

## **Fluid and Solid Operations**

ECH 3203 Section 19CB

**Class Periods:** MWF, Period 6, 12:50 PM – 1:40 PM

**Virtual Location:** <https://ufl.zoom.us/j/95740292840?pwd=TVFCUnkxNWUwTEExXQINuc2N3Zz09>

**Academic Term:** Fall 2020

### **Instructor:**

Peng Jiang

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(352) 392-2189 (office)

(352) 226-3246 (cell)

Office Hours: TR, 2:00 PM – 3:00 PM, please use the same zoom link shown above.

### **Teaching Assistant/Peer Mentor/Supervised Teaching Student:**

Bo Yu, [yubo1@ufl.edu](mailto:yubo1@ufl.edu), (352) 278-0055, TR 9:00 – 10:00 AM, please use the same zoom link shown above.

### **Course Description**

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.

### **Course Pre-Requisites / Co-Requisites**

COT 3502 and ECH 3264

### **Course Objectives**

Upon completion of this course, a student is expected to be able to:

- Identify process variables and conduct a dimensional analysis.
- Apply shell balance approach to set up mass and momentum balances.
- Evaluate the operation of process 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.
- Work ethically with other students, engaging in discussions and working independently as appropriate.

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).

**Materials and Supply Fees**

None.

**Professional Component (ABET):**

ABET Program Outcomes:

- (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 multi-disciplinary 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
- (k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice
- (l) A recognition of industrial health and safety issues, and an ability to engage in fostering and exercising health and safety rules and regulations

**Relation to Program Outcomes (ABET):**

Outcome	Coverage*
(a) An ability to apply knowledge of mathematics, science, and engineering.	High
(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.	Medium
(d) An ability to function on multi-disciplinary teams	
(e) An ability to identify, formulate, and solve engineering problems.	High
(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.	Medium
(i) A recognition of the need for, and an ability to engage in life-long learning.	Medium
(j) A knowledge of contemporary issues.	
(k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.	Medium

(I) A recognition of industrial health and safety issues, and an ability to engage in fostering and exercising health and safety rules and regulations.	
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\*Coverage is given as high, medium, or low. An empty box indicates that this outcome is not covered or assessed in the course.

### **Required Textbooks and Software**

- *Fundamentals of Fluid Mechanics*
- Munson, Young, and Okiishi
- 8<sup>th</sup> (preferred), 7<sup>th</sup>, 6<sup>th</sup>, or 5<sup>th</sup> Edition, John Wiley & Sons

### **Recommended Materials**

- *Fluid Mechanics and Its Applications*
- V. Gupta and S. Gupta
- 3<sup>rd</sup> Edition, New Academic Science
- ISBN number: 978-1906574925

### **Tentative Course Schedule**

Week 1 (Aug 31, Sept 2, 4): Course introduction and Chapter 1 (Review on units of systems, unit conversion, and dimensional analysis)

Week 2 (Sept 7, 9, 11): Chapter 2 (Fluid Statics: hydrostatic equilibrium and pressure measurements)

Week 3 (Sept 14, 16, 18): Chapter 2 (Buoyancy), Chapter 3 (Fluid dynamics), **Quiz 1** (covering Chapters 1 & 2)

Week 4 (Sept 21, 23, 25): Chapter 3 (The Bernoulli equation)

Week 5 (Sept 28, 30, Oct 2): Chapter 3 (Applications/limitations of the Bernoulli equation), Chapter 4 (Fluid kinematics)

Week 6 (Oct 5, 7, 9): **Quiz 2** (covering Chapter 3), Chapter 4 (Reynolds Transport Theorem)

Week 7 (Oct 12, 14, 16): Chapter 5 (Finite control volume analysis)

Week 8 (Oct 19, 21, 23): **Mid-term Exam** (covering Chapters 1-5), Chapter 6 (Differential analysis of fluid flow)

Week 9 (Oct 26, 28, 30): Chapter 6 (The Navier-Stokes Equations)

Week 10 (Nov 2, 4, 6): Chapter 6 (Simple solutions for viscous, incompressible fluids)

Week 11 (Nov 9, 11, 13): **Quiz 3** (Covering Chapter 6), Chapter 8 (Viscous flow in pipes)

Week 12 (Nov 16, 18, 20): Chapter 8 (pipe flow and flowrate measurement)

Week 13 (Nov 23, 25, 27): Chapter 9 (Flow over immersed bodies)

Week 14 (Nov 30, Dec 2, 4): **Quiz 4** (covering chapter 8), Chapter 9 (Drag and lift)

Week 15 (Dec 7, 9): Chapter 12 (Turbomachines), Chapter 12 (Pumps)

Final Exams Week: **Final Exam** (Dec 16, 7:30AM – 9:30 AM)

### **Attendance Policy, Class Expectations, and Make-Up Policy**

Attendance of all online lectures is highly recommended. Although all lectures will be recorded, it is the student's responsibility to obtain any notes, assignments, etc. that they may have missed during their absence. Repeated absences may lead to a lower grade in the class. Excused absences must be consistent with university policies in the undergraduate catalog (<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>) and require appropriate documentation.

As a courtesy to the other students and to the instructor, the students should turn off the ringers for all cell phones during lecture and they should not answer incoming calls. If a student is expecting an emergency call, please notify the instructor prior to class.

Makeup exams and quizzes will be given only in case of an emergency – **documentation of the emergency has to be provided**. It is required that, whenever possible, the student notifies the instructor about the situation prior to the exam, preferably at least two weeks in advance.

### ***Evaluation of Grades***

<b>Assignment</b>	<b>Total Points</b>	<b>Percentage of Final Grade</b>
Quizzes (4)	100 each	20%
Midterm Exam	100	40%
Final Exam	100	40%
		100%

Homework sets: 10 homework sets will be assigned throughout the semester. Homework will not be graded. The homework solutions will be posted on the class website 1 week after the assignment date.

Quizzes: 4 quizzes (15 minutes each) are equally weighted. All quizzes will be closed book and closed notes. All quizzes will be closely proctored by ProctorU or Honorlock.

Mid-term and final exams: The two-hour mid-term exam and two-hour final exam will be closed book and closed notes. All relevant formulas will be given. Partial credit will be assigned, and no credit will be given for problems that have a solution but all the work leading to this solution is not shown. All exams will be closely proctored by ProctorU or Honorlock.

### ***Grading Policy***

<b>Percent</b>	<b>Grade</b>	<b>Grade Points</b>
100 - 90	A	4.00
85 - 89	A-	3.67
80 - 84	B+	3.33
75 - 79	B	3.00
70 - 74	B-	2.67
65 - 69	C+	2.33
60 - 64	C	2.00
55 - 59	C-	1.67
50 - 54	D+	1.33
45 - 49	D	1.00
40 - 44	D-	0.67
0 - 39	E	0.00

More information on UF grading policy may be found at:

<https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

### ***Students Requiring Accommodations***

Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, <https://www.dso.ufl.edu/drc>) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure 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/>.

### ***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 Honor Code (<https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. 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
- Robin Bielling, Director of Human Resources, 352-392-0903, [rbielling@eng.ufl.edu](mailto:rbielling@eng.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>

All class sessions will be recorded for students in the class to refer back and for enrolled students who are unable to attend live. Students who participate with their camera engaged or utilize a profile image are agreeing to have their video or image recorded. If you are unwilling to consent to have your profile or video image recorded, be sure to keep your camera off and do not use a profile image. Likewise, students who un-mute during class and participate orally are agreeing to have their voices recorded. If you are not willing to consent to have your voice recorded during class, you will need to keep your mute button activated and communicate exclusively using the "chat" feature, which allows students to type questions and comments live. The chat will not be recorded or shared. As in all courses, unauthorized recording and unauthorized sharing of recorded materials is prohibited.

### ***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:** <http://www.counseling.ufl.edu/cwc>, 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://www.crc.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://www.dso.ufl.edu/documents/UF\\_Complaints\\_policy.pdf](https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf).

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