

Fluid and Solid Operations

ECH 3203 Section 19CB

Class Periods: MWF, Period 7, 1:55 PM – 2:45 PM

Location: 303 MAEA

Academic Term: Fall 2019

Instructor:

Peng Jiang

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(352) 392-2189 (office)

Office Hours: TR, 2:00 PM – 3:00 PM, ChE 319, or by appointment

Teaching Assistant/Peer Mentor/Supervised Teaching Student:

Please contact through the Canvas website

- Yifan Yu, yifan2015@ufl.edu, ChE, office hours

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
- 8th, 7th, 6th, or 5th Edition, John Wiley & Sons

Recommended Materials

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

Tentative Course Schedule

Week 1 (Aug 21, 23): Chapter 1 (Review on units of systems, unit conversion, and dimensional analysis)
Week 2 (Aug 26, 28, 30): Chapter 2 (Fluid Statics: hydrostatic equilibrium and pressure measurements)
Week 3 (Sept 4, 6): Chapter 2 (Buoyancy), Chapter 3 (Fluid dynamics)
Week 4 (Sept 9, 11, 13): **Quiz 1** (covering Chapters 1 & 2), Chapter 3 (The Bernoulli equation)
Week 5 (Sept 16, 18, 20): Chapter 3 (Applications/limitations of the Bernoulli equation), Chapter 4 (Fluid kinematics)
Week 6 (Sept 23, 25, 27): **Quiz 2** (covering Chapter 3), Chapter 4 (Reynolds Transport Theorem)
Week 7 (Sept 30, Oct 2): Chapter 5 (Finite control volume analysis)
Week 8 (Oct 7, 9, 11): **Mid-term Exam** (covering Chapters 1-5), Chapter 6 (Differential analysis of fluid flow)
Week 9 (Oct 14, 16, 18): Chapter 6 (The Navier-Stokes Equations)
Week 10 (Oct 21, 23, 25): Chapter 6 (simple solutions for viscous, incompressible fluids)
Week 11 (Oct 28, 30, Nov 1): **Quiz 3** (Covering Chapter 6), Chapter 8 (Viscous flow in pipes)
Week 12 (Nov 4, 6, 8): Chapter 8 (pipe flow and flowrate measurement)
Week 13 (Nov 13, 15): **Quiz 4** (covering chapter 8), Chapter 9 (Flow over immersed bodies)
Week 14 (Nov 18, 20, 22): Chapter 9 (Drag and lift)
Week 15 (Nov 25): Chapter 12 (Turbomachines)
Week 16 (Dec 2, 4): **Final Exam** (Dec 4), Chapter 12 (Pumps)

Attendance Policy, Class Expectations, and Make-Up Policy

Attendance of all lectures is highly recommended. 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 class 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

| Assignment | Total Points | Percentage of Final Grade |
|-------------------|---------------------|----------------------------------|
| Quizzes (4) | 100 each | 20% |
| Midterm Exam | 100 | 40% |
| Final Exam | 100 | 40% |
| | | 100% |

Homework sets: 8 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.

Mid-term and final exams: The two-hour mid-term exam and two-hour final exam will be closed book and closed notes. You will be allowed to bring one sheet of paper (8.5×11 inch, one side only) for formulas. 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.

Grading Policy

| Percent | Grade | Grade Points |
|----------------|--------------|---------------------|
| 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
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, taylor@eng.ufl.edu
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, 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 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

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.
<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.

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