Instructor: Spyros A. Kinnas, ECJ 8.610, phone: 512-475-7969, *kinnas@mail.utexas.edu*

Meeting times and place: Tuesday and Thursday, 9:30-11:00a.m., ECJ 1.322

Office hours: Monday 3:00 – 4:00pm; Wednesday 10:00 - 11:00a.m.

TA (to demonstrate Labs): Kyungjung Cha, CAEE/OE Graduate Student, kjcha@utexas.edu

Tutor: Maria J. Cardenas, CAEE Senior, mariajcardenas@utexas.edu

Tutor hours: Mondays: 1-3pm and Fridays: 9:30-10:30am in Room: **ECJ 8.504**

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

Academic/learning goals for the course: Understand the *principles of standing or flowing fluids* and the resulting forces on bodies in contact with the fluid, with *applications* to problems related to civil, architectural and environmental engineering.

How the academic/learning goals will be assessed: through the results of two tests, a comprehensive final, weekly homework assignments, and participation in laboratory experiments.

Prerequisites: EM 306

Required Textbook: Engineering Fluid Mechanics, by Elger, Lebret, Crowe, and Roberson, *John Wiley & Sons* (11th edition, 2016) **ISBN-13: 9781118880685 - ISBN-10: 1118880684**

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

WEB SITE: http://www.caee.utexas.edu/prof/kinnas/319LAB includes course information, homework assignments and solutions, web-outs, laboratory descriptions, announcements, terms to remember, links to related sites, and *interactive learning tools*.

Exams:

- Test I: Thursday, **February 27, 2020**
- Test II: Thursday, **April 16, 2020**
- Final Exam (Comprehensive): **Saturday, May 16, 2020, 9:00 am-12 noon**

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.**

The University of Texas at Austin provides, upon request, appropriate academic accommodations for qualified students with disabilities. For more information, contact the Division of Diversity and Community Engagement, Services for Students with Disabilities, 512-471-6259 (Videophone: 512-410-6644) or http://diversity.utexas.edu/disability

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Attendance: Highly recommended.

Grading policy: Homework: 10%; Test I: 23%; Test II: 27%; Final: 30%; Lab participation: 10%
The total grade (TG) will be determined by this formula: TG=0.1*HWAVG+Lab+XG, where:
XG=0.23*TestI+0.27*TestII+0.3*FG; TestI, TestII, and FG are the grades the student received in Test I, II, and the Final, respectively. HWAVG is the average of the HW grades, and Lab is the grade from the labs (see next section). In the event the grade in **the final (FG) is greater than that of Test I or Test II**, then the grade of Test I **OR** Test II (**NOT both**) will be replaced with that of FG. In other words, XG will be the **largest** of the following 3 values:
XG1=0.23*TestI+0.27*TestII+0.3***FG**
XG2=0.23***FG**+0.27*TestII+0.3***FG**
XG3=0.23*TestI+0.27***FG**+0.3***FG**
Example 1: if a student S1 receives (all out of 100 max) 85 in Test I, 70 in Test II, and 75 in the final, then: XG1=60.95, XG2=58.65, and XG3=62.3. Then XG=62.3 for student S1.
Example 2: if a student S2 receives (all out of 100 max) 75 in Test I, 75 in Test II, and 80 in the final, then: XG1=61.5, XG2=62.65, and XG3=62.85. Then XG=62.85 for student S2.
Example 3: if a student S3 receives (all out of 100 max) 75 in Test I, 80 in Test II, and 70 in the final, then: XG1=59.85, XG2=58.7, and XG3=57.15. Then XG=59.85 for student S3.

The plus/minus grading system will be followed:

A	4.0
A-	3.67
B+	3.33
B	3.0
B-	2.67
C+	2.33
C	2.0
C-	1.67
D+	1.33
D	1.0
D-	0.67
F	0

Laboratory demonstrations: A fluids lab will supplement this course. Students are expected to attend the lab sessions and do the required work during the labs. **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. Labs will **start the week of January 27**, and will be offered EVERY week (we will notify you if otherwise). Please pay attention to the following:

- **Labs missed will NOT be made-up. NO EXCEPTIONS!**

- Due to the fact that all labs are at full capacity (which CANNOT be exceeded due to safety regulations), **you will NOT be allowed to attend any other lab, EXCEPT the one you have registered for. NO EXCEPTIONS!** Please do NOT contact the lecturer or the TAs if you wish to change your lab times. Lab times can only be changed officially through the drop/add process.

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 additional information on these items see the Dean of students website, and University General Information Catalog, at: **http://deanofstudents.utexas.edu/conduct/ and http://catalog.utexas.edu/general-information/appendices/appendix-c/student-discipline-and-conduct/**

Drop policy for long sessions:

- **Undergraduate Students**:
  From the 1st through the 12th class day (4th class day in the summer sessions), an undergraduate student can drop a course via the web and receive a refund, if eligible. From the 13th (5th class day in the summer sessions) through the university's academic drop deadline, a student may Q drop a course with approval from the Dean, 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:

An evaluation of the course and instructor will be conducted at the end of the semester using the approved UT Course/Instructor evaluation forms. 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.

Emergency Preparedness Plan:

Emergency Preparedness means being ready. It takes an effort by all of us to create and sustain an effective emergency preparedness system. You are your own best first responder. Please use
https://preparedness.utexas.edu/welcome-emergency-preparedness
as a resource to better understand emergency preparedness at the university, and how you can become part of and contribute to the preparedness community. To monitor emergency communications for specific instructions, go to utexas.edu/emergency. To report an issue (none emergency) call 512-471-4441. In case of emergency, call 911.

Subject Matter of Lectures:

(Two lectures will be dedicated to the two tests, and are not included in the next list)

Lecture 1 **Introduction**	o Physical characteristics of the fluid state o The scope of fluid mechanics
Lectures 2, 3 & 4 **Properties of fluids**	o Units o Extensive and intensive properties o Mass and weight of fluid (density, specific weight, specific volume) o Viscosity o Surface tension, capillarity o Vapor pressure
Lectures 5,6,7 & 8 **Hydrostatics**	o Absolute and gage pressure o Pressure variation with elevation o Pressure measurement o Pressure forces on plane or curved surfaces o Buoyancy – Archimedes' principle
Lectures 9,10, 11 **Fluids in motion**	o Velocity, streamlines and pathlines o Flow-rate o Fluid acceleration o Control volume approach o Conservation of mass – The continuity equation
Lectures 12, 13,14, & 15 **Pressure variation in flowing fluids**	o Fluid masses subjected to acceleration o Euler's equation o Bernoulli's equation o Stagnation pressure and the Pitot tube o Cavitation
Lectures 16, 17, 18 & 19 **Momentum principle**	o The momentum equation o Applications – Forces on fluid boundaries
Lectures 20, 21, 22, & 23 **Flow in conduits**	o Wall shear stress and head loss o Laminar flow in pipes o Turbulent flow inside smooth and rough pipes – The Moody diagram o Local losses in pipelines
Lectures 24 & 25 **Dimensional analysis**	o Reduction of parameters in a physical problem o Common dimensionless numbers o Similitude and model testing o The drag and pressure coefficients
Lectures 26 & 27 **Surface resistance**	o The no-slip condition and the boundary layer o Turbulent flow and Reynolds stresses o Flow separation
Lecture 28 **Advanced topics**	o The Navier-Stokes equations and the need for computational fluid dynamics (CFD) and experimental fluid dynamics (EFD)