1. **Course number and name - CHBE 3205 – Fluid Mechanics** ***(required)***

2. **Credits and contact hours** - 2 credit hours, 2 lecture hours (2-0-0-2)

3. **Instructor's or course coordinator's name -** Dr. Victor Breedveld

4. **Textbook, title, author, and year**
   Fundamentals of Momentum, Heat and Mass Transfer, 7th edition, J.R. Welty, G.L. Rorrer and D.G. Foster, John Wiley & Sons Inc. (2019) (6th ed. also suitable)

5. **Specific course information**
   a. **Catalog Description -** The basic principles of fluid mechanics are introduced and the analysis and design of equipment using these principles is practiced.
   b. **Prerequisites or co-requisites** – CHBE 2100 Chemical Process Principles (grade "C" or better), MATH 2551 Multivariable Calculus (grade "C" or better); PHYS 2211 Introductory Physics I. Pre-requisite with concurrency: MATH 2552 Differential Equations (grade "C" or better).
   c. **Required, elective, or selected elective course** – Required

6. **Specific goals for the course**
   a. **Specific outcomes of instruction**:
   By the end of this course, a student should be able to:
      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) Work in teams to perform experimental characterization of frictional losses in system containing pump and tubing.

b. **Connection with Student Outcomes**

CHBE 3205							
	Student Outcomes						
Course Outcomes	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Course Outcome 1	**X**						
Course Outcome 2	**X**						
Course Outcome 3	**X**	**X**					
Course Outcome 4	**X**					**X**	
Course Outcome 5	**X**					**X**	
Course Outcome 6	**X**				**X**	**X**	

Student Outcomes

(1) an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

(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

(3) an ability to communicate effectively with a range of audiences

(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

(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

(6) an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions

(7) an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

7. **Brief list of topics to be covered**
   a. Fluid Statics
      1) Concepts of fluid stresses, pressure, surface tension
      2) Buoyancy
   b. Macroscopic Balance Equations of Fluid Motion
      1) Macroscopic mass balance
      2) Macroscopic momentum balance
      3) Macroscopic energy balance, Bernoulli's equation
   c. Shear Stress in Laminar Flow
      1) Shell momentum balance, velocity profile
      2) Non-Newtonian fluids, pipe flow

d. Differential Balance Equations of Fluid Motion
    1) Differential mass balance: continuity equation
    2) Shell momentum balance, non-Newtonian Fluids
    3) Differential momentum balance, Navier-Stokes equations
    4) Analysis of flow profiles, both analytical (1D) and numerical (2D)
e. Dimensional Analysis
    1) Similarity
    2) Buckingham Methods, Model Analysis
f. Theory and Applications of Viscous Flow
    1) Boundary layer theory, form drag
    2) Mechanical energy balance, frictional losses
    3) Piping network design (incl. numerical methods)
    4) Flow in packed and fluidized beds, filters
    5) Pumps, developed head, lift, cavitation

Example grade scheme and course policies *(details may vary slightly by semester/instructor)*

ACTIVE PARTICIPATION AND ATTENDANCE

Although classes may be recorded, 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/

GRADING SYSTEM

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 difficult 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**. To calculate the final score, we will use the highest score between these two options.

	Option 1	**Option 2**
Midterm Exam I	25 %	19 %
Final Exam	35 %	35 %
Homework	10 %	10 %
Quizzes	20 % (10% each)	26 % (13% each)
Project	10 %	10 %
Total	100%	100%

There is no predetermined number of As, Bs, etc. Grade estimates are given after exams.

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.

PIAZZA
We will be conducting all class-related discussion items here this term. The quicker you begin asking questions on Piazza (rather than via emails), the quicker you will benefit from the collective knowledge of your classmates and instructors. We encourage you to ask questions when you are struggling to understand a concept (you can even do so anonymously)

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 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.

CAMPUS STUDENT RESOURCES
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.