Chemical Engineering Fluid Operations  
CHEN 304-500  
Credit 3 (3-0)  
Course Syllabus (Spring 2009)

Instructor: Victor M. Ugaz  
Office Hours: Monday, Thursday 3–5 PM, or by appointment  
Phone: 458-1002  
E-mail: ugaz@tamu.edu

Graduate Assistant: Mr. Xin Jin  
Office Location: TBD  
E-mail: xin.jin@chemail.tamu.edu

Class Time: Monday, Wednesday, Friday; 1:50 – 2:40 PM  
Classroom: 104 Jack E. Brown Bldg.

Textbook (required)  

Prerequisites  
CHEN 205, MATH 308.

Course Description  
This course presents a unified treatment of the fundamental conservation laws of mass, energy, linear momentum and angular momentum, and the second law of thermodynamics, that lay the foundation upon which our description of fluid mechanics is based. These principles are then applied (1) to develop an understanding of the nature of, as well as the methods for analyzing, the flow behavior of incompressible and compressible fluids including Newtonian and non-Newtonian fluids, (2) to analyze and design process equipment, e.g. conduits of all shapes with fittings; pumps and compressors; flow measurement and control devices; and fluid-solid separations and operations such as filtration, centrifugation, settling, sedimentation, fluidization. This course also endeavors to train students to develop a thorough and organized approach to problem solving and to think when analyzing problems.
Course Objectives
Upon completing this course, students will be able to:
1. State and formulate conservation principles for fluid mechanics in macroscopic and continuum systems including mass, linear momentum, angular momentum, and energy.
2. Apply conservation of mass and linear momentum to simple Newtonian fluid mechanics problems such as Poiseulle and Couette flow.
3. State and apply empirical correlations for use in pipe sizing, estimating friction loss, etc.
4. Size pipes, pumps and compressors given design criteria.
5. Apply correlations for measuring and sizing flow controllers, estimate pressure losses due to measuring apparatus, and understand differences between apparatuses (e.g. Venturi versus orifice meter).
6. Understand the differences between the bulk flow versus flow in porous media.

Attendance
You are expected to attend all lectures.

Reading Assignments
Reading assignments will be provided prior to the lecture in which the corresponding material is covered. You are responsible for all material in the reading (for Homework and Exams). Supplementary notes will be provided for topics where lecture coverage is significantly different from the text.

Homework
Homework sets will usually be assigned on Fridays, and will be due the following Friday in class. Organized help sessions outside of regular class hours may be scheduled if there is interest. Please make use of my office hours for homework help. Specific questions regarding homework grades should be addressed to the grader, then to me in the event that a dispute cannot be resolved. Homework assignments must be submitted individually.

Homework assignments turned in late will receive a score of zero (exceptions can be made in extenuating circumstances if arranged in advance). The homework assignments will be your primary resource in preparing for exams, so is in your best interest to make every effort to at least attempt each homework assignment!

Midterm Exams
Three midterm exams are scheduled from 7–9 PM on the following dates (Room TBD):
- Wednesday, Feb 18
- Wednesday, March 25
- Wednesday, April 22

Makeup exams will only be given in extenuating circumstances if arranged in advance. Exams are structured to ask questions that do not simply repeat problems that were solved in the homework assignments. The exams assess your ability to take what has been discussed in class and apply it to other similar problems or to different situations whose basis has been already addressed in class. All exams will be closed book, closed notes.
Final Exam
An optional comprehensive final exam may be taken and uses replace a low grade on one midterm exam. The final exam will be comprehensive and is scheduled on Tuesday May 12 from 3:30–5:30 PM. All exams will be graded by the instructor.

Grading Policy
Course grades will be assigned as follows.

- Homework 10%
- Midterm Exam #1 30%
- Midterm Exam #2 30%
- Midterm Exam #3 30%
- Final Exam 30% (optional, may replace a midterm exam)

Final grades are expected to be distributed according to the following percentage scale:
A = 90–100%, B = 80–89%, C = 70–79%, D = 60–69%, F < 59%.

Email and Course Web Page
Copies of course related materials and individual grades will be posted on the course website at http://elearning.tamu.edu/. Late breaking news and information regarding class meetings, homework, and exams will be transmitted via email. You are responsible for checking your Neo email account on a regular basis.

Americans with Disabilities Act (ADA) Policy Statement
The Americans with Disabilities Act (ADA) is a federal antidiscrimination 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 Room B118 of Cain Hall or call 845-1637.

Aggie Honor Code: “An Aggie does not lie, cheat, or steal or tolerate those who do.”
Upon accepting admission to Texas A&M University, a student immediately assumes a commitment to uphold the Honor Code, to accept responsibility for learning and to follow the philosophy and rules of the Honor System. Students will be required to state their commitment on examinations, research papers, and other academic work. Ignorance of the rules does not exclude any member of the Texas A&M University community from the requirements or the processes of the Honor System. For additional information please visit the website: www.tamu.edu/aggiehonor/
Course Outline (subject to change as necessary)

<table>
<thead>
<tr>
<th>Topic</th>
<th>Chapter</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Part 1 – Fundamentals and Macroscopic Balances</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Course introduction</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2. Fluid properties, dimensional analysis</td>
<td>2,3</td>
<td>1</td>
</tr>
<tr>
<td>3. Fluid Statics</td>
<td>–</td>
<td>3</td>
</tr>
<tr>
<td>4. Macroscopic balances and applications</td>
<td>5,6</td>
<td>6</td>
</tr>
<tr>
<td><strong>Part 2 – Microscopic Balances and Solutions</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Microscopic balances and 1-D flows</td>
<td>7,8</td>
<td>6</td>
</tr>
<tr>
<td>6. Accelerating and converging flows</td>
<td>9,10</td>
<td>3</td>
</tr>
<tr>
<td>7. Creeping flow, lubrication approximation</td>
<td>12,13</td>
<td>3</td>
</tr>
<tr>
<td>8. Boundary layer flow</td>
<td>15</td>
<td>3</td>
</tr>
<tr>
<td><strong>Part 3 – Practical Applications and Advanced Topics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Analysis of pipe flow networks</td>
<td>–</td>
<td>4</td>
</tr>
<tr>
<td>10. Particulate flows, porous media</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>11. Microfluidics</td>
<td>–</td>
<td>3</td>
</tr>
<tr>
<td>12. Non-Newtonian flows</td>
<td>19</td>
<td>3</td>
</tr>
<tr>
<td>13. Computational Fluid Dynamics (CFD)</td>
<td>–</td>
<td>3</td>
</tr>
</tbody>
</table>

Total hours 42

Relationship of Course Objectives to CHEN Program Outcomes

<table>
<thead>
<tr>
<th>Course Objectives</th>
<th>CHEN Program Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ability to state and formulate conservation principles for fluid mechanics in macroscopic and continuum systems including mass, linear momentum, angular momentum, and energy.</td>
<td>1, 3, 5, 13</td>
</tr>
<tr>
<td>Ability to apply conservation of mass and linear momentum to simple Newtonian fluid mechanics problems such as Poiseulle and Couette flow.</td>
<td>1, 3, 5, 13</td>
</tr>
<tr>
<td>Ability to state and apply empirical correlations for use in pipe sizing, estimating friction loss, etc.</td>
<td>1, 2, 3, 5, 13</td>
</tr>
<tr>
<td>Ability to size pipes, pumps and compressors given design criteria.</td>
<td>1, 2, 3, 5, 13</td>
</tr>
<tr>
<td>Ability to apply correlations for measuring and sizing flow controllers, estimate pressure losses due to measuring apparatus, and understand differences between apparatuses (e.g. Venturi versus orifice meter).</td>
<td>1, 2, 3, 5, 13</td>
</tr>
<tr>
<td>Ability to understand the differences between the bulk flow versus flow in porous media.</td>
<td>1, 5, 13</td>
</tr>
</tbody>
</table>