OCEN 689-601
Special Topics in Environmental Fluid Mechanics
Spring 2011, TR 9:35-10:50 in CE 217

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**Special topics in mixing and transport in the environment. (3-0). Credit 3.** A first course in environmental fluid mechanics: an introduction to fluid and mass transport in naturally occurring flows. Topics include molecular and turbulent diffusion; dispersion; river, estuary, and ocean mixing; dissolution boundary layers; tidal mixing; offshore wastewater outfalls; and an introduction to environmental quality numerical modeling. Prerequisite: CVEN 311.

The objective of this course is to introduce the physics and chemistry of transport and mixing of substances in the hydrosphere by learning to:

- Understand the effects of diffusion, advection, dispersion, and chemical reactions on concentrations in the environment
- Apply the governing transport equations to solve problems with diverse boundary and initial conditions
- Evaluate the important processes affecting fate and transport in a range of problem situations
- Synthesize the analysis tools developed in the course to solve real-world transport problems

### 1. Textbooks and Other Resources

There is no required textbook for this course. The following book is recommended:


There is also an on-line textbook by the course instructor available from the course website (see below) under the Book index heading:

- Socolofsky, S. A. and Jirka, G. H. (2005), *Special Topics on Mixing and Transport in the Environment*, available for download from the course website under the topic “Book”.

To access the other online course materials (downloads of assignments, course handouts, related resources), please see the course web pages at

- [http://ceprofs.tamu.edu/ssocolofsky/OCENx89/](http://ceprofs.tamu.edu/ssocolofsky/OCENx89/)
Among the many other good textbooks on this subject, the following reference books are also recommended:


2. Tentative Course Calendar

The following table presents a tentative course calendar. In addition to the class meeting times, four important dates should be noted:

- Exam 1: February 24, 2011, from 9:35 a.m.-10:50 a.m. in CE 217
- Exam 2: April 14, 2011, from 9:35 a.m.-10:50 a.m. in CE 217
- Final Project Presentations: April 28, 2008, 9:35 a.m.-10:50 a.m. in CE 217

In the following table, the sections in the Reading column marked “C” are from Chin (2006) and those marked “S” are from Socolofsky and Jirka (2005); reading should be completed before the indicated lecture.

<table>
<thead>
<tr>
<th>Date</th>
<th>Lecture</th>
<th>Topic</th>
<th>Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/18</td>
<td>1</td>
<td>Introduction, concentration, units of measure, dimensional analysis</td>
<td>C1.1-1.4, S1.1</td>
</tr>
<tr>
<td>1/20</td>
<td>2</td>
<td>Fick’s law</td>
<td>C2.1-2.6, S1.2</td>
</tr>
<tr>
<td>1/25</td>
<td>3</td>
<td>Diffusion equation</td>
<td>C3.1, S1.2</td>
</tr>
<tr>
<td>1/27</td>
<td>4</td>
<td>Instantaneous point source solution in 1D</td>
<td>C3.2.1, S1.3</td>
</tr>
<tr>
<td>2/1</td>
<td>5</td>
<td>Point source solution continued</td>
<td>C3.2.2-3.2.5, S1.3-1.4</td>
</tr>
<tr>
<td>2/3</td>
<td>6</td>
<td>Advection diffusion equation</td>
<td>C3.1, S2.1</td>
</tr>
<tr>
<td>2/8</td>
<td>7</td>
<td>Measuring diffusion coefficients</td>
<td>S3.3-3.4, S2.2</td>
</tr>
<tr>
<td>2/10</td>
<td>8</td>
<td>Initial spatial distributions; fixed concentrations</td>
<td>C3.3, S2.2</td>
</tr>
<tr>
<td>2/15</td>
<td>9</td>
<td>Other solutions; superposition; image sources*</td>
<td>S2.3-2.4, S3.1</td>
</tr>
<tr>
<td>2/17</td>
<td>10</td>
<td>Properties of turbulence</td>
<td>C4.1, S3.1</td>
</tr>
<tr>
<td>2/22</td>
<td>11</td>
<td>Reynolds decomposition; turbulent diffusion</td>
<td>C4.2, S3.1</td>
</tr>
<tr>
<td>2/24</td>
<td>--</td>
<td>Exam 1: Fick’s law, diffusion equation, and basic solutions to the diffusion equation. (through lecture 9)</td>
<td></td>
</tr>
</tbody>
</table>
3/1 12  Taylor dispersion  C4.2  S3.2
3/3 13  Dispersion coefficients; Cowaselon Creek dye study example  C4.3-4.4  S3.3-3.4
3/8 14  Reaction kinetics  S4.1-4.2
3/10 15  Solution to the reacting advective transport equation  S4.3
3/15  --  Spring Break – no class
3/17  --  Spring Break – no class
3/22 16  Boundary exchange  S5.1

<table>
<thead>
<tr>
<th>Date</th>
<th>Page</th>
<th>Topic</th>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/24</td>
<td>17</td>
<td>Air/water interface</td>
<td>C4.4.2-4.4.4</td>
</tr>
<tr>
<td>3/29</td>
<td>18</td>
<td>Sediment/water interface</td>
<td>S5.2</td>
</tr>
<tr>
<td>3/31</td>
<td>19</td>
<td>Ocean outfalls: Near field 1</td>
<td>C8.1</td>
</tr>
<tr>
<td>4/5</td>
<td>20</td>
<td>Ocean outfalls: Near field 2</td>
<td>C8.2</td>
</tr>
<tr>
<td>4/7</td>
<td>21</td>
<td>Ocean outfalls: Far field*</td>
<td>C8.3</td>
</tr>
<tr>
<td>4/12</td>
<td>22</td>
<td>Applications to Oil Well Blowouts</td>
<td>Handouts</td>
</tr>
<tr>
<td>4/14</td>
<td>23</td>
<td>Exam 2: River, boundary, and estuary mixing</td>
<td></td>
</tr>
<tr>
<td>4/19</td>
<td>23</td>
<td>Water quality control in estuaries</td>
<td>C8.4</td>
</tr>
<tr>
<td>4/21</td>
<td>24</td>
<td>Stratification and the Boussinesq Approximation</td>
<td>Handouts</td>
</tr>
<tr>
<td>4/26</td>
<td>25</td>
<td>Active Mixing: Stratification and Convection</td>
<td>Handouts</td>
</tr>
<tr>
<td>4/28</td>
<td>26</td>
<td>Final project presentations</td>
<td>Handouts</td>
</tr>
</tbody>
</table>

*Advanced topics will be covered as time permits

### 3. Grading

Your final grade is broken down as follows:

- Homework: 15
- Group Project: 15
- Exam 1: 35
- Exam 2: 35

Letter grades will be assigned from your total course score according to ≥90% to 100%: A, ≥80% and <90%: B, ≥70% and <80%: C, ≥60% and <70%: D, below 60%: F. Please note that homework and the group project are 40% of your total grade.

### 4. Homework Assignments

Homework will be assigned periodically and the due date announced. A tentative schedule of homework assignments is posted on the course website.

POLICY: Homework is a substantial part of your course grade and must be completed individually. You may ask others for help at places where you have made diligent attempts and have become stumped. You may ask others for confirmation of results at significant milestones in the problem. You may not share computer programs, Word documents, or Excel files. Copying another student’s solution, even if
you slightly change the presentation will be considered as cheating and given a grade of zero (see Plagiarism statement below).
Homework problems must be answered clearly, showing all your work, and should be easy to follow. Where applicable, the solution to each problem should contain:

- A brief statement of the problem
- A sketch or graph
- A list of all the important assumptions made to solve the problem
- The general form of the equations used to solve the problem
- An equation with the plugged in numbers and the highlighted solution

Failure to include one of these elements will result in lost credit for the problem. Not all homework problems may be graded. Partial credit will be given for wrong answers that demonstrate some of the correct solution method.

Homework is due at the start of class on the assigned day either in class or in my mailbox on the 8th floor of the CE/TTI building. Unless you have a university excuse (see Absences below), late assignments will not be accepted for full credit. Please do not ask for exceptions.

5. Group Project

There will be one group project that will be due on the last day of class (April 28). Different aspects of the project will be assigned throughout the semester. You will work in groups of three students each. Details will be presented in February.

6. Class Participation and Quizzes

You are expected to attend all classes, turn in all assignments, and complete all exams at their scheduled times. Exceptions are only permitted for university excused absences (see Absences below).

Classes will start on time, and pointers for the homework assignments and last-minute changes to the schedule may be announced in class. It is your responsibility to be in class to receive this information or to get the information from another student.

In-class quizzes will be counted toward up to 5% of the homework grade.

7. Exams

Two 75-minute exams are scheduled (see Course Calendar above for scheduling). The grading of the exams will be based on both the approach and the final answer. Exams will be closed book and closed notes. You may prepare notes on the front and back of one page of 8½ x 11 paper for each exam. You will need a hand-held calculator for each exam. It is your responsibility to ensure that your calculator is working and will perform in the examination.

8. Graduate-level Component

This course meets together with OCEN 474-500, an undergraduate-level course in Environmental Fluid Mechanics. Although the lectures for both course offerings will be the same, the assignments will be different for undergraduates compared to graduate students. To receive graduate-level credit for this course, graduate students will be expected to complete separate homework assignments from the undergraduate students and a separate, group course project. Both the graduate assignments and the course project will be assigned at a graduate level. The goal of these assignments will be to get graduate students to
a level that they can easily read the journal literature in environmental fluid mechanics. Hence, assignments will be directed toward research.

9. Plagiarism and Cheating

“An Aggie does not lie, cheat, or steal or tolerate those who do.” Students are expected to understand and abide by the Aggie Honor Code presented on the web at:

- [http://www.tamu.edu/aggiehonor/](http://www.tamu.edu/aggiehonor/)

No form of scholastic misconduct will be tolerated. Academic misconduct includes cheating, fabrication, falsification, multiple submissions, plagiarism, complicity, etc. These are more fully defined in the above web site. As commonly defined, plagiarism consists of passing off as one's own the ideas, words, writings, etc., which belong to another. In accordance with this definition, you are committing plagiarism if you copy the work of another person and turn it in as your own, even if you should have permission of that person. Since the homework grade for this course is a high percentage of your total grade, no plagiarism or cheating will be permitted in the homework. Violations will be handled in accordance with the Aggie Honor System Process described on the web site.

10. Absences

The university views class attendance as an individual student responsibility. Students are expected to attend class and to complete all assignments. Instructors are expected to give adequate notice of the dates on which major tests will be given and assignments will be due. This information should be provided on the course syllabus, which should be distributed at the first class meeting. For more details, please read Part I, Rule~7 of the Texas A&M University Student Rules at

- [http://student-rules.tamu.edu/](http://student-rules.tamu.edu/)

Please contact me as soon as you know you will miss a class or an exam so that a reasonable alternative can be accommodated. Unexcused absences will result in a grade of zero for the missed work. The instructor is under no obligation to provide an opportunity for the student to make up work missed because of an unexcused absence.

12. Americans with Disabilities Act (ADA)

The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact the Department of Student Life, Services for Students with Disabilities, in Cain Hall or call 845-1637.