

# Course Syllabus for ECH 3203, Fall 2021

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**Course Title:** Fluid and Solid Operations

**Course Content:** Characteristics of laminar and turbulent flow, mechanical energy balance, flow through packed beds and fluidization of solids, design of pumping systems and piping networks, and metering of fluids.

**Prerequisites:** COT 3502 and ECH 3264

**Class Meetings:** MWF period 7 (1:55 pm - 2:45 pm) in CSE E221

**Please note the following points in response to COVID-19:**

- You are expected to wear approved face coverings at all times during class and within buildings even if you are vaccinated.
- If you are sick, stay home and self-quarantine. Please visit the UF Health Screen, Test & Protect website about next steps, retake the questionnaire and schedule your test for no sooner than 24 hours after your symptoms began. Please call your primary care provider if you are ill and need immediate care or the UF Student Health Care Center at 352-392-1161 (or email covid@shcc.ufl.edu) to be evaluated for testing and to receive further instructions about returning to campus.
- If you are withheld from campus by the Department of Health through Screen, Test & Protect, you are not permitted to use any on campus facilities. Students attempting to attend campus activities when withheld from campus will be referred to the Dean of Students Office.
- UF Health Screen, Test & Protect offers guidance when you are sick, have been exposed to someone who has tested positive or have tested positive yourself. Visit the UF Health Screen, Test & Protect website for more information.
- Please continue to follow healthy habits, including best practices like frequent hand washing. Following these practices is our responsibility as Gators.

*The class website on e-learning will be used to share and update any additional information regarding the impact of COVID-19 on our class activities. I ask that you be patient as we work together during this challenging time.*

- Instructor:** Jason E. Butler  
Professor of Chemical Engineering  
431 Chemical Engineering Bldg. (CHE)  
e-mail: butler@che.ufl.edu  
Office hours TR 2-3 pm, or by appointment  
Note that office hours will be hosted  
simultaneously in person and on zoom
- Supervised  
Teacher:** Ziyao Liu  
Doctoral Candidate, Chemical Engineering  
e-mail: ziyao.liu@ufl.edu  
Office Hours WF 3-4 pm, or by appointment  
Office hours on zoom, links provided on website
- Textbook:** Munson, Young, Okiishi, Gerhart, Gerhart & Hochstein  
*Fundamentals of Fluid Mechanics*  
8th Edition, John Wiley & Sons
- Class Website:** · <https://elearning2.courses.ufl.edu/portal>  
· posting of HW assignments, solutions, etc.
- Grading Criteria:** Quizzes, 3 at 5% each  
Regular Assessments, 2 at 25% each  
Final Assessment, 35%  
\*\* All assessments cumulative.
- Exam dates:** · Regular Assessments  
*will occur in the evenings* Dates TBD  
· Final Assessment  
Wednesday, December 15th, 10:00 am - 12:00 noon
- Grading  
Scale** These percentages will earn you a letter grade of *at least*  
≥ 78% - A-  
≥ 64% - B  
≥ 54% - C  
Note that a score of C or better required before continuing  
in the ChE program: A C- will not be a qualifying grade for  
critical tracking courses. In order to graduate, students must  
have an overall GPA and an upper-division GPA of 2.0 or better  
(C or better). Note: a C- average is equivalent to a GPA of  
1.67, and therefore, it does not satisfy this graduation require-  
ment. More information on UF grading policy may be found at:  
<https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

**Homework**

- Homework will not be graded.
- Suggested homework problems will be assigned on a 1-2 week basis with a *completion date*.
- Prior to the completion date, solutions will be posted on the class website.

**Grading:**

- Award of partial credit on individual questions will be made on a basis specified by the instructor and will be consistently applied.
- Graders will attempt to assess the value of all work accurately; however, you should present solutions that are neat and well thought-out to maximize your grade.
- Meeting the percentages listed above guarantees the specified letter grade at least.
- Instructor may employ a curve only to lower the threshold for attaining the letter grades specified above.
- The percentages for obtaining grades not listed (A, B+, etc.) above will be set by a curve.

**Attendance**

- Students are strongly encouraged to attend all lectures, though attendance is not required.
- Exams/quizzes will be rescheduled only for those students who missed due to an acceptable reason (illness, serious family emergencies, military obligation, religious holidays, and participation in official university activities) as listed in the undergraduate catalog (<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>).
- Students arriving late for a quiz/exam will be given only the balance of time remaining to complete their work unless an acceptable reason (see above) is provided.

# Objectives & Outline for ECH 3203, Fall 2021

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At the completion of this course, you will be able to

- Identify flow process variables and conduct a dimensional analysis.
- Apply shell balance approaches to set up mass and momentum balances.
- Evaluate the operation of processes involving a flow through pipes (pressure drop, frictional loss, flow rate).
- Design a pipe network for a specific process.
- Estimate the drag force on an object immersed in a fluid flow.
- Evaluate the operation of packed beds, fluidized beds, and filters for specific fluids.
- Select and evaluate the performance of pumps.

Specific topics covered will include:

- Unit systems.
- Dimensional analysis.
- Thermo-physical properties.
- Hydrostatic equilibrium, barometric equation, manometer, buoyancy force.
- Integral mass and momentum balances.
- Potential flow, Bernoulli's equation, and friction factors.
- Laminar and turbulent flows.
- Pipe network.
- Pumps and flow meters.
- Flow of compressible fluids (adiabatic and isothermal flows).
- Stokes law, drag coefficient, settling velocity.
- Flow through porous media, Darcy's law.
- Packed bed, fluidized bed.
- Operations involving particulates (filtration, mixing, gas cleaning).

The course consists of the following material, with parallel readings from the book listed:

- Introduction, familiarize yourself with the terminology and notation. Chapter 1.
- Fluid statics, which should be review. Read chapter 2.
- Bernoulli equation: derivation and usage. Read chapter 3.
- Reynolds transport theorem and macroscopic balances for mass, momentum, and energy. Read chapters 4 and 5.
- Inviscid flows, potential flows, and Bernoulli's equation with alternate derivation. Read chapter 6.4-6.7.
- Navier Stokes equations and viscous flows. Chapter 6-6.3, 6.8-end.
- Flow over immersed objects and boundary layers. Read chapter 9.
- Pipe flow, networks, and flow measurement. Read chapter 8.
- Pumps, turbines, and their analysis/design. Read chapter 12.
- Advanced material, including packed beds, fluidized beds, sedimentation, and flow through porous media.

### Relation to Program Outcomes (ABET):

OUTCOME	COVERAGE
1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	High
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	Medium
3. An ability to communicate effectively with a range of audiences	Low
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	-

**Students Requiring Accommodations:** Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting <https://disability.ufl.edu/students/get-started/>. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

**Course Evaluation:** Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.ua.ufl.edu/students/>. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.ua.ufl.edu/public-results/>.

**In-Class Recording** Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A “class lecture” is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To “publish” means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

**University Honesty Policy:** UF students are bound by The Honor Pledge which states, We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: On my honor, I have neither given nor received unauthorized aid in doing this assignment. The Conduct Code (<https://sccr.dso.ufl.edu/process/student-conduct-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. If you have any questions or concerns, please consult with the instructor or TAs in this class.

**Commitment to a Safe and Inclusive Learning Environment:** The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following: · Your academic advisor or Graduate Program Coordinator · Jennifer Nappo, Director of Human Resources, 352-392-0904, [jpennacc@ufl.edu](mailto:jpennacc@ufl.edu) · Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, [taylor@eng.ufl.edu](mailto:taylor@eng.ufl.edu) · Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, [nishida@eng.ufl.edu](mailto:nishida@eng.ufl.edu)

**Software Use:** All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

**Student Privacy:** There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <https://registrar.ufl.edu/ferpa.html>

## Campus Resources

*Health and Wellness U Matter, We Care:* Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact [umatter@ufl.edu](mailto:umatter@ufl.edu) so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

*Counseling and Wellness Center:* <https://counseling.ufl.edu>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

*Sexual Discrimination, Harassment, Assault, or Violence:* If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the Office of Title IX Compliance, located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, [title-ix@ufl.edu](mailto:title-ix@ufl.edu)

*Sexual Assault Recovery Services (SARS)* Student Health Care Center, 392-1161.

*University Police Department* at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

*Academic Resources:* E-learning technical support, 352-392-4357 (select option 2) or e-mail to [Learning-support@ufl.edu](mailto:Learning-support@ufl.edu). <https://lss.at.ufl.edu/help.shtml>.

*Career Resource Center:* Reitz Union, 392-1601. Career assistance and counseling; <https://career.ufl.edu>.

*Library Support:* <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

*Teaching Center,* Broward Hall, 392-2010 or 392-6420. General study skills and tutoring. <https://teachingcenter.ufl.edu/>.

*Writing Studio,* 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers. <https://writing.ufl.edu/writing-studio/>.

*Student Complaints Campus:* <https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/>; <https://care.dso.ufl.edu>.

*On-Line Students Complaints:* <http://www.distance.ufl.edu/student-complaint-process>.