CE 380S – Environmental Fluid Mechanics

University of Texas, Department of Civil Engineering
Instructor: Dr. B. R. Hodges

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(please include CE380S in subject line)

Office Hours (ECJ 8.208)
DATE AND TIME; other times by appointment.

Availability on Monday, Wednesday, Friday: On these days, I am generally at the UT Pickle Research Campus, CRWR, Building 119. I can usually meet with you about class out there, however, if you are making a trip to CRWR to visit me it is best to make an appointment by phone or email.

Class web site: Canvas

Exam dates: There will be no exams in this class. Grading will be based on written reports and presentations.

Theme: This course is focused on applications of fluid mechanics that provide insight into the physics and transport in environmental systems. Over the course of the term, students will work through state-of-the-art journal articles on EFM problems and will learn the fundamentals of advection, diffusion, turbulence and mixing in stratified natural systems. Lakes, rivers and estuaries will be used as example environmental systems, which will be used to motivate investigations into fluid mechanics processes such as turbulence, internal waves, plumes, jets and convective mixing. The methodology emphasizes use of scaling analyses and balance arguments to reduce the Navier-Stokes equations to first-order balancing of key processes.

Primary Objectives: The course is designed to guide students through learning:
1) the qualitative descriptions of environmental flows,
2) an introduction to the jargon of EFM research and turbulence,
3) scaling analysis as a tool for understanding environmental systems,
4) basic processes that control different typical EFM flows.

Secondary Objectives: This course is designed to provide students experience in:
1) reading and analyzing academic literature,
2) writing a critical review of a journal article,
3) preparing a literature review in a subject,
4) presentation of material in a whiteboard technical lecture.

Scope of course within the graduate curriculum: This is not a substitute for a graduate-level incompressible flow course (e.g. ME 381P) that teaches the fundamentals of fluid dynamics and solutions for the basic equations. This course is designed without a graduate-level prerequisite by approaching environmental fluid mechanics using both a top-down approach (starting from the system level) and a bottom-up approach (starting from fundamental equations). Students who are interested in more detailed study of fluid mechanics are encouraged to take ME 381P as a complement to this course. Within the EWRE curriculum, CE 397, Computational Environmental Fluid Mechanics, is a natural follow-on to this course for students interested in EFM.

Prerequisites: Elementary Fluid Mechanics CE 319F, or the equivalent.
**Textbooks:** Recommended (not required): *Fluid Mechanics*, Pijush K. Kundu and Ira M. Cohen, Elsevier, 2004 (any graduate-level fluid mechanics textbook may be substituted). I do not teach out of the book, but it is a good graduate-level reference.

**Attendance:** Class attendance is strongly encouraged. Students who do not attend class will find the professor less willing to spend extra time outside of class. Students who miss more than 5 lectures will be dropped from the class.

**Effect of class participation:** Class participation, including attendance and asking questions, is strongly encouraged. The instructor reserves the right to add or subtract up to 5% on a final grade for class participation. Students should not count on obtaining these points in their final grade without showing significant effort in class.

**LaTeX:** Writing equations with MS-Word or most other word processors is a huge waste of time. In this class, I expect to see equations and derivations in your reports so all assignments will be completed using the LaTeX type-setting package. There will be a short introductory lecture and some LaTeX templates provided in class. You will need to install a LaTeX package on your computer. This can be downloaded for free from a variety of different places. On a Mac computer, I recommend TexShop (www.texshop.org). On Windows machines, I previously used MiKTeX (miktex.org), but there may be other versions that are better.

**Important Submission Dates:**
September XX: Submit general topic for your EFM studies to professor via email.
September XX: Submit paper that is subject for critical review to professor via email.
October XX: Submit 3 related papers for synthesis report to professor via email.

**Assignments:**
1) Critical Review: 15% of final grade,
2) Synthesis Report: 15% of final grade
3) Student Lecture: 20% of final grade,
4) Final Project: 40% of final grade,
5) Peer Review: 10% of final grade.

**Peer Review:**
- **Due dates as listed for each assignment below.**
Critically reviewing and commenting on the work of others is an important skill for any engineer/scientist to develop. Practice at reviewing can also help you be a better writer. In this class, all assignments will be submitted for peer review. Each student will read and critique the submissions of three different students for each assignment. The students will have an opportunity to further revise their own papers to answer the peer review before submission to the professor. The professor will grade the peer reviewer on their attention to detail, provision of helpful comments.

**Critical Review:**
- **Draft for peer review:** due October XX.
- **Peer review:** due October XX.
- **Final for professor grading:** due October XX.
The Critical Review is an in-depth review of a portion of a single journal paper. Students are expected to check line-by-line through a selection of the paper’s mathematics to confirm equations are correctly derived. References are to be checked to see if they indeed say what the authors’ claim, or if prior research has been misconstrued. Graphs are to be evaluated to see if they have errors or are designed to
hide deficiencies in the work. A detailed assignment sheet will be provided when this assignment is
discussed in class.

**Synthesis Report:**
- **Draft for peer review:** due October XX.
- **Peer review:** due October XX.
- **Final for professor grading:** due November XX.

The synthesis report requires the student to read and understand 3 articles by different authors on a similar
subject. The student will synthesize the ideas in these papers and explain the relationship between the
different approaches used by the authors. A detailed assignment sheet will be provided when this
assignment is discussed in class.

**Student Lecture:**
- **Completed throughout term, starting Oct XX.**

M.S. and Ph.D. graduates should be able to explain technical topics with the use of a whiteboard.
Unfortunately, most students get neither the training nor opportunity to develop these skills. In this
course, each student will be responsible for preparing and giving a 20 minute lecture on the details of
some topic in EFM. This lecture must be in the details of the mathematics of fluid mechanics, and not
simply an overview. These lectures will begin approximately 4 weeks into the semester with 1 student
per class thereafter (typically 2 per class in the last week). Ph.D. students and 2nd year M.S. students will
be expected to prepare the first several lectures so as to give new M.S. students more time to become
acclimated. A detailed assignment sheet will be provided when this assignment is discussed in class.

**Final Project:**
- **Draft for peer review:** due November XX
- **Peer review:** due November XX.
- **Final to professor grading:** due December XX.

The final project is a complete literature review in an EFM area of interest to the student. d. This report
should cover all the related literature. Be sure that the report is not simply “researcher A did X and
research B did Y”. This report should explain why different approaches were taken and what the results
mean. The goal is to contrast the present state-of-knowledge with the outstanding questions that are still
unknown in some area of EFM. A detailed assignment sheet will be provided when this assignment is
discussed in class.

**Grading Policies:** Grades will be based on a standard scale of 93-100 = A; 90-92 = A-; 87-89 = B+; 83-
86 = B; 80-82 = B-; 70-79 = C; 60-69 = D; below 60 = failing.

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

**Scholastic dishonesty:** 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/

**Students with disabilities:** 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, 471-6259
(voice) or 232-2937 (video phone) or http://www.utexas.edu/diversity/ddce/ssd. 
Web and Privacy Policy: Web-based, password-protected class sites will be associated with all academic courses taught at the University. Syllabi, handouts, assignments and other resources are types of information that may be available within these sites. Site activities could include exchanging e-mail, engaging in class discussions and chats, and exchanging files. In addition, electronic class rosters will be a component of the sites. Students who do not want their names included in these electronic class rosters must restrict their directory information in the Office of the Registrar, Main Building, Room 1. For information on restricting directory information, see the General Information Catalog or go to: http://registrar.utexas.edu/catalogs/gi09-10/app/gi09.appc02.html#chapter-9-educational-records.

Course drop date: 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.