CIVIL EN 413: Fluid Mechanics

Autumn Quarter 2008

Instructor: Ethan Kubatko
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Office Hours: MWF after class and by appointment

Class Schedule:

Lecture:	MWF	12:30 – 1:18	MQ	264
Recitations:	R	11:30 – 1:18	BO	412
	R	1:30 – 3:18	DL	305
	R	3:30 – 5:18	BO	428

Prerequisites:

Mech Eng 430 and Civil En 405 or FA & B Eng major; minimum CPHR of 2.0; or written permission of dept chairperson.

Required Text:

Fluid Mechanics, V. Streeter, K.W. Bedford and E.B. Wylie, 9th Edition, WBC/McGraw-Hill, 1998. Hardcover, 740 pages, ISBN 0-07-062537-9. Relevant chapters of the text book will be available electronically on the course website.

Website:

Class materials (including the text book), announcements, and grades will be available on Carmen: http://telr.osu.edu/carmen

Course Objectives:

To develop an understanding of the properties of fluids and the principles of fluid static and dynamic behavior with application of this knowledge to solving practical problems, particularly those arising in civil engineering. Concepts will be presented with physical meaning and analytical support. Fluid behavior will be studied by basic derivation of the governing mathematical expressions and their analysis. Problems will be solved by application of working formulae and experimentally determined coefficients. Laboratory exercises will be used to support the lecture material.

Course Content:

The course consists of four "units":

Unit 1: Fluid Mechanics Basics (5 Lectures)

- General introduction – Definition of a fluid; the continuum concept; system of units
- Fluid properties and definitions – Viscosity, surface tension, etc

Unit 2: Fluid Statics (9 Lectures)

- Force, stress and pressure at a point
- Basic equation of fluid statics
- Pressure measurements
- Forces on submerged surfaces and bodies
- Relative equilibrium

Unit 3: Fluid Dynamics I: Inviscid Flow (10 Lectures)

- Flow concepts and kinematics
- Basic equations of fluid flow – Conservation of mass, energy, momentum

Unit 4: Fluid Dynamics II: Viscous Flow (6 Lectures)

- Dimensional Analysis and Similitude
- Viscous flow in pipes

Recitation:

In addition to the lectures, there are weekly recitations. The recitations serve the following purposes: homework review; quiz/exam review; laboratories (2); and mini project discussion. The recitation instructor is Ms. Alison Burcham (office hours TBA).

Homework:

Problems from the textbook will be assigned weekly and reviewed in recitation. These problems, along with material covered in lecture, will form the basis for quiz and exam problems.

Quizzes:

There will be seven 10-minute quizzes. Each quiz will be given in Monday's lecture and returned (graded) in Thursday's recitation. The best six (out of the seven) quizzes will count toward the final grade.

Exams:

There will be two, closed-book examinations – a midterm and a final. The midterm will cover Units 1 and 2. The final exam will be comprehensive with an emphasis on the material covered after the midterm (Units 3 and 4). No student will be permitted to make up an exam unless *advanced* notice of absence is given to the instructor (not the TA) in person.

Laboratories:

Two laboratory experiments will be performed during the quarter; one on energy conservation principles by analysis of a venturi meter; and one on momentum/energy conservation principles via analysis

of a jet impacting a surface. A "mini-project" is associated with each lab, which consists of a series of questions and problems related to the laboratory experiments. Each student will be required to submit a report upon project completion. The reports are technical documents, presenting first, the logic that each student used to reach the answers to the problems assigned, second the answers to the assigned problems and finally, conclusions and/or recommendations.

Final Grade:

Your final course grade will be based on the following weighting:

1) Quizzes	20%
2) Laboratories:	20 %
3) Midterm exam:	25 %
4) Final exam:	35 %

Academic Misconduct:

Please help maintain an academic environment of mutual respect, fair treatment, and personal growth. Although students are encouraged to work together on homework assignments, students are expected to produce original and independent work for quizzes and exams. Academic misconduct will not be tolerated and will be dealt with procedurally in accordance with University Rule 3335-31-02. (This policy can be found at http://oaa.osu.edu/procedures/1.0.html.)

E-mail Correspondence:

In order to protect your privacy, all course e-mail correspondence must be done through a valid OSU name.nn account. If you have not activated your OSU email account, you can activate your account at https://acctmgt.service.ohio-state.edu/cgi-bin/KRB1EntryAdd.

Special Accommodations:

All students who feel they may need accommodations based on the impact of a disability should contact the instructor privately to discuss their specific needs. Students with documented disabilities must also contact the Office of Disability Services (ODS) in 150 Pomerene Hall (phone: 292-3307) to coordinate reasonable accommodations for the course. ODS forms must be given to your instructor as early in the quarter as possible to be filled out and returned to you.

Drop date:

The last day to drop an Autumn Quarter course without a "W" on your record is October 10.

Tentative Class Schedule

Lecture #	Day	Date	Topic	Reading	Homework
1	W	09/24	Course Overview/Introduction	···	···
	R	09/25	No Recitation		
2	F	09/26	Definitions, Dimensions & Units, Viscosity	1.1, 1.2, 1.3, 1.4	1.2, 1.3, 1.4, 1.5
3	M	09/29	Mass, temperature and thermodynamic variables	1.5, 1.6	1.6, 1.7, 1.11, 1.15
4	W	10/01	Pressure and bulk modulus	1.7, 1.8	1.12, 1.16, 1.18, 1.19, 1.20
	R	10/02	Review Homework		
5	F	10/03	Vapor pressure and surface tension	1.9, 1.10	1.44, 1.56, 1.58, 1.63, 1.67, 1.70
6	M	10/06	QUIZ #1, Force, stress, & pressure at a point	2.1	···
7	W	10/08	Basic equations of fluid statics	2.2	2.8, 2.15, 2.17, 2.27, 2.32, 2.33, 2.34
	R	10/09	Review Homework, return quiz #1		
8	F	10/10	Units & scales of pressure measurement, manometers	2.3, 2.4	···
9	M	10/13	QUIZ #2, Forces on plane areas I	2.5	2.38, 2.47, 2.65, 2.66, 2.72
10	W	10/15	Forces on plane areas II: Examples	···	2.84, 2.89, 2.99
	R	10/16	Review Homework, return quiz # 2		
11	F	10/16	Forces on curved areas	2.6	···
12	M	10/20	QUIZ #3, Buoyant force & stability	2.7, 2.8	···
13	W	10/22	Relative equilibrium I	2.9	2.121, 2.123, 2.126, 2.128
	R	10/23	Review Homework, return quiz #3		
14	F	10/24	Relative equilibrium II: Examples	···	···
15	M	10/27	Flow concepts and kinematics I	3.1	···
16	W	10/29	Flow concepts and kinematics II	···	···
	R	10/30	Review for Exam # 1		
			*** EXAM # 1 *** Time and place TBA		
17	F	10/31	The general control volume conservation equation	3.2	···

Tentative Class Schedule, cont'd

Lecture #	Day	Date	Topic	Reading	Homework
18	M	11/03	The conservation of mass & the energy equation	3.3, 3.4	···
19	W	11/05	Energy equation applications I	3.5	3.15, 3.16, 3.17, 3.18, 3.31. 3.34
	R	11/06	Return exam #1		
			Introduction to Lab #1: Energy/Venturi		
20	F	11/07	Energy equation applications II	···	3.38, 3.39, 3.41, 3.47, 3.53
21	M	11/10	QUIZ #4, Conservation of linear momentum	3.6	···
22	W	11/12	Momentum examples I	···	···
	R	11/13	Review Homework, return quiz #4		
			Introduction to Lab # 2: Force/Momentum		
23	F	11/14	Momentum examples II	···	3.62, 3.63, 3.67
24	M	11/17	QUIZ #5, Momentum examples III	···	3.72, 3.73, 3.85, 3.115
25	W	11/19	Dimensional Analysis and Dynamic Similitude I	5.1, 5.2, 5.3	···
	R	11/20	Review Homework, return quiz #5		
26	F	11/21	Dimensional Analysis and Dynamic Similitude II	5.4, 5.5, 5.6	5.18, 5.37, 5.44
27	M	11/24	QUIZ #6, Laminar and turbulent flow introduction	6.1	···
28	W	11/26	Laminar flow	6.2, 6.3	···
	R	11/27	No recitation – Thanksgiving Day		
	F	11/28	No Lecture – Columbus Day observed		
29	M	12/01	QUIZ #7, Turbulent flow	6.4, 6.5	···
30	W	12/03	Pipe flow	6.7	···
	R	12/04	Review Homework, return quiz #6, #7, final comments		
31	F	12/05	Review	···	···
*** FINAL EXAM *** Monday Dec 8, 11:30–1:18 PM					