ILLINOIS | Department of Civil and Environmental Engineering

UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Grainger College of Engineering
DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

CEE 331 – FLUID DYNAMICS IN THE NATURAL AND BUILT ENVIRONMENT

Fundamentals of fluid motion and transport processes in the natural, managed, and built environment. Focus on physical understanding of the behavior of fluids for applications in natural and engineering challenges. Hydrostatics, dimensional analysis, equations of incompressible fluid motion, open channel flow, flow in porous media, groundwater, pipe flow, boundary layers, drag and lift, turbulence, fluids and energy, are covered within a global context to emphasize the role of fluid dynamics on the environment within the framework of the hydrologic cycle in nature and in the built environment.

COURSE INFORMATION:

Course:	CEE331 – Fluid Dynamics in the Natural and Built Environment
Department:	Civil and Environmental Engineering
Meeting time:	Lectures: 11:00-11:50 Monday, Wednesday & Friday
Lab sessions:	FD1, Monday 15:00-16:50 FD2, Thursday 10:00-11:50 FD3, Tuesday 13:00-14:50 FD4, Wednesday 12:00-13:50 FD5, Wednesday 15:00-16:50 FD6, Tuesday 15:00-16:50 FD7, Thursday 08:00-09:50
Meeting location:	Lecture: CEEB 1017 – Lab A: CEEB 0030; Lab B: CEEB 1015
Credits:	4 hours
Prerequisites:	TAM 211. Credit or concurrent registration in TAM 212.
Website:	Canvas https://canvas.illinois.edu/courses/69994
Instructor:	Rafael O. Tinoco, Ph.D. Associate Professor Department of Civil and Environmental Engineering University of Illinois at Urbana-Champaign 3028 Hydrosystems Laboratory (CEEB) 205 N Mathews Ave. Urbana IL 61801 Office phone number: (217) 265-6931 Email: tinoco@illinois.edu
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Office hours:	Monday	12:00-13:00	CEEB 2015
	Monday	13:00-14:00	CEEB 2015
	Tuesday	12:00-13:00	NCEL 3310
	Tuesday	13:00-14:00	CEEB 3017
	Wednesday	12:00-13:00	CEEB 3028
	Wednesday	14:00-15:00	CEEB 3017
	Thursday	13:00-14:00	NCEL 3310
	Friday	14:00-15:00	CEEB3017

Contact: Email strongly preferred. Please **include "CEE331" as the subject** in all communications. I'll read emails within 9am-5pm and will do my best to reply within 24 h. If you don't receive a response after 2 days, please send a reminder.

1. Course Description

Fundamentals of fluid motion and transport processes in the natural, managed, and built environment. Focus on physical understanding of the behavior of fluids for applications in natural and engineering challenges. Hydrostatics, dimensional analysis, equations of incompressible fluid motion, open channel flow, flow in porous media, groundwater, pipe flow, boundary layers, drag and lift, turbulence, fluids and energy, are covered within a global context to emphasize the role of fluid dynamics on the environment within the framework of the hydrologic cycle in nature and in the built environment.

Lectures will focus on covering fundamental processes of fluid dynamics in a global societal and environmental context. We will provide students with a clear and direct connection between the materials covered and why they need to know them. For example, pipe flow in the context of the risks of contamination on a water supply network (e.g., Flint Michigan crisis), drag forces in the context of flood and coastal protection (e.g., damage by Hurricane Sandy), rapidly varying flow in the context of preventing drowning on low-head dams (e.g., Glenn Palmer Dam, Yorkville, IL). Lab projects will not only provide experiential learning related to engineering design, but will also provide team and leadership experience, computational and data analysis skills, and improve technical writing and communication skills while incorporating the pedagogical concept of writing to learn. Student-collected data will be used during lectures to emphasize the relevance and usefulness of their laboratory efforts.

2. Learning objectives

- Students will be able to apply knowledge of fundamentals of fluid dynamics on the context of Civil and Environmental Engineering challenges.
- Students will be able to describe the physical properties of fluids, how such properties are relevant for life and flow-biota interactions, and how they affect fluid flows in natural and man-made systems.
- Students will apply conservation principles of mass, linear momentum, and energy to solve fluid problems in water systems.
- Students will learn the physical principles needed in the design of dams, water networks, in-stream structures, turbomachinery, flood protection infrastructure, hydrokinetic and wind energy structures, among others.
- Students will be able to explain flow interactions in the context of the water cycle, from groundwater processes to surface flows and their interaction with the ecosystem.
- Students will learn about flows in urban areas, from flooding challenges, to heat island effects and urban boundary layers.
- Students will identify and calculate the forces exerted by static and moving waters, and learn design criteria for structures to withstand and/or utilize such forces.
- Students will develop leadership and teamwork skills as they rotate roles as leader (coordinating team member activities), scribe (preparing the final version of written assignments to be submitted), editor (reviewing the final solution for accuracy and responsible for submission), and monitor (to make sure everyone understands the procedures and solutions submitted), while working in their homework assignments and laboratory projects motivated by realistic engineering scenarios.
- Students will develop their data analysis skills using data analysis software, such as Excel, R, Matlab, and/or Python.
- Students will develop their technical writing skills. Advanced composition aspects will be addressed through assessment of laboratory reports, focusing on technical writing.

3. Course Outcomes

The learning objectives listed above contribute to the curriculum outcomes (ABET 1-7) by fostering:

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.

4. Course Mechanics

4a. Lecture:

- We'll have three 50-minutes sessions a week. Required and suggested readings will be posted online in advance and discussed during the lecture. We will also provide a list of additional, recommended readings. Lecture slides will be posted **before** each lecture. Some examples and additional material covered during the lectures will not be in the slides. It is the responsibility of each student to take notes.
- Online lectures: Lectures will be recorded. You can request access to the recordings in case you have to miss a lecture, or if you want to review the material. **Recordings are NOT a substitute for attending lectures in person.** Videos will be available through Illinois mediaspace: https://mediaspace.illinois.edu/. This is not an online course. If a lecture is not recorded due to technical problems, is the students' responsibility to ask their classmates for their lecture notes in case they missed some material.

4b. Assignments:

- Individual weekly assignments will take place throughout the semester to reinforce the technical and mathematical concepts from class. Assignments will be a combination of textbook-like problems, conceptual questions, and data-driven exercises. The goal of assignments is to enhance understanding of course content and to develop analytical and computational skills. **Practice, practice, practice!**
- Guidelines for assignment reports will be provided in Canvas. Homeworks will be available in PrairieLearn. Link for PrairieLearn will be provided in Canvas. Homework assignments are **individual**. However, you can discuss the problems with your classmates. Please read carefully the HW guidelines and the use of AI section in this syllabus.
- Assignments are due by the end of the due day (11:59pm) unless otherwise specified in Canvas. A 24 hour, no-questions-asked extension is automatically granted with no grade deduction if you need it. No late assignments (past the 24h automatic extension) will be accepted except for documented cases of extenuating circumstances or emergencies (see relevant university policies). If you will be traveling or have any conflicts with the schedule, please plan in advance and contact the instructors in advance.

- Office hours are provided for you to: 1) ask questions about topics covered during lectures or labs, and 2) to ask questions about the assigned homeworks **AFTER** you have tried solving them. We are there to assist you, but you should try your best first (we already know how to solve them, our goal is for you to learn how to do it!).

4c. Laboratory

- Each team will have one 2-hour laboratory session every week. Seven laboratory sessions will be conducted. Each laboratory project will take place over two weeks. The first week (week A) is dedicated to experiment execution and data collection. The second week (week B) is for assistance with post-processing, data analysis, and writing your technical report. Laboratory A sessions will meet at the Environmental Fluid Mechanics Lab (CEEB 0030) unless otherwise specified by the instructors. Lab sessions B will meet at CEEB 1015.
- Laboratory reports will be due at the beginning of your next lab session (e.g., Lab report 1 is due before you start your Lab 2). Each team should submit one report (single pdf file) as a team. Report should be submitted through Canvas. Reports will be graded based on both technical content and presentation. For technical content, it must include a brief **Introduction**, a detailed **Methods** section, a **Results** section incorporating visual and verbal representation of the findings, a **Discussion** section stating the relevance of the phenomena investigated in the lab session, and a **Conclusion** section describing what was learned. Presentation will be assessed based on the format of tables and figures, as well as clarity of the written report.
- Participation in the laboratory sessions is **mandatory**. If a student misses their session for a justifiable reason, they can reschedule to attend with another team. If a student can't reschedule during that week, they can still work on the report with their team, but the student who didn't attend the lab session will get a 50% reduction of their grade for that report (the other team members won't be affected).

4d. Mini-Exams

- There will be four in-class in-person exams. These exams are individual. Topics covered by each exam will be described in class. Exams will be closed book, but a one-page (front and back) hand-written sheet of notes will be allowed. You can use a calculator (any type). The note-sheet must be submitted with the exam (you'll get it back afterwards). The use of wearable electronics (smart watches, smart glasses, etc.) to assist you in solving the exam is not allowed. Exams will be time limited (we only have the time of the lecture 11:00-11:50). The goal of the exams is to test your understanding of fundamental concepts and your ability to solve simplified problems. **All students are expected to abide by the University Academic Code of Integrity.**

4e. Mini-Projects

- There will be two take-home mini-projects. You will work in teams (same as lab teams). The goal of the mini-projects is to test your ability to use your fluid mechanics training to design solutions to simplified engineering problems. Mini-projects should be submitted through Canvas (only one report per team). **All students are expected to abide by the University Academic Code of Integrity**.

4f. Final Exam

- The final exam will be comprehensive, in-person, closed book, at the time and place determined by the University. You can only use a calculator (any type) and your 4 note sheets from the mini-Exams (or a new one). **All students are expected to abide by the University Academic Code of Integrity**.

4g. Attendance and participation

- Students are expected to attend and actively participate during class discussions. As engineers and scientists, you should be able to work collaboratively and communicate and

express your ideas in both technical and layman terms. Class participation is a unique way to practice such professional skills.

4h. Grading

There is no curve-grading in the course. Your grade depends only on your work. We'll use the percentages below to calculate your final grade.

Homework (~13, individual weekly assignments)	15%
Lab reports (6, biweekly, in teams)	15%
Mini-Exams (4 in-class, individual)	25%
Mini-projects (2 take home, in teams)	15%
Final exam (individual)	30%
Total	**100%**

Letter grades will be assigned as follows:

A	93.0 – 100%	B-	80.0 – 82.9%	D+	67.0 – 69.9%
A-	90.0 – 92.9%	C+	77.0 – 79.9%	D	63.0 – 66.9%
B+	87.0 – 89.9%	C	73.0 – 76.9%	D-	60.0 – 62.9%
B	83.0 – 86.9%	C-	70.0 – 72.9%	F	00.0 – 59.9%

4i. Policies on re-grading

If you consider there is a mistake in how your work was graded, notify your instructor **within one week** of receiving your graded material. Late requests will not be considered. Do not alter your assignment in any way – if you need to write notes to clarify what you want regraded, do so on a separate document or piece of paper. Notify your instructor in writing clearly specifying the parts that you want to be regraded.

5. Learning resources:

5a. Key readings

No textbook is required. An extensive set of lecture notes will be provided. Manuscripts from scientific journals and news articles will be assigned as required reading for discussion. You can consult ANY Fluid Mechanics textbook for reference. Some are freely available online through the Library. Suggested reading materials (not required to buy them) include:

- Life in Moving Fluids. 2nd Edition, Vogel, Princeton University Press (recommended for accessible concepts and examples).
- Fluid Mechanics, 8th Edition, White, McGraw Hill (recommended for sample exercises and applications).
- Fundamentals of Fluid Mechanics, 8th Edition, Munson, Young & Okiishi, Wiley (recommended for sample exercises and applications).

5b. Software

Some assignments will benefit from the use of computer analysis software. While you can solve most of them with a calculator, you are encouraged to explore capabilities of Excel, R, Python, Matlab, or Matlab-like open-source alternatives (e.g., Octave or FreeMat). We will provide limited discussion during the lectures, and will provide links for online tutorials when appropriate.

5c. Online recordings

Lectures will be recorded and made available at https://mediaspace.illinois.edu/. They will be made available **if needed.** Recordings are NOT a substitute for attending the lectures.

5d. Use of Artificial Intelligence (AI) tools, Large Language Models (LLM), and Generative Pre-trained Transformers.

In this class, you will be engaging with readings, analyzing sources, synthesizing information, solving problems, and sharing your results through writing. AI can help with some scholarly tasks, but not all. The policies below will help you gain key scholarly skills while using AI ethically and thoughtfully. Please keep in mind that this course policy may be different from your other courses. Unauthorized uses of AI in this course will be considered a violation of the code of academic conduct. If you are unsure if you can use AI for a course-related task, please email your instructor.

Permitted Uses of AI:

As you brainstorm ideas for your assignments, you may use generative AI tools to:

- Transcribe speech to text to create a rough draft
- Ask you questions about the material to test your understanding
- Suggest possible examples and applications
- Create an outline for your assignments

When summarizing and analyzing materials, you may use generative AI:

- Extract text from images
- Explain general concepts
- Translate your ideas from another language into English
- Suggest guidelines to generate code for visualizing or analyzing data

As you work on your assignment, you may use AI tools to:

- Suggest alternate phrasing
- Correct punctuation and grammar
- Create topic sentences for paragraphs
- Transform citations from one style into another
- Suggest titles for your essay

Below are examples of commonly used tools. Keep in mind that accuracy and privacy settings vary from tool to tool:

- Chat Illinois
- ChatGPT 4.0mini (free) or 5.0 (subscription)
- Google Doc's "Help me write" feature (free with agreement to participate in Labs)
- Google Doc's Text-to-Speech tool

If you use AI as part of your assignment, you must document your use.

Prohibited Uses

Although generative AI can be a helpful writing tool, it can undermine the ways that you engage with the material in this course. In this class, the following behaviors are prohibited:

- **Present AI-generated content as your own without citation**
  Why? When uncited, presenting generative AI outputs as your own ideas can be considered plagiarism by "representing the words, work, or ideas of another as your own." This is considered a violation of the academic code of conduct.
- **Include personally identifiable or sensitive information about yourself, your instructor, or your classmates in AI prompts**
  Why? Some (but not all) AI tools use the information that you provide to further train the models. Including sensitive information like your name or address can compromise your safety and privacy.
- **Include sources cited by AI without reviewing them**
  Why? Because GPTs can hallucinate sources, they can inadvertently lead to fabrication, which the Provost's Office defines as "the falsification or invention of any information, including citations." This is also considered a violation of the academic code of conduct.

- **Rely exclusively on AI-generated summaries of content**
  Why? Large language models know which words are likely to appear together, but they don't understand the meaning of the words. This means that LLMs can sometimes create summaries that are inaccurate. If you use an AI tool to summarize material that you want to include in one of your assignments, you must also read the source and evaluate the quality and accuracy of the article. You are also expected to identify which parts of the article are relevant to your own interests.
- **Rely exclusively on scholarly articles or resources suggested by AI**
  Why? GPTs are pretrained, so they don't always have access to the latest information. Some generative AI tools can search the internet, but they can point you to sources that are inaccurate or incomplete. The library catalog or a subject guide offers access to reliable information and a wider range of sources.

If you are unsure if you can use AI for a course-related task, please email your instructor.

Citing AI

Documentation and citation are vital parts of good scholarship. The citation practices below promote transparency while also showcasing how you reviewed and engaged with AI-generated content.

For short assignments, if you use AI-generated content, a short label will meet the requirements for transparent use. Here's a sample:

"Includes content generated by ChatGPT"

For assignments that require a bibliography, you are expected to cite any tools that you used to generate and review your written work. Here's an example of how to properly format these citations:

APA: OpenAI. (2023). ChatGPT (Mar 14 version) [Large language model]. https://chat.openai.com/chat

MLA: "Write a civil war letter from the point of view of a dying 3D printer." prompt. ChatGPT, 13 Feb. version, OpenAI, 8 Mar. 2023, https://chatgpt.com/share/6fe6d8a3-23f1-42b2-89c7-fd938929198b

Chicago: ChatGPT, response to "Pretend that you are a Victorian scientist. Give me 5 names for mythical creatures that have been recently observed.," OpenAI, March 7, 2023. https://chatgpt.com/share/ef6bd888-072a-4489-84d6-36a396f5073e.

Check out the links below for more detailed guidance.

- APA Style Blog: How to cite ChatGPT
- MLA Style Center: How do I cite generative AI in MLA style?
- The Chicago Manual of Style Online: Citation, Documentation of Sources, ChatGPT

5e. Policy on pictures and videos

We want our lectures, labs, and office hours to be a safe space for all of us to feel comfortable asking questions and discussing the materials of the course.

- We ask you to **not** take photos or videos of the lectures, your classmates, or your instructors, and specially not posting them online. The (incomplete) slides and the video recordings of the lectures will be available to all registered students if you want to revisit part of the lectures.

- You can take pictures and videos of your lab experiments and demos (fluid mechanics is cool!). Do not post them online unless you have consent from every person shown in the video.

5f. Policy on posting course material online.
We have prepared lecture slides, homework questions, exam and project questions for students registered in this course. **Posting any of our course material in other websites is not allowed and will be considered in violation of the code of academic conduct**.

6. COURSE POLICIES

Absence Policy
The Student Code outlines those circumstances in which a student may be eligible to obtain a letter from the Office of the Dean of Students for missed class. When eligible, students must submit an absence letter request within two weeks of returning to class following the absence.

Sexual Misconduct Reporting Obligation
The University of Illinois is committed to combating sexual misconduct. Faculty and staff members are required to report any instances of sexual misconduct to the University's Title IX Office. In turn, an individual with the Title IX Office will provide information about rights and options, including accommodations, support services, the campus disciplinary process, and law enforcement options.

A list of the designated University employees who, as counselors, confidential advisors, and medical professionals, do not have this reporting responsibility and can maintain confidentiality, can be found here:
wecare.illinois.edu/resources/students/#confidential

Other information about resources and reporting is available here:
wecare.illinois.edu

Academic Integrity
The University of Illinois at Urbana-Champaign Student Code should also be considered as a part of this syllabus. Students should pay particular attention to Article 1, Part 4: Academic Integrity. Read the Code at the following URL:
http://studentcode.illinois.edu/

Academic dishonesty may result in a failing grade. Every student is expected to review and abide by the Academic Integrity Policy:
https://studentcode.illinois.edu/article1/part4/1-401/.
Ignorance is not an excuse for any academic dishonesty. It is your responsibility to read this policy to avoid any misunderstanding. Do not hesitate to ask the instructor(s) if you are ever in doubt about what constitutes plagiarism, cheating, or any other breach of academic integrity.

Violations of the student code in an assignment or exam will result in a grade of zero in that assignment and students will be referred for disciplinary action. Altering assignments or exams to request regrading will result in a grade of zero in that assignment and students will be referred for disciplinary action. Repeated violations (N>1) will result in a failing grade of the course (F) and students will be referred for disciplinary action.

Religious Observances
Illinois law requires the University to reasonably accommodate its students' religious beliefs, observances, and practices in regard to admissions, class attendance, and the scheduling of examinations and work requirements. You should examine this syllabus at the beginning of the semester for potential conflicts between course deadlines and any of your religious observances. If a conflict exists, you should notify your instructor of the conflict and follow the procedure at:
https://odos.illinois.edu/community-of-care/resources/students/religious-observances/
to request appropriate accommodations. This should be done in the first two weeks of classes.

Disability-Related Accommodations
To obtain disability-related academic adjustments and/or auxiliary aids, students with disabilities must contact the course instructor and the Disability Resources and Educational Services (DRES) as soon as possible. To contact DRES, you may visit 1207 S. Oak St., Champaign, call 333-4603, e-mail disability@illinois.edu or go to https://www.disability.illinois.edu/. If you are concerned you have a disability-related condition that is impacting your academic progress, there are academic screening appointments available that can help diagnosis a previously undiagnosed disability. You may access these by visiting the DRES website and selecting "Request an Academic Screening" at the bottom of the page.

Family Educational Rights and Privacy Act (FERPA)
Any student who has suppressed their directory information pursuant to Family Educational Rights and Privacy Act (FERPA) should self-identify to the instructor to ensure protection of the privacy of their attendance in this course. See https://registrar.illinois.edu/academic-records/ferpa/ or more information on FERPA.

Emergency Response Recommendations
Emergency response recommendations can be found at the following website: https://police.illinois.edu/services/campus-safety-tips/. I encourage you to review this website and the campus building floor plans website within the first 10 days of class. https://www.police.illinois.edu/em/mitigation/emergency-action-plans/

Anti-Racism and Inclusivity Statement
The Grainger College of Engineering is committed to the creation of an anti-racist, inclusive community that welcomes diversity along a number of dimensions, including, but not limited to, race, ethnicity and national origins, gender and gender identity, sexuality, disability status, class, age, or religious beliefs. The College recognizes that we are learning together in the midst of the Black Lives Matter movement, that Black, Hispanic, and Indigenous voices and contributions have largely either been excluded from, or not recognized in, science and engineering, and that both overt racism and micro-aggressions threaten the well-being of our students and our university community.

The effectiveness of this course is dependent upon each of us to create a safe and encouraging learning environment that allows for the open exchange of ideas while also ensuring equitable opportunities and respect for all of us. Everyone is expected to help establish and maintain an environment where students, staff, and faculty can contribute without fear of personal ridicule, or intolerant or offensive language. If you witness or experience racism, discrimination, micro-aggressions, or other offensive behavior, you are encouraged to bring this to the attention of the course director if you feel comfortable. You can also report these behaviors to the Bias Assessment and Response Team (BART) [https://diversity.illinois.edu/report-an-incident/]. Based on your report, BART members will follow up and reach out to students to make sure they have the support they need to be healthy and safe. If the reported behavior also violates university

policy, staff in the Office for Student Conflict Resolution may respond as well and will take appropriate action.

Support Resources and Supporting Fellow Students in Distress
As members of the Illinois community, we each have a responsibility to express care and concern for one another. If you come across a classmate whose behavior concerns you, whether in regards to their well-being or yours, we encourage you to refer this behavior to the Student Assistance Center (1-217-333-0050) or online at

odos.illinois.edu/community-of-care/referral/

Based upon your report, staff in the Student Assistance Center reaches out to students to make sure they have the support they need to be healthy and safe. Further, as a Community of Care, we want to support you in your overall wellness. We know that students sometimes face challenges that can impact academic performance (examples include mental health concerns, food insecurity, homelessness, personal emergencies). Should you find that you are managing such a challenge and that it is interfering with your coursework, you are encouraged to contact the Student Assistance Center (SAC) in the Office of the Dean of Students for support and referrals to campus and/or community resources. The SAC has a Dean on Duty available to see students who walk in, call, or email the office during business hours. For mental health emergencies, you can call 911 or contact the Counseling Center

Disruptive Behavior
Behavior that persistently or grossly interferes with classroom activities is considered disruptive behavior and may be subject to disciplinary action. Such behavior inhibits other students' ability to learn and an instructor's ability to teach. A student responsible for disruptive behavior may be required to leave class pending discussion and resolution of the problem and may be reported to the Office for Student Conflict Resolution (https://conflictresolution.illinois.edu; conflictresolution@illinois.edu; 333-3680) for disciplinary action.

Mental Health
Significant stress, mood changes, excessive worry, substance/alcohol misuse or interferences in eating or sleep can have an impact on academic performance, social development, and emotional wellbeing. The University of Illinois offers a variety of confidential services including individual and group counseling, crisis intervention, psychiatric services, and specialized screenings which are covered through the Student Health Fee. If you or someone you know experiences any of the above mental health concerns, it is strongly encouraged to contact or visit any of the University's resources provided below. Getting help is a smart and courageous thing to do for yourself and for those who care about you.

- Counseling Center (217) 333-3704
- McKinley Health Center (217) 333-2700
- National Suicide Prevention Lifeline (800) 273-8255
- Rosecrance Crisis Line (217) 359-4141 (available 24/7, 365 days a year)

If you are in immediate danger, call 911.

Important dates
Please check the calendar at:
https://senate.illinois.edu/a_calendar.asp
for deadlines to add and drop courses, as well as elect and change credit/no credit options.

7. Course content.

Specific dates will be provided in Canvas at the beginning of each semester. Changes might occur due to unexpected circumstances (see part 6. Course Policies).

Topic
Introduction No water, no life. Description and quantification of fluid properties that allow life in our planet (3 hrs)
We all live within a fluid. Hydrostatics and kinematics, buoyancy and stability (5 hrs)
Making water work for you - 1. Conservation of mass and momentum from a control volume approach. The mighty energy equation (7 hrs)
Mathematics as the language of fluids. Conservation of mass, momentum, and energy from a differential approach (2 hrs)
It's a turbulent world. Mathematical description of fluid motion, Navier-Stokes equation and fundamentals of turbulence (3 hrs)
Mathematics as the language of fluids. Dimensional analysis and similitude for fluid problems. The importance of non-dimensional parameters: Froude, Reynolds, Strouhal (2 hrs)
Water challenges: providing a safe water supply. Pipe flow, major and minor losses, pipe networks (5 hrs)
Living in a moving fluid 1: from stream to atmospheric boundary layers. Laminar and turbulent boundary layers, shear in outer flows (2 hrs)
Living in a moving fluid 2: using nature to inform our engineering designs. Drag and lift (1 hrs)
Living in a moving fluid 3: Fundamentals of flow-biota interactions and ecohydraulic engineering challenges (1 hrs)
From substrate to surface: Groundwater. Fundamentals of porous media, water table, Darcy's law (1 hrs)
From river management to river restoration to river naturalization 1: Fundamentals of open channel flow (2 hrs)
From river management to river restoration to river naturalization 2: work in urbanized streams (2 hrs)
From river management to river restoration to river naturalization 3: applications for flood protection alternatives in a changing climate (1 hrs)
Power challenges: environmental flows as a reliable source of clean energy. Fundamentals of hydrokinetic, wind, tidal, and wave turbines (2 hrs)