Revised: 11/7/2010

Fluid Mechanics
University of Massachusetts – Department of Chemical Engineering
10.303 – Fall 2010

Lecture Time & Location: MWF, 11:00-11:50 AM, Kitson Hall 301

Prerequisites: 92.234 Differential Equations or 92.236 Eng Differential Equations

Textbook: Yunus A. Cengel; and John M. Cimbala, Fluid Mechanics Fundamentals and Applications, 2nd edition, McGraw-Hill

Handouts: Handouts covering the day's material will be posted into Blackboard. These notes are a primary resource for course material.

Instructor: Prof**.** Seongkyu Yoon, (EB108, 978-934-4741, seongkyu_yoon@uml.edu)
TA: Andrew Bawn, (EB219, andrew_bawn@student.uml.edu).

Office Hours: MWF 1:00-2:00 PM (Instructor), TT 1:00-2:00 PM (TA). If there are questions on course, please contact Seongkyu Yoon or TA via office hours, email, or individual appointment. You can also stop by my office without an appointment, but I may have to postpone if that time is inconvenient.

Learning Goals: This course introduces the student to several fundamental concepts and applications of fluid mechanics. It overviews the basic properties of fluids, the study of fluid statics and fluid flow systems, and the development and application of the appropriate mass, momentum, and energy balance relationships needed to solve a variety of practical problems, with a particular focus on the macroscopic view. Emphasis is on the ability to apply the basic principles to the design and analysis of engineering systems involving applications in hydrostatics, internal, open-channel, and external flows, pump selection, flow measurement, etc. The course also focuses on proper problem solving strategy and on the correct use of units in engineering analysis. The following summarizes the course objectives.

- Course Objective
  - Obtain knowledge of basic concepts and terminology associated with properties of fluids including pressure, specific weight, density, vapor pressure and viscosity
  - Determine the magnitude and effective location of the lines(s) of action of force(s) on surfaces due to pressure from static fluids.
  - Obtain knowledge of the basic concepts and terminology associated with fluid flow including types of flow (ideal vs. real, steady vs. unsteady, laminar vs. turbulent, etc) as well as analysis approaches using systems and control volumes
  - Calculate forces, momentum, and energy due to steady flow of fluids over both stationary and moving vans and pressured conduits.
  - Obtain basic understanding of the concepts and significance of common dimensionless parameters such as the Reynolds number.

  - Analyze problems involving steady incompressible flow in pressure conduits with friction including pressure loss and discharge and with consideration of straight-line losses and minor losses.
  - Analyze and calculate the Energy and Hydraulic Grade Lines (EGL and HGL)
  - Analyze simple pumps and turbines.

- Program Objective
  - I can understand, analyze and design physics and chemical processes.
  - I can identify and solve chemical engineering problems
  - I am proficient in the oral and written communication of my work
  - I am proficient in the use of engineering tools and equipment
  - I can learn and work independently, and practice leadership and teamwork in and across disciplines
  - I can design and perform laboratory experiments to gather data, test theories and solve problems.
  - I understand the safety and environmental consequences of my work
  - I understand the regional, global and societal impact of engineering problems and solutions
  - I am prepared for a lifetime of continuing education
  - I act in accordance with the highest ethical standards.

Class Communication: Although most course information will be transmitted during classtime, Blackboard (and its email) will be used for various announcements regarding homework questions, feedback on exams, etc. Thus, students are expected to check their email on a regular and frequent basis. Materials for this class will be posted on the web at http://lowell.umassonline.net Selecting Fluid Mechanics from the drop-down menu will take you to this class section. Pre-lecture will be made available prior to class. The lecture style will assume that you have these notes with you. It is your responsibility to print these pages out and bring them to class. You are encouraged to make use of these notes to fill in areas you may have missed in lecture. Homework will not be handed out in class, but you will be told when it is available on the web page.

Homework: Homework due dates will be specified at the time of the assignment. Typically, it will be one week after the assignment. These due dates are firm, so plan ahead. The penalty is 10% for each day past the deadline (i.e. 3 days late and the highest score you could obtain would be 0.7 * 100% = 70%). Once solution sets are posted (typically 3-5 days after the homework has been handed in), no credit will be given. Although working on homework in groups is permitted, homeworks are expected to be the work of each individual. Any sign of copied work will result in dividing the grade by the number of copies found (i.e. 3 people found to be submitting the same work would each get 1/3 of the grade). Reading assignments are given in the course outline.

Attendance: Attendance in class is the responsibility of the student. If class is missed, you are responsible for obtaining the notes from another student or from the class notes posted on the web.

Exams: The details of a particular test (open/closed book, etc.) will be given before each test. The exams will be given during the scheduled class time. All exams will be either closed-book or open-everything. The exams will have problems similar to those on the homework assignments; therefore, students who have mastered the course material through the homework assignments will probably do quite well on the exams, and students who shortchange the homeworks with also come up short on the exams. The final exam will be comprehensive, covering the entire course material. Review sessions will be held prior to all tests. These review sessions will last 1 hour. Attendance is voluntary.

Attendance at test is mandatory unless arrangements have been made beforehand. A written excuse will be necessary for rescheduling an exam. If there is an extreme emergency, contact me *before* exam date for permission to be excused. If excused, the final exam grade will be used in place of the missed exam. If the final exam is excused, the grade on the previous exams will be averaged and used in place of the final exam. If more than one exam is missed, an incomplete/fail will be given for the course. Exam solutions will be posted in the blackboard after the exams are returned. If it is believed that an exam has been graded unfairly, please resubmit within one week for re-grade of entire exam.

Grading: 12 Homework 25%, 3 In-Class Exams 45%, Final 30%

Important Dates
Oct 1 (Fri), Exam #1
Oct 22 (Fri), Exam #2,
Nov 19 (Fri), Exam #3,
During final exam period, Final Exam (Time and Place will be announced)

Quality and Presentation of Written Work: Written work in this course must satisfy a quality standard. If it does not, it will be returned to the student ungraded and a zero grade will be recorded. They must be neat and organized. Problem solutions involving derivations and calculations must include explanatory comments between steps and results must be set off clearly. The units must be clearly labeled. Homework assignment solutions must be on engineering paper if hand-written or on white paper if typed or computer-printed. Multiple pages must be stapled in the upper left corner.

Academic Ethics: If a student violates academic ethics in this course, the consequences will be an automatic F in the course, a letter of reprimand placed in the student's College file, and referral of the matter to the Committee on Undergraduate Academic Affairs for possible further action. The basic rule is that a student may not present as their own the work of another student nor allow their own work to be presented as the work of another student. In group work, all members are required to participate fully in the assignment.

Tentative Course Schedule and Outline

Topic #	Subjects to be Discussed	Chapters in Text
1	Course Introduction/Overview	1 (2)
2	Fluid Properties	2 (2)

3	Fluid Statics	3 (3)
4	Basic Flow Phenomena -- Kinematics	4 (3)
5	Mass, Bernoulli and Energy Equation	5 (3)
6	Basic Equations of Fluid Flow (mass, energy, and momentum balances)	6 (2)
7	Dimensional Analysis	7 (3)
8	Internal Flows	8 (3)
9	Differential Analysis of Fluid Flow	9,10 (4)
10	External Flows	11 (3)
11	Compressible Flows	12 (3)
12	Uniform Open Channel Flows	13 (3)

Class Schedule

Date	Day	Week	Event	Class	RA; Homework; Exam
9/1/2010	W	1		1	C1
9/3/2010	F	1		2	C1
9/6/2010	M	2	University Closed		
9/8/2010	W	2		3	C2
9/10/2010	F	2		4	C2; C1 Assignment Due
9/13/2010	M	3		5	C3
9/15/2010	W	3		6	C3
9/17/2010	F	3		7	C3; C2 Assignment Due
9/20/2010	M	4		8	C4
9/22/2010	W	4		9	C4
9/24/2010	F	4		10	C4; C3 Assignment Due
9/27/2010	M	5		11	C5
9/29/2010	W	5		12	
10/1/2010	F	5	Umetrics Workshop	13	**In-Class Exam (C1234)**
10/4/2010	M	6		14	C5
10/6/2010	W	6		15	C5
10/8/2010	F	6		16	C6; C4 Assignment Due
10/11/2010	M	7	Columbus Day (Univ Closed)		
10/12/2010	T	7	Monday Class Schedule	17	C6
10/13/2010	W	7		18	C6
10/15/2010	F	7		19	C7; C5 Assignment Due
10/18/2010	M	8		20	C7
10/20/2010	W	8		21	
10/22/2010	F	8	IBC Workshop (21-22)	22	C6 Assignment Due, **In-Class Exam (C567)**
10/25/2010	M	9		23	C7,C8
10/27/2010	W	9	PPAR Workshop (26-27)	24	C8

10/29/2010	F	9		25	C8; C7 Assignment Due
11/1/2010	M	10		26	C9
11/3/2010	W	10		27	C9
11/5/2010	F	10	2 Hr Class	28	C10; C8 Assignment Due
11/8/2010	M	11	AIChE Annual Conference	29	Student Development Center
11/10/2010	W	11	Thursday Class schedule		
11/11/2010	R	11	Veterans Day Observed		
11/12/2010	F	11	AIChE Annual Conference	30	C9
11/15/2010	M	12		31	C10
11/17/2010	W	12		32	C10, C9 Assignment Due
11/19/2010	F	12		33	**In-Class Exam (C8,9, 10);** C11; C10 Assignment Due
11/22/2010	M	13		34	C11
11/24/2010	W	13		35	C12
11/26/2010	F	13	Thanksgiving		
11/29/2010	M	14		36	C12
12/1/2010	W	14		37	C12
12/3/2010	F	14		38	C13; C11 Assignment Due
12/6/2010	M	15		39	C13
12/8/2010	W	15		40	Catch-up; C12 Assignment Due
12/10/2010	F	15	Last day of Fall Semester	41	
12/16/2010	R		Final Exam Period		Final Exam: TBD