Lecture MW 1:30-2:20 pm W107 PBB
Discussion F 1:30-2:20 pm 134 TH

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Prof. Jennifer Fiegel, 4128 Seamans Center**;** jennifer-fiegel@uiowa.edu
(please allow 24 hours for a response)

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CBE Second-Year Study/HW Hours:
Sun 6-7 pm, 2040 SC
Tues 5-6 pm, 2040 SC
Thurs 6-7 pm, 2040 SC

Time to Talk to Prof. Fiegel:
M/W/F 2:20-3 pm, in classroom

(I am happy to schedule another time to meet if the scheduled times don't work for you; just ask!)

CBE:3109 – Fluid Flow

The University of Iowa Spring 2023

Course Description

Welcome to Chemical and Biochemical Engineering Fluid Flow! This is a first-level course in fluid mechanics which will introduce you to fundamental principles underlying the behavior of fluids and how these principles can be applied to the solution of practical engineering problems.

Course Learning Objectives

The course activities are designed to develop your competency in several areas of fluid flow. Specifically, by the end of the course you should:

- Be able to solve problems using fluid statics principles and dimensional analysis;
- Be able to apply the mechanical energy balance to solve pipe flow problems involving the flow of Newtonian and non-Newtonian fluids;
- Be able to size and select a pump or compressor for a given flow situation;
- Be able to solve problems involving external flow, specifically flow through packed and fluidized beds and flow around submerged objects;
- Have had opportunities to further your professional development through studying professional ethics, practicing written communication skills, and being exposed to contemporary issues.

Teaching Philosophy for Fluid Flow

The value of a flipped classroom is that students get to work through problems and receive immediate feedback on their work. However, I also know that this setting does not work for every student. Therefore, in the Fluid Flow class, I combine the advantages of traditional lectures with the flipped classroom and teach the Fluid Flow class in a hybrid model: lecture for two days of the week and hands-on problem solving in a TILE classroom or in Zoom breakout rooms one day a week. This allows you, the student, to hear directly from me what material I believe is most important in the lectures, while also giving you the chance to practice your problem-solving skills in a monitored setting. When you work problems on the board, I can quickly scan the room to see if there are common misconceptions or issues that groups are having and I can address them immediately. In this setting, you should feel free to ask questions and request help or clarification while you are working through the problems.

During the week, you will also be given mini homework assignments every night based on the material taught in that day's class to help you keep up with the material and quickly identify concepts you are not understanding. These are low stakes assignments which are graded for effort rather than correct answers to encourage you to attempt them on your own. I do require you to follow a format for these problems, as I will be using the same format to grade your exams.

To push you beyond the immediate course material and help you better understand the fundamental concepts of the course, you will be given weekly assignments focused on online fluid mechanics demonstrations, Jove education videos, ethical case studies, and short topical papers on "real world" engineering application of course concepts. Overall, I try to provide you with many different opportunities to learn course content. If something is not working for you, let me know.

CBE Second-Year Study/HW Hours
These study/homework hours are a chance for you to join your fellow second-year classmates and TAs from your CBE classes (Fluid Flow, Thermodynamics, and Process Calculations) to work together, ask questions, develop engineering study groups, and build community. These are times which have been set aside by the TAs to help you with material that is not clear and to answer any questions you have about course material or requirements. Please use them to help you with this class! We enjoy seeing your faces outside of classroom time. I encourage you to **seek help** and use the provided resources to meet the requirements of the course. We will make every effort to guide you toward completion of all requirements, but the ultimate responsibility for satisfying these requirements is yours.

How to Survive This Course
Find a study group! - Find a study group! - Find a study group! - (Seriously, this is very important!) Take advantage of the study/HW hours and times to talk to Prof. Fiegel! Attend them even if you think you understand the material perfectly – there is always a chance that you'll learn something new! If you have a question, ask it – no matter how silly you think it is. Enjoy the subject and its numerous applications in science and engineering!

Course Materials
Textbook: *Fluid Mechanics for Chemical Engineers*, 3rd or 4th Edition, de Nevers, John Wiley and Sons. The digital version (ISBN: 9781260475524) will be automatically charged to your U-Bill ($39.90) unless you opt-out by 1/30. If you want a physical copy of the textbook ISBN: 9781260587401 (4th edition) or ISBN: 9780072566086 (3rd edition), you'll need to order one online. It will be helpful to have the textbook with you during the Friday discussion sections.

Other course materials you need to be successful in the course will be provided on the ICON website. These materials will be posted throughout the semester.

Attendance and Absences
Please be here and engaged when you are here. This class works best when all of us are involved in discussing and learning the material, and it is more interesting and meaningful for all when that occurs. Having said that, I understand that there are times when something will prevent your attendance: people get sick, emergencies occur, there's a religious holy day, you're participating in an athletic or university event that requires travel, and so on (sleeping in or just blowing off class aren't in this category). If an emergency or similar unforeseen event occurs, please contact me as soon as it's feasible and we'll talk about making up any assignments you might have missed. If you're traveling to, or participating in, a university event, please let me know ahead of time so we can make arrangements regarding the course material and assignments. If we keep the lines of communication open, we'll be able to better handle any situations that may arise. Thanks for your help with this.

On Your Own Outside of Class
You have probably heard that you should be spending 2-3 hrs studying for every hour spend in the classroom. I'm less concerned about the exact amount of time you spend outside class than how you are using that time and if you are successfully learning the course material. So, what can you be doing with time outside of class to help with your success in this class?

- Complete homework problems and weekly challenge assignments – this works particularly well if you are generating your own solutions, but not so much if you just copy a solution. You may struggle with some of the problems, but don't despair – this is not a sign that you're *not* learning, it's a sign that you *are* learning!
- Summarize class notes and begin to prepare your 8.5x11" piece of paper for the exam. Rewriting notes in your own words is an opportunity to "replay" what was said and done in class. Identifying what to put on your notes page for the exam helps you organize the information and think about the importance and relationships among concepts.
- Read the textbook to clarify concepts – I know reading the book can be boring, but even skimming through the material and reading those sections that didn't make perfect sense in class can help your understanding.

- Work through sample problems in the textbook on your own – again, this works well if you read over the problem statement and try the problem completely on your own, before looking over the solution.
- Take notes on the textbook material and tab the location of key information – we will keep referring back to material in the text, so tabbing your book can save you time.
- Read ahead, or at least look over the material that we will be covering next – this can help you better understand what we are covering in class and help see the relationship between the material.

Some Notes Regarding Technology

Please get in the habit of checking your UIowa email regularly. I will communicate important class information and announcements via email. Students are responsible for official correspondences sent to their UI email address (@uiowa.edu) and must use this address for all communication within UI (Operations Manual, III.15.2).

We'll be using ICON for course materials, assignment submissions, and for you to see grades and feedback. Let us know if you need any additional assistance with the course site. Some of the material we'll use (videos and demos) require a high-speed internet connection in order to work effectively. All of our campus computer labs have the necessary connection speeds, as does campus WiFi. If you have concerns about being able to access this online material, please come see me and we'll figure out a way to make sure you can get what you need.

Netiquette (from 'Internet etiquette')

"Netiquette" refers to the standards for appropriate interaction in an online environment. Students are expected to display proper netiquette in their communications with their instructor, teaching assistants, and other students. This includes being polite, disagreeing agreeably when necessary, including your name and other necessary identifiers on any communication, and practicing collegiality and mutual respect. We're not here to troll or to flame, but to learn and be in community. If an email or discussion post ever concerns you, please notify me privately and we'll work towards a resolution.

Assignments & Grading

In-class Activities and Homework (15% of grade):

Discussion Section: In-class activities in the TILE classroom will include both individual and group assignments. Because group work and participation are at the heart of the discussion time, you are required to attend class. You can prepare for these sessions before class to make the most of the class time by reading the textbook and reviewing your notes prior to discussion. Students also find it helpful to have a copy of the textbook and their class notes with them when working through problems. Tangible outputs of in-class activities will be collected in various formats (e.g., Excel spreadsheets and photos of whiteboard work uploaded to the ICON dropbox).

Daily Homework: True learning of the course concepts must begin with practice, and the homework provides you with the opportunity to apply the course concepts to realistic engineering problems. There will be **daily** homework assignments due at the **beginning** of the next class. Late homework is accepted, but with a 20% grade reduction for each day late. Group discussion of the homework problems is allowed (and encouraged); however, individual solutions showing your own work must be handed in (see guidelines at the end of the syllabus for further clarification). All homework will be graded 50% on effort, 50% on neatness and following the required format. This is done to help prepare you for the exams!

Solution Format: For all assigned problems, first draw a diagram or picture of the problem, show all of your work (we must be able to follow step-by-step how you solved the problem; this includes writing down and simplifying equations BEFORE plugging in numbers, stating all assumptions, and showing points used for the MEB on your diagrams), include proper units throughout your calculations and in the final answer (credit will not be given for answers without the proper units), and box in or underline your final answer. When turning in homework on paper, make sure you staple your pages and remove any frizzies (rough edges) from the page. If you use Excel to solve a problem, you must include a printout of the spreadsheet or upload the spreadsheet to the appropriate ICON dropbox. All Excel spreadsheets must be well labelled and include equations that are being used to solve the problem (preferably in a text box). Make sure you include your name, due date, and problem numbers on your homework!

Weekly Challenges (15% of grade): Each week of the semester, you will be assigned a weekly challenge. These challenges include many different activities such as discussing ethical case studies, trying out and reviewing online fluid mechanics demonstrations, watching and reviewing Jove education videos, conducting online research and writing about what you find, and preparing for or reflecting on the exams. These assignments are due on Fridays by 5 pm.

Exams (60% of the grade):
There will be four examinations during the semester. Each exam is worth 100 points and will contain both short (multiple-choice, short-answer) questions, as well as longer, sometimes multi-part, problems. The purpose of these examinations is to assess your command of the material we've covered in a particular unit, as well as your ability to synthesize concepts to solve original problems in fluid flow. A sample past exam will be provided on the ICON site for you to use as practice before each exam. We regularly do exam prep problems in the discussion section and the TAs will provide an exam review session. But bear in mind that the best way to prepare for these exams is to keep up with the readings, homework, and in-class activities.

The exams are closed-book. Each student can bring one 8.5x11" piece of paper with hand-written notes to each exam, plus any note sheets from the previous exam(s). Each student should also bring a calculator and writing utensils to the exams. No other materials will be allowed in the exams.

	Material Covered	Date	Place
Exam 1	Fluid properties, statics, and MEB	6:30-7:30 pm, Th Feb 9th	1505 SC
Exam 2	Pipe flow and pump selection	6:30-7:30 pm, Th Mar 9th	1505 SC
Exam 3	Compressors, gas flow, external flow	6:30-7:30 pm, Th Apr 13th	1505 SC
Final Exam	all material, emphasis on last fourth	to be announced by registrar office	TBD

If you need to schedule a make-up exam because of a class conflict, an exam conflict, religious holy day, or a sponsored University activity (such as an away game for Iowa Athletics or a conference) that conflicts with the exam, please fill out the "Exam Conflict Notification" form at least 1 week prior to the exam (available on the course ICON site). Students can make up an exam which has been missed due to illness, religious holy days, or other unavoidable circumstances such as an emergency. In these instances, please email me as soon as possible (I worry about students that miss an exam!).

A regrade for an exam can be requested within 3 calendar days of the return date of the exam. Please fill out "Regrade Request" form available on the course ICON site.

Project (10% of grade): This project is a chance for you to get creative in explaining fluid flow concepts. There are six options for the project (see Fluid Flow Project Choice Board on ICON). You can partner with one other person in the class or do the project on your own. The project can complete any time during the second half of the semester, but you must choose a project by the end of March and turn in all project pieces by the end of April (files, videos, etc. should be submitted to the ICON dropbox and physical objects turned in during class). No two projects will be allowed to tackle the same idea. Therefore, getting permission for your project early may increase your chances of it being accepted.

Course letter grades: Course letter grades are NOT based on a curve, but most past offerings of the course have had mean scores in the B range.

Education is not the learning of facts, but the training of the mind to think.
— Albert Einstein

Tentative Schedule of Topics

Week	Date	Topic	Reading
1	Mon, Jan 16	Martin Luther King Day - No Class	
	Wed, Jan 18	Introduction, Fluid Properties	Ch. 1
	Fri, Jan 20	Discussion - Fluid Properties	
2	Mon, Jan 23	Fluid Properties and Statics	Ch. 2
	Wed, Jan 25	Fluid Statics	
	Fri, Jan 27	Discussion - Fluid Statics and Introduction to Wolfram Demos	
3	Mon, Jan 30	Mechanical Energy Balance (MEB)	Ch. 5 and MEB handout
	Wed, Feb 1	MEB for Fluid Flow Measurement	
	Fri, Feb 3	Discussion - MEB Application	
4	Mon, Feb 6	MEB, Exam Prep	
	Wed, Feb 8	Pipe Flow for Incompressible Newtonian Fluids	Ch. 6
	Exam 1		
	Fri, Feb 10	Discussion - Pipe Flow Basics	
5	Mon, Feb 13	Pipe Flow Turbulence and Fitting Losses	
	Wed, Feb 15	Pipe Flow Iterative Solutions and Economic Pipe Diameter	
	Fri, Feb 17	Discussion - Pipe Flow w/ Turbulence and Fitting Losses	
6	Mon, Feb 20	Pump Intro	
	Wed, Feb 22	Pump Selection	Ch. 10
	Fri, Feb 24	Discussion – Pump Selection	
7	Mon, Feb 27	Pumps, Net Positive Suction Head and Cavitation	
	Wed, Mar 1	Pump Selection Tips and Affinity Laws	
	Fri, Mar 3	Discussion – Pump Cavitation, Exam Prep	
8	Mon, Mar 6	Compressors	
	Wed, Mar 8	Compressors	
	Exam 2		
	Fri, Mar 10	Discussion – Compressors	
	Spring Break		
9	Mon, Mar 20	Flow Around Submerged Objects	Ch. 6, pgs. 223-230
	Wed, Mar 22	Terminal Velocity	
	Fri, Mar 24	Discussion – Drag and Terminal Velocity Compressible Gas Flow	
10	Mon, Mar 27	Packed Beds	Ch. 11
	Wed, Mar 29	Packed Beds	
	Fri, Mar 31	Discussion – Packed Beds	
11	Mon, Apr 3	Fluidized Beds	
	Wed, Apr 5	Non-Newtonian Fluids	Ch. 13
	Fri, Apr 7	Discussion – Fluidized Beds and Non-Newtonian Fluids	
12	Mon, Apr 10	Non-Newtonian Fluids: Power Law Fluids	
	Wed, Apr 12	Non-Newtonian Fluids: Bingham Plastics	
	Exam 3		
	Fri, Apr 14	Discussion – Non-Newtonian Fluids	
13	Mon, Apr 17	High Velocity, Compressible Gas Flow	Handout and Ch. 8 (no shock waves or diffusers)
	Wed, Apr 19	Compressible Gas Flow – Graphical Solution	
	Fri, Apr 21	Discussion – Compressible Gas Flow	
14	Mon, Apr 24	Dimensional Analysis – Buckingham's Pi Method	Ch. 9
	Wed, Apr 26	Dimensional Analysis and Scale-up	
	Fri, Apr 28	Discussion – Dimensional Analysis and Scale-up	
15	Mon, May 1	Navier Stokes Equations	Ch. 15
	Wed, May 3	Navier Stokes Equations	
	Fri, May 4	Discussion – Final Exam Prep	
Final Exam			

The College of Engineering is the administrative home of this course and governs its add/drop deadlines, sanctions for academic dishonesty, and other policies. For more details see: https://engineering.uiowa.edu/current-students/advising-and-academic-information/academic-policies-and-procedures.

University Policies

Student Mental Health
As a student, you may experience a range of challenges that can interfere with learning, such as strained relationships, increased anxiety, substance use, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may impact your ability to attend class, concentrate, complete work, take an exam, or participate in daily activities. Students are encouraged to be mindful of their mental health and seek help if they are feeling overwhelmed and/or incapable of meeting course expectations. For assistance with the class, students are encouraged to talk to their faculty member. For additional support and counseling, students are encouraged to contact The University Counseling Service (UCS) in 1950 University Capital Centre Suite or 3223 Westlawn South. Call 319.335.7294 to schedule appointments (Mon-Fri. 8AM-4:30PM). Find out more about the UCS at http://counseling.uiowa.edu. After hours, call the Johnson County Crisis Line at 319-351-0140 or 911 if you are having a mental health emergency. Find out more about UI mental healthservices at: http://mentalhealth.uiowa.edu.

Accessibility
The University is committed to provide an educational experience that is accessible to all students. If you have a diagnosed disability or any other condition that would impair your ability to complete the course requirements as stated above, please inform Professor Fiegel as early in the semester as possible, but no later than two weeks prior to the scheduled activity. Students needing accommodations must register with Student Disability Services, (SDS) to obtain a Letter of Accommodation (LOA). The LOA will specify what reasonable course accommodations the student is eligible for and those the instructor should provide. Additional information can be found at https://sds.studentlife.uiowa.edu/accommodations/apply.

Basic Needs and Support for Students
Student Care & Assistance provides assistance to University of Iowa students experiencing a variety of crisis and emergency situations, including but not limited to medical issues, family emergencies, unexpected challenges, and sourcing basic needs such as food and shelter. More information on the resources related to basic needs can be found at: https://basicneeds.uiowa.edu/resources/. Students are encouraged to contact Student Care & Assistance in the Office of the Dean of Students (Room 135 IMU, dos-assistance@uiowa.edu, or319-335-1162) for support and assistance with resources.

Free Speech and Expression
The University of Iowa supports and upholds the First Amendment protection of freedom of speech and the principles of academic and artistic freedom. We are committed to open inquiry, vigorous debate, and creative expression inside and outside of the classroom. For information on the university's policies on free speech and academic freedom, see https://freespeech.uiowa.edu.

Sexual Harassment /Sexual Misconduct and Supportive Measures
The University of Iowa prohibits all forms of sexual harassment, sexual misconduct, and related retaliation. The Policy on Sexual Harassment and Sexual Misconduct governs actions by students, faculty, staff and visitors. Incidents of sexual harassment or sexual misconduct can be reported to the Title IX and Gender Equity Office or to the Department of Public Safety. Students impacted by sexual harassment or sexual misconduct may be eligible for academic supportive measures and can learn more by contacting the Title IX and Gender Equity Office. Information about confidential resources can be found at: https://osmrc.uiowa.edu/confidential-resources. Watch this video for an explanation of these resources: https://www.youtube.com/watch?v=Jfjo6v6_b3Y.

Nondiscrimination in the Classroom
The University of Iowa prohibits discrimination in employment, educational programs, and activities on the basis of race, creed, color, religion, national origin, age, sex, pregnancy, disability, genetic information, status as a U.S. veteran, service in the U.S. military, sexual orientation, gender identity, associational preferences, or any other classification that deprives the person of consideration as an individual. The university also affirms its commitment to providing equal opportunities and equal access to university facilities. For additional information on nondiscrimination policies, contact the Director, Office of Institutional Equity, the University of Iowa, 202 Jessup Hall, Iowa City, IA 52242-1316, 319-335-0705, oie-ui@uiowa.edu. Students may share their pronouns and chosen/preferred names in MyUI, which is accessible to instructors and advisors.

Final Examination Policies
The final exam schedule is announced around the fifth week of classes; students are responsible for knowing the date, time, and place of the final exam. Students should not make travel plans until knowing this information. Visit https://registrar.uiowa.edu/final-examination-scheduling-policies.

Notes on Academic Integrity and Misconduct

Academic Integrity, based on the values of honesty, trust, fairness, respect, and responsibility, is a fundamental principle in higher education. You are expected adhere to the University's Code of Student Life[1], the College of Engineering policy of academic misconduct[2], and course-specific policies outlined in this syllabus

In this course, I will hold you to the high standard of academic integrity expected of all students at the university. I do this for two reasons. First, it is essential to the learning process that you are the one doing the work. I have structured the assignments in this course to enable you to gain a mastery of the course material. Failing to do the work yourself will result in a lesser understanding of the content, and therefore a less meaningful education for you. Second, it is important that there be a level playing field for all students in this course and at the university so that the rigor and integrity of the university's educational program is maintained. Some guidelines are provided below to explain various aspects of academic misconduct and sanctions that will be used in this course, as well as how you can still collaborate together on homework assignments.

What is considered academic misconduct? (this list is not exhaustive, but provides you some common examples)

- Looking at the exam or quizzes of others, even if nothing is copied from them.
- Any communication with others during exams or quizzes (verbal, electronic, gestures, etc.).
- Copying answers from another exam paper or someone else's assignment.
- Using unapproved resources during an exam.
- Any use of unapproved resources to complete homework or in-class assignments, including any solution manual for the textbooks used in this course, previous year's homework solutions, completed assignments or exams from previous years, Chegg or similar online "services".

So what is appropriate collaboration on homework and in-class work?

- Appropriate collaboration on homework is working together on the assignment, without viewing each other's written work. If you want to explain something to a friend, explain it verbally or use a spare sheet of paper and explain it using a separate example from the assigned problem. Rather than telling your friend the next step or the answer, ask them questions that will help them develop the solution logic themselves. Then let them apply that example to their own work.
- A good recommendation for collaboration on homework is to discuss how to do the problems, but to not actually look at completed work of your friends, until after you have fully worked out the problem yourself.
- Verbally comparing final answers is OK. Inspecting a friend's incomplete work to identify an error or recommend a next step in the problem is on the borderline of academic misconduct and should be done with caution. It should only be done (a) after you have completed the problem; (b) without sharing your written work; and (c) help should be given on the concepts underlying the problem; in other words, the answer should not be provided, and the detailed steps to the solution should not be provided. Instead, ask questions that might help correct your friend's thinking, or point to the general area of the problem where they are stuck or wrong and suggest work on "this portion" of the problem. If a term is negligible and your friend does not realize it, work with them and explain why the term is negligible and under what circumstances it might not be negligible.
- Each student should write out the final calculation for themselves, and calculate any quantities using their own calculator or spreadsheet. This includes excel calculations – while working together to get the basic idea of a numerical problem, the final parameter adjustments and graphs should be done individually.

Cheating lowers the morale of all students and makes grading less fair. If you are aware of cheating, use of solution manuals, or academic misconduct, please report it to the instructor.

[1] https://dos.uiowa.edu/policies/code-of-student-life/

[2] https://www.engineering.uiowa.edu/current-students/undergradute-students/academic-advising/academic-policies-and-procedures/academic

What are the consequences for academic misconduct in this course?

- Cheating on a midterm or final exam will result in an F in the course.
- Homework or in-class activities that have been copied from another student, a solution set, Chegg, etc. will be assigned a zero. A repeat offense will result in a zero for this portion of the class (e.g. a zero for all homework and in-class activities).
- Cheating on projects or papers will result in a zero for the Ethical Case Studies, Demonstration Reviews, Jove Video Reviews, and Topical Papers portion of the class.
- The instructor will provide written documentation of every infraction to the Associate Dean for Academic Programs.
- If academic misconduct is suspected by the instructor, College of Engineering policies will be used to investigate and (if needed) take action in terms of repercussions against the student.
    - A discussion with the suspected student will be held. If the suspicion of academic misconduct cannot be cleared by the discussion, it will be documented in writing, a zero will be assigned to the appropriate portion of the class, and the documentation will be submitted to the Associate Dean for Academic Programs. The student may appeal to the Dean's office. For 2nd offenses, the Dean's office may take additional actions against the student (cancellation of the student's registration, disciplinary probation, suspension from the College, or recommendation of expulsion from the University).

If you can't fly then run.
If you can't run then walk.
If you can't walk then crawl.
But whatever you do, you have to keep moving forward.
— Martin Luther King Jr.

https://www.youtube.com/watch?v=7p_eKV3SzwE

The above schedule and procedures in this course are subject to change in the event of extenuating circumstances.