

ChBE 3205 Fluid Mechanics Summer 2025

Location: Georgia Tech Europe, TBD
Time: TBD
Credits: 02
Prerequisites: ChBE 2100, MATH 2551 and PHYS 2211.
Co-requisite: MATH 2552
Textbook: Fundamentals of Momentum, Heat and Mass Transfer, 7th Ed, by J.R. Welty, G.L. Rorrer and D.G. Foster, John Wiley & Sons, Inc. (2019), ISBN: 978-1-119-49541-3

Instructor:

Dr. Christian Martin Cuba-Torres
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Office Hours: TBD

Learning Outcomes:

This course introduces the fundamental concepts of momentum transfer as well as their use in typical engineering applications. Special emphasis is put on analogies between the balance equations of fluid flow and heat flow, on dimensional analysis, and the prediction of friction losses. Applications include the analysis and design of flow models, piping networks, packed and fluidized beds. Upon satisfactory completion of this course, the student should be able to do the following:

1. Apply the macroscopic balances of mass, momentum, and energy, as well as the differential continuity equation and the equations of motion to simple systems using both Cartesian and polar coordinates, using both analytical and numerical methods.
2. Apply the concepts of boundary layer flow to interpret local momentum transfer and drag/friction in geometries for which analytical solutions are not readily available.
3. Design/simulate the operation of process piping systems (estimate frictional losses, size pipes, size pumps, etc.) for the specific flow of liquids and gases, using analytical as well as numerical methods.
4. Design/simulate the operation of packed beds, fluidized beds, and filters for specified fluid flow rates.
5. Design flow models and interpret experimental data using dimensional analysis.
6. Design/simulate the operation of process piping systems (estimate frictional losses, size pipes, size pumps, etc.) for the specific flow of liquids and gases.

Active Participation and Attendance:

Students are expected to attend all lectures unless you have a compelling reason not to do so. If you miss class, you must find out what was presented and obtain any handouts or other materials you may have missed. Problems on exams will directly reflect the material discussed in class and the textbook. The textbook and class lectures are complementary, but neither replaces the other.

In the case of an absence when an exam is given, a make-up Exam may be given when the absence is caused by an official GT event or illness; such absences must be

documented with a letter from the appropriate Georgia Tech official, a physician, or the Dean of Students. Additional information about Georgia Tech policies about class attendance and other general policies can be found at <https://catalog.gatech.edu/rules/4/>

Tentative Grading System (this may be updated by the first day of classes):

IMPORTANT: One of the main aims of this course is the assessment of **each individual students' ability** to grasp the basic concepts of Fluid Mechanics which is harder to assess only through HWs or project. Please note below that HW + Quizzes + Project accounts for a total of 40% of your grade while **the exams account for 60% of your overall grade.**

| | |
|--------------|------|
| Midterm Exam | 25 % |
| Final Exam | 35 % |
| Homework | 15 % |
| Quizzes | 15 % |
| Project | 10 % |
| Total: | 100% |

Honor Code:

Students are expected to follow the Georgia Tech Honor Code at all times. (<http://osi.gatech.edu/content/honor-code>) and avoid all instances of academic misconduct, including, but not limited to:

1. Possessing, using, or exchanging improperly acquired written or oral information in preparation for exams or the final.
2. Copying homework solutions from classmates, previous students, solution manuals, or otherwise representing the work of others as their own.
3. Using prohibited materials or means to complete homework, exams or the final.
4. False claims of performance or work that have been submitted by a student.

All worked turned in for grading must be original. Copying from other students (current and former), solution manuals, web sites or other sources are considered violations of the Georgia Tech Honor Code. Students will be asked to acknowledge their acceptance of these stipulations and their willingness to abide by all terms of the Honor Code by signing an "Honor Agreement" attached to all exams and the final. Violations of the *Student Honor Code* – plagiarism, copying problem solution from previous years or from solution manuals, etc. – will be reported to the Office of Student Integrity.

Accommodations

Students may request an accommodation through the Office of Disability Services (ODS). Registering with ODS is a 3-step process that includes completing an application, uploading documentation related to the accommodation request, and scheduling an appointment for an "intake meeting" (either in person or via phone or video conference) with a disability coordinator. If you have been approved by ODS for an accommodation, Dr. Cuba-Torres will work closely with you to understand your needs and make a good faith effort to investigate whether or not requested accommodations are possible for this course. If the accommodation request results in a fundamental alteration of the stated learning outcomes of this course, ODS, academic advisors, and the school will work with you to find a suitable alternative that as far as possible preserves your progress toward graduation.

CARE Center, Counseling Center, Stamps Health Services, and the Student Center

These uncertain times can be difficult, and many students may need help in dealing with stress and mental health. The [CARE Center](#) and the [Counseling Center](#), and [Stamps Health Services](#) will offer both in-person and virtual appointments. Face-to-face appointments will require wearing a face covering and social distancing, with exceptions for medical examinations. Student Center services and operations are available on the [Student Center](#) website. For more information on these and other student services, contact the Vice President and Dean of Students or the [Division of Student Life](#).

Diversity and Disability Statement

Your experience in this class is important to us. If there are aspects of the instruction or design of this course that result in barriers to your inclusion or accurate assessment or achievement, please notify the instructor as soon as possible.

Students with disabilities should contact the Office of Disability Services to discuss options of removing barriers in this course, including accommodations. If you have already established accommodations with the Offices of Disability Services, please communicate this to your instructor so we can discuss your needs in this course. If you have not yet established services through Disability Services, but have a temporary health condition or permanent disability that requires accommodations (conditions include but not limited to; mental health, attention-related, learning, vision, hearing, physical or health impacts), please contact the Office of Disability Services at 404.894.2563 or dsinfo@gatech.edu or <https://disabilityservices.gatech.edu>

Health and Well-being Statement

Wellness is about maintaining an overall quality of life and the pursuit of optimal emotional, mental, physical, and interpersonal health. Wellness not as the absence of disease, illness, or stress but the presence of purpose in life, active involvement in satisfying work and play, joyful relationships, a healthy body and living environment, and happiness.

The way to achieve wellness is through making proactive, healthy choices. The road to wellness begins with becoming more aware of your present condition, and then making the conscious decision to change the way you live.

Balance is a key component to achieving wellness and optimal functioning. The path to greater wellness is through living in a manner that is consistent with your own personal needs, values, and goals.

Advice:

- **Do** the assigned reading before class, not just the night before the exam.
- **Do not** be afraid to ask questions and interact in class.
- **Do** take homework assignments seriously. They confirm that you understand key concepts and may even introduce variations on those concepts.
- **Do not** fall behind. Later topics depend heavily on earlier topics.

A good rule of thumb for this class is to spend **3 hours outside of class** reading and practicing problems **for every 1 hour of class**.

Brief list of topics to be covered

- a. Fluid Statics: Concepts of fluid stresses, pressure, surface tension, Buoyancy.
- b. Macroscopic Balance Equations of Fluid Motion: Macroscopic mass balance, Macroscopic momentum balance, Macroscopic energy balance, Bernoulli's equation.
- c. Shear Stress in Laminar Flow: Shell momentum balance, velocity profile, Non-Newtonian fluids, pipe flow.
- d. Differential Balance Equations of Fluid Motion: Differential mass balance: continuity equation, Shell momentum balance, non-Newtonian Fluids, Differential momentum balance, Navier-Stokes equations, Analysis of flow profiles, both analytical (1D) and numerical (2D).
- e. Dimensional Analysis: Similarity, Buckingham Methods, Model Analysis.
- f. Theory and Applications of Viscous Flow: Boundary layer theory, form drag, Mechanical energy balance, frictional losses, Piping network design (incl. numerical methods), Flow in packed and fluidized beds, filters, Pumps, developed head, lift, cavitation.