Instructor: Spyros A. Kinnas, ECJ 8.604, ph: 475-7969, *kinnas@mail.utexas.edu*

Meeting times and place: Tuesday and Thursday, 9:30-11:00 am - CPE 2.212

Office hours: Monday 2:00 - 4:00 pm; Wednesday 10:00 am -11:00 am

TAs (to demonstrate Labs): Bryan Barnett (*bryanworthbarnett@hotmail.com*) and Chi Phuong Hoang (*hoangphuongchi@yahoo.com*).

Tutor: Nick David (*nwd73@mail.utexas.edu*) - Hours: Thursdays: 3-4pm, Sundays: 4-5pm, and Mondays: 4-7pm - Location: Student Lounge at the basement of ECJ.

Course objectives: Understand the *principles* of statics and dynamics of fluids and their *applications* to problems in engineering.

Prerequisites: EM 306

Required Textbook: Engineering Fluid Mechanics, by Crowe, Elger, Williams, and Roberson *John Wiley & Sons* (9th edition, 2009) - **ISBN-13: 978-0470-25977-1**

Educational videos: from the *Encyclopedia Britannica Series* or from Prof. Kinnas' research; to be shown occasionally in class.

WEB SITE: *http://www.ce.utexas.edu/prof/kinnas/319LAB/* includes course information, homework assignments and solutions, laboratory descriptions, announcements, Q&A sessions, graphs, terms to remember, sample problems and solutions, links to related sites, and **interactive learning tools**.

Exams:

- Test I: Thursday, February 26, 2009 (tentative), in class
- Test II: Thursday, April 16, 2009 (tentative), in class
- Final Exam: Saturday, May 16, 2009, 2:00-5:00 pm

Failure to attend an exam will lead to a mark of zero. The only exception will be for documented medical emergencies.

Homework (weekly): Original assignments must be submitted by each student. Solutions will be posted on the web site of the course. The homework assignment will be graded for solution procedure, numerical results, clarity and appearance of the report. Students must submit their solutions **at the beginning** of class on the assigned due date. **Late assignments will not be accepted**.

Grading policy: Homework: 15%; Test I: 20%; Test II: 25%; Final: 30%; Lab participation: 10%

Attendance: Highly recommended. Prof. Kinnas favors interactive teaching.

"The University of Texas at Austin provides, upon request, appropriate academic adjustments for qualified students with disabilities. Any student with a documented disability (physical or cognitive) who requires academic accommodations should contact the Services for Students with Disabilities area of the Division of Diversity and Community Engagement at 471-6259 as soon as possible to request an official letter outlining authorized accommodations. For more information, contact that office at 471-6259, Video Phone 232-2937, or the School of Engineering Director of Students with Disabilities at 471-4321."

Laboratory demonstrations: A fluids lab will supplement this course. **ALL STUDENTS MUST REGISTER FOR THE LABS**. Students are expected to attend the lab sessions. 10% credit of the total grade will be given for lab participation. For labs missed a proportionate amount will be subtracted from the 10% credit. For example, if a student collects 67 points from the HW, Test I, Test II, and Final Exam, and has missed 2 out of 10 labs, her/his total grade will be 67+8=75 points. If the same student had not missed any labs her/his total grade would be 67+10=77 points. NO Labs in the first week of class. Assume that labs will be offered EVERY week (we will notify you if otherwise). Labs missed will NOT be made-up.

Scholastic Dishonesty Policy:

Students who violate University rules on scholastic dishonesty are subject to disciplinary penalties, including the possibility of failure in the course and/or dismissal from the University. Since such dishonesty harms the individual, all students, and the integrity of the University, policies on scholastic dishonesty will be strictly enforced. For further information, visit the Student Judicial Services web site *http://deanofstudents.utexas.edu/sjs/*, and the General Information Catalog information at *http://registrar.utexas.edu/catalogs/gi08-09/app/gi08.appc03.html#chapter-11-student-discipline-and-conduct*

Dropping policy:

- **Undergraduate Students:**

  From the 1st through the 12th class day, an undergraduate student can drop a course via the web and receive a refund if eligible. From the 13th through the 20th class day, an automatic Q is assigned, no refund; approval from the Dean and departmental advisor is required. From the 21st class day through the mid-semester deadline, approval is required from the Dean, instructor of the course and departmental advisor.

- **Graduate Students:**

  From the 1st through the 4th class day, graduate students can drop a course via the web and receive a refund. During the 5th through 12th class day, graduate students must initiate drops in the department that offers the course and receive a refund. After the 12th class day, no refund is given. No class can be added after the 12th class day. From the 13th through the 20th class day, an automatic Q is assigned with approval from the Graduate Advisor and the Graduate Dean. From the 21st class day through the last class day, graduate students can drop a class with permission from the instructor, Graduate Advisor, and the Graduate Dean. **Students with 20-hr/week GRA/TA appointment or a fellowship may not drop below 9 hours.**

Course/Instructor Evaluation Plan: Course/instructor evaluation forms will be distributed during one of the final lectures. A student within the class will be asked to distribute and collect the evaluation forms, and to return them to the Department of Civil Architectural & Environmental Engineering main office on the 4th-floor of ECJ Hall.

COURSE OUTLINE (tentative number of lectures)

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1. Introduction (1 lecture)

- Physical characteristics of the fluid state
- The scope of fluid mechanics

2. Properties of fluids (2 lectures)

- Units
- Extensive and intensive properties
- Mass and weight of fluid (density, specific weight, specific volume)
- Viscosity
- Surface tension, capillarity
- Vapor pressure

3. Hydrostatics (3 lectures)

- Absolute and gage pressure
- Pressure variation with elevation
- Pressure measurement
- Pressure forces on plane or curved surfaces
- Buoyancy and stability - Archimedes' principle

4. Fluids in motion (3 lectures)

- Velocity, streamlines and pathlines
- Flow-rate
- Acceleration, substantive derivative
- Control volume approach
- Conservation of mass - The continuity equation

5. Pressure variation in flowing fluids (4 lectures)

- Fluid masses subjected to acceleration
- Euler's equation

- Bernoulli's equation
- Stagnation pressure and the Pitot tube
- Cavitation

6. Momentum principle (3 lectures)

- The momentum equation
- Applications - Forces on fluid boundaries

7. Energy principle (3 lectures)

- The energy equation
- The pump and the turbine
- The hydraulic and the energy grade lines

8. Flow in conduits (4 lectures)

- Wall shear stress and head loss
- Laminar flow in pipes
- Turbulent flow inside smooth and rough pipes - The Moody diagram
- Local losses in pipelines

9. Dimensional analysis (2 lectures)

- Reduction of parameters in a physical problem
- Common dimensionless numbers
- Similitude and model testing
- The drag and pressure coefficients

10. Surface resistance (2 lectures)

- The no-slip condition and the boundary layer
- Turbulent flow and Reynolds stresses
- Flow separation

11. The need for Computational Fluid Dynamics - CFD (1 lecture)