.	Chapter 6	
12	Diff. Analysis : Viscous Flow	Some simple solutions for viscous, incompressible fluids.	Chapter 6	
13	Dimensional Analysis and Modelling	Dimensional analysis. Buckingham Pi theorem, Common dimensionless groups in fluid mechanics. Modelling and similitude.	Chapter 7	Ch.7 / 6,13,18,20,27,50,58, 61,67,70