CEGE 3502: Fluid Mechanics Lectures
Fall 2020

Lectures: Tue and Thu 11:15am-12:30pm (synchronously)
Laboratories: Mon 9-10aM; Tue 8-9aM & 12:45-1:45pM; Wed 2:30-3:30PM (synchronously)
(Lectures and lab lectures will be recorded and available for asynchronous attendance)
Mid Term #1: Oct 20-22 Mid term #2: Nov 22-24; Final Exam: Dec 17-19

CEGE 3502 Fluid Mechanics (4.0 cr; Prereq-[AEM 2012 or AEM 3031], Math 2373, [CSE or ForP major]): Fluid statics/dynamics. Kinematics of fluid flow, equations of motion, pressure-velocity relationships, viscous effects, boundary layers. Momentum / energy equations. Lift/drag. Flow in pipes and pipe systems. Fluid measurements.

Credits and Workload Expectations
For undergraduate courses, one credit is defined as equivalent to an average of three hours of learning effort per week (over a full semester) necessary for an average student to achieve an average grade in the course. For example, a student taking a four credit course that meets for five hours a week, should expect to spend an additional seven hours a week on coursework outside the classroom.

Instructor:
Judy (Qingjun) Yang, Email: judyyang@umn.edu, Phone: 617-415-3478
Office Hours: Tue 1:30 - 3:00 pm; Fri 1:30 - 3:00 pm (or by appointment)

Guest Lecturer:
Vinicius Taguchi, Email: taguc006@umn.edu
Lab lectures 1-3 & 5 (zoom invitation will be sent through emails)

Graduate Teaching Assistants:
David Ray, Email: ray00073@umn.edu
Lab grading and homework grading; Office Hours: Mon 12:00 – 1:30 pm; Thu 1:00-2:30 pm
Garrett Bartelt, Email: barte460@umn.edu
Homework grading; Office Hours: Wed 10:00-11:30 am; Fri 10:00 – 11:30 am

Grading (on an A – F basis with following weighting)
Homework 20%
Mid term exams 30% (2×15%)
Lab 20%
Final 30%

Grading criteria

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<thead>
<tr>
<th>Grade</th>
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<tbody>
<tr>
<td>A-</td>
<td>90</td>
<td>B-</td>
<td>80</td>
<td>C-</td>
<td>70</td>
<td>D-</td>
<td>60</td>
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<tr>
<td>A</td>
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<td>83</td>
<td>C</td>
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<tr>
<td>B+</td>
<td>87</td>
<td>C+</td>
<td>77</td>
<td>D+</td>
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<td>A+</td>
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<td>87</td>
<td>C+</td>
<td>77</td>
<td>D+</td>
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Text (required): Crowe, (LeBret), Elger, and Roberson, Engineering Fluid Mechanics, 9th -- 12th ed, (John Wiley & Sons, New York). There is an electronic version available (for a considerably reduced price) from the publisher. Old editions 9th and beyond are acceptable. Please note that you are automatically signed up for a discounted electronic textbook at the cost of $72.95. The deadline for opt out/cancel the purchasing is September 18th.
Lab materials will be sent before each lab sessions and available through canvas.
# Course outline (subject to modification, check website and emails for updates)

<table>
<thead>
<tr>
<th>#</th>
<th>Date</th>
<th>Topics</th>
<th>Readings (11th ed): Chapters: pages</th>
<th>Homework</th>
<th>Lab</th>
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<tbody>
<tr>
<td>1</td>
<td>9/8</td>
<td>Introduction &amp; Fluid Properties</td>
<td>1:all</td>
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<tr>
<td>2</td>
<td>9/10</td>
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<tr>
<td>3</td>
<td>9/15</td>
<td>Fluid Properties &amp; Fluid Statistics</td>
<td>2: all 3: 60-86 &amp;90</td>
<td>Problem set 1 out [Due 9/29]</td>
<td>Lab 1</td>
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<tr>
<td>4</td>
<td>9/17</td>
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<tr>
<td>5</td>
<td>9/22</td>
<td>Fluid Statistics</td>
<td>3: 60-86 &amp;90 4: 104-118</td>
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<td>Lab 2</td>
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<td>6</td>
<td>9/24</td>
<td>Intro to fluid dynamics</td>
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<tr>
<td>7</td>
<td>9/29</td>
<td>Euler equation</td>
<td>4: 118-142</td>
<td>Problem set 2 out [Due 10/13]</td>
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<td>8</td>
<td>10/1</td>
<td>Bernoulli equation 1</td>
<td>4: 118-142</td>
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<td>9</td>
<td>10/6</td>
<td>Bernoulli equation 2</td>
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<td>10</td>
<td>10/8</td>
<td>Rotation &amp; vorticity</td>
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<td>11</td>
<td>10/13</td>
<td>Continuity</td>
<td>5: 154-174</td>
<td>Problem set 3 out [Due 10/20]</td>
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<tr>
<td>12</td>
<td>10/15</td>
<td>Review</td>
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<tr>
<td>13</td>
<td>10/20</td>
<td>Midterm test 1</td>
<td></td>
<td>Take home exam 1 [2 days, Due 10/22]</td>
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<tr>
<td></td>
<td>Break</td>
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<td>14</td>
<td>10/27</td>
<td>Momentum</td>
<td>6:188-226</td>
<td>Problem set 4 out [Due 11/10]</td>
<td>Lab 4</td>
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<td>15</td>
<td>10/29</td>
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<td>11/5</td>
<td>Momentum 2</td>
<td>6:188-226</td>
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<td>Lab 5</td>
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<td>17</td>
<td>11/10</td>
<td>Energy</td>
<td>7: 227-244</td>
<td>Problem set 5 out [Due 11/19]</td>
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<td>18</td>
<td>11/12</td>
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<td>19</td>
<td>11/17</td>
<td>Dimensional analysis</td>
<td>8:263-286</td>
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<td>20</td>
<td>11/19</td>
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<tr>
<td>21</td>
<td>11/24</td>
<td>Midterm test 2</td>
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<td>Take home exam 2 [Due 11/24]</td>
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<td>T-day</td>
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<td>22</td>
<td>12/1</td>
<td>Boundary layer</td>
<td>9: 292-304</td>
<td>Problem set 6 out [Due 12/15]</td>
<td>Lab 6</td>
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<tr>
<td>23</td>
<td>12/3</td>
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<td>25</td>
<td>12/10</td>
<td>Drag &amp; Lift</td>
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<td>26</td>
<td>12/15</td>
<td>Review</td>
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<td>No</td>
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<tr>
<td>27</td>
<td>12/17</td>
<td>Final</td>
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<td>Take home final [2 days, Due 12/19]</td>
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Lab 1: Fluid Properties (Specific gravity, kinematic and dynamic viscosity, surface tension, Manometer) -- Synchronously
Lab 2: Pressure and velocity measurements -- Synchronously
Lab 3: Bernoulli equation -- Synchronously
Lab 4: Evaluation and propagation of uncertainty -- recorded
Lab 5: Application of the momentum theorem -- Synchronously
Lab 6: Laminar and turbulent flow -- recorded
Lab 7: Measurements of pipe friction – recorded

Lab reports are due by Friday each week.
Homework and lab reports submitted after due date will be receive only 50% total grades.
**Additional information**

**University Grading Standards** will be followed in assigning grades for this course. A achievement that is outstanding relative to the level necessary to meet course requirements. B achievement that is significantly above the level necessary to meet course requirements. C achievement that meets the course requirements in every respect. D achievement that is worthy of credit even though it fails to meet fully the course requirements. F represents failure (or no credit) and signifies that the work was either (1) completed but at a level of achievement that is not worthy of credit or (2) was not completed and there was no agreement between the instructor and the student that the student would be awarded an I.

I (Incomplete) Assigned at the discretion of the instructor when, due to extraordinary circumstances, a student is prevented from completing the work of the course on time; this requires a written agreement between instructor and student.

**Class Conduct**: Please turn off your audio while attending the lecture synchronously. Please don’t eat, sleep, or talk with others when your video is on.

**Collaboration on Assignments**: Collaboration on the concepts covered in the homework assignments is encouraged; however, the **assignment that you submit must be your own original work**! You may ask questions of each other, and discuss general procedures and strategies about how to approach a problem, but the step-by-step calculations, spreadsheets, figures, conclusions, etc. must be your own work. To do otherwise is plagiarism, which is grounds for earning an "F" in the course, and possible expulsion from the University of Minnesota. All instances of scholastic dishonesty are required to be reported to the UofMN Office for Student Conduct & Academic Integrity.

**Academic Dishonesty** Academic dishonesty in any portion of the academic work for a course shall be grounds for awarding a grade of F or N for the entire course. The academic code of conduct can be found at [https://regents.umn.edu/sites/regents.umn.edu/files/2020-01/policy_student_conduct_code.pdf](https://regents.umn.edu/sites/regents.umn.edu/files/2020-01/policy_student_conduct_code.pdf)

**Makeup Work for Legitimate Absences** Students will not be penalized for absence during the semester due to unavoidable or legitimate circumstances. Such circumstances include verified illness, participation in intercollegiate athletic events, subpoenas, jury duty, military service, bereavement including related travel, religious observances, participation in formal University system governance. Such circumstances do not include voting in local, state, or national elections. For complete information, please see: [https://policy.umn.edu/education/makeupwork](https://policy.umn.edu/education/makeupwork).

**Appropriate Student Use of Class Notes and Course Materials** Taking notes is a means of recording information but more importantly of personally absorbing and integrating the educational experience. However, broadly disseminating class notes beyond the classroom community or accepting compensation for taking and distributing classroom notes undermines instructor interests in their intellectual work product while not substantially furthering instructor and student interests in effective learning. Such actions violate shared norms and standards of the academic community. For additional information, please see: [https://policy.umn.edu/education/studentresp](https://policy.umn.edu/education/studentresp).

**Discrimination, Sexual Harassment, and Assault** The University of Minnesota and federal law prohibit sexual assault, sexual harassment, stalking, dating violence, and discrimination. "Sexual harassment" means unwelcome sexual advances, requests for sexual favors, and/or other verbal or physical conduct of a sexual nature. Such conduct has the purpose or effect of unreasonably interfering with an individual's work or academic performance or creating an intimidating, hostile, or offensive working or academic environment in any University activity or program. Such behaviors are not acceptable. I care about each of these problems and the negative impact they have on our community. You are welcome to speak with me about any of these issues, and I can help you connect with campus and community resources. Please be aware that in some instances I cannot keep these conversations confidential and may be required to report some of what I hear to university officials and/or to police. Within the requirements of my job, I will be as responsive to your requests for confidentiality as possible. To learn about Title IX complaints, visit
Equity, Diversity, Equal Opportunity, and Affirmative Action
The University provides equal access to and opportunity in its programs and facilities, without regard to race, color, creed, religion, national origin, gender, age, marital status, disability, public assistance status, veteran status, sexual orientation, gender identity, or gender expression. For more information, please consult Board of Regents Policy: https://regents.umn.edu/sites/regents.umn.edu/files/2019-09/policy_equity_diversity_equal_opportunity_and_affirmative_action.pdf.

Disability Accommodations
The University of Minnesota views disability as an important aspect of diversity, and is committed to providing equitable access to learning opportunities for all students. The Disability Resource Center (DRC) is the campus office that collaborates with students who have disabilities to provide and/or arrange reasonable accommodations.

- If you have, or think you have, a disability in any area such as, mental health, attention, learning, chronic health, sensory, or physical, please contact the DRC office on your campus (UM Twin Cities 612.626.1333) to arrange a confidential discussion regarding equitable access and reasonable accommodations.
- Students with short-term disabilities, such as a broken arm, can often work with instructors to minimize classroom barriers. In situations where additional assistance is needed, students should contact the DRC as noted above.
- If you are registered with the DRC and have a disability accommodation letter dated for this semester or this year, please contact your instructor early in the semester to review how the accommodations will be applied in the course.
- If you are registered with the DRC and have questions or concerns about your accommodations please contact your (access consultant/disability specialist).

Additional information is available on the DRC website: UM Twin Cities - https://diversity.umn.edu/disability/ or e-mail UM Twin Cities - drc@umn.edu) with questions.

Mental Health and Stress Management
As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance and may reduce your ability to participate in daily activities. University of Minnesota services are available to assist you. You can learn more about the broad range of confidential mental health services available on campus via the Student Mental Health Website: http://www.mentalhealth.umn.edu/.

Academic Freedom and Responsibility:
Academic freedom is a cornerstone of the University. Within the scope and content of the course as defined by the instructor, it includes the freedom to discuss relevant matters in the classroom. Along with this freedom comes responsibility. Students are encouraged to develop the capacity for critical judgment and to engage in a sustained and independent search for truth. Students are free to take reasoned exception to the views offered in any course of study and to reserve judgment about matters of opinion, but they are responsible for learning the content of any course of study for which they are enrolled.*

Reports of concerns about academic freedom are taken seriously, and there are individuals and offices available for help. Contact the instructor, the Department Chair, your adviser, the associate dean of the college, or the Vice Provost for Faculty and Academic Affairs in the Office of the Provost. [Customize with names and contact information as appropriate for the course/college/campus.]

* Language adapted from the American Association of University Professors “Joint Statement on Rights and Freedoms of Students”.

ABET Student Outcomes –
Through 2019, for ABET accreditation, each program must have documented student outcomes that prepare graduates to attain the associated program educational objectives. ABET specified eleven
student outcomes are outcomes that must be satisfied by each program:
(a) an ability to apply knowledge of mathematics, science, and engineering;
(b) an ability to design and conduct experiments, as well as to analyze and interpret data;
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability;
(d) an ability to function on multidisciplinary teams;
(e) an ability to identify, formulate, and solve engineering problems;
(f) an understanding of professional and ethical responsibility;
(g) an ability to communicate effectively;
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context;
(i) a recognition of the need for, and an ability to engage in life-long learning;
(j) a knowledge of contemporary issues; and
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Starting in 2019, ABET has used a slightly different set of criteria (mapped to student outcomes as noted by "SO":

1) An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics (SO (e))
2) An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors (SO (c))
3) An ability to communicate effectively with a range of audiences (SO (g))
4) An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts (SO (f))
5) An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives (SO (d))
6) An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions (SO (b))
7) An ability to acquire and apply new knowledge as needed, using appropriate

Regular evaluation of CEGE 3502 focuses on two of these newly formulated ABET objectives:
1) An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics (SO (e))
6) An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions (SO (b))

CEGE Student Writing Abilities
Students should be able to demonstrate the following writing skills. All are necessary to perform well in the course, and we will discuss and guide you to continue to develop these skills through your homework, labs, and exams.

1) Evidences appropriate pre-planning processes and sufficient levels of knowledge
2) Recognizes and uses audience specific writing conventions
3) Uses and defines appropriate terminology and notation
4) Makes effective use of charts, visuals, and non-textual representations
5) Organizes communications effectively
6) Presents technical processes effectively
7) Describes uncertainty of analysis
8) Expresses complex data succinctly but comprehensively
9) Clearly communicates abstract ideas or complicated phenomenon
10) Writes with proper mechanics and formal presentation (grammar, proofreading, etc.)
11) Demonstrates proper scholarship and avoids plagiarism
12) Critically self-evaluates own work