CEE 452 – Hydraulic Analysis and Design

Spring 2026 - Course Syllabus

Meets 3:00 – 4:50 PM, Tuesday/Thursday

2015 CEE Building

Table 1.—Instructor Information

Professor: Arthur Schmidt
Office: 2022 CEE Building (Hydro Lab)
Email: aschmidt@illinois.edu
Cell: 217.649.9561
Office Hours: TBD or by appointment

Course Description and Objectives

This course focuses on the engineering analysis and design of hydraulic systems including open and closed conduits, pipe networks, control structure, stilling basins and scour control structures, and hydraulic machinery. As a design course, the principles of hydraulic analysis and design are presented in the context of the design of two hydraulic systems—one pressurized flow network and one free-surface system.

Objectives: My overall objective for this course is that you learn how to appropriately apply scientific fluid mechanics principles, empirical knowledge, and numerical methods to critically evaluate hydraulics problems encountered by civil and environmental engineers. These will include problems related to water distribution, water-excess management, and environmental protection. Because of the complexity of many hydraulic systems, engineers often rely on numerical methods to approximate the behavior of these systems under different conditions. I have designed this course to provide you opportunity to get instruction and hands-on experience in applying some of the most commonly used models and methods to realistic engineering problems. In particular, I want you to experience and work through some of the pitfalls associated with these models and methods. The resulting background and experience with these tools will allow you recognize circumstances that violate the assumptions behind the methods you are using and guide you to appropriately select an alternative approach. Students should be able to design open-channel and closed conduit systems that address a water resources problem and that also address a variety of potentially competing stakeholder objectives.

Learning Outcomes: The Accreditation Board for Engineering and Technology (ABET) has documented seven learning outcomes that need to be attained to prepare students for professional engineering practice. The materials and exercises in CEE 452 address the following ABET outcomes:

1) an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics. [homework and projects]
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. [projects]
3) an ability to communicate effectively with a range of audiences. [project reports]
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. [addressing stakeholder criteria in projects]
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. [project and homework teams]

6) an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions. [projects—identifying alternatives from manufacturer specifications and using these in design]
7) an ability to acquire and apply new knowledge as needed, using appropriate learning strategies. [projects—students need to self-learn materials for design in advance of class presentation]

The course emphasizes applying the materials presented in class to real-world engineering calculations. **Regular attendance is therefore expected**, since the material presented in class will provide much greater detail than the text or supplemental material. The course will include two half-semester design projects that will require the students to apply the principles from class, as well as their own independent study, to develop an engineering design to address the objectives of the project. The projects will be done in self-selected teams of approximately 3-4 students.

Course Resources

Course Notes: CEE 452 course packet available on Canvas

Additional References you may find useful:

- Mays, L.M. (ed.), (1999). "Hydraulic Design Handbook", McGraw Hill, (available on-line through UIUC library)
- Houghtalen, Akan and Hwang, Fundamentals of Hydraulic Engineering Systems, Pearson, New York.
- Julien, Pierre, Essentials of Hydraulics. Cambridge University Press, 2022
- Roberson, J.A., Cassidy, J. J., and Chaudhry, M., (1998). "Hydraulic Engineering (2nd Edition)". John Wiley & Sons, Inc.
- Mays, L.W., (2011). "Water Resources Engineering (3rd Edition)", John Wiley & Sons, Inc
- Additional reference materials are available on the course web site.
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Class Participation: I encourage you to pose questions and comments about the class material and relevant water-resources issues before, during, and after class. Various activities will be included during the lecture-discussion time to facilitate discussion with both the instructor and your peers. In particular, the on-line discussion area is on-line student's greatest opportunity for participation. Twelve percent of your semester grade will reflect your participation in in-class exercises, classroom discussion, Student Hours, and on-line discussions.

Learning Management System: *Canvas*: Supplemental instructional materials for this course will be delivered to you via the *Canvas* LMS. Canvas contains a variety of different modules, including supplemental references, various design manuals and manuals of practice, commonly used software, links to related web sites, homework assignments and solutions, example problems, etc. You may access the course website using an Internet browser at https://canvas.illinois.edu/.

You will need to login using your NetID and your NetID password. Some help resources are available at https://online.illinois.edu/getting-started/learning-management-systems/canvas to get you started with Canvas.

On-line exercises and Exams: PrairieLearn:

For many of the exercies in CEE 452 we will use PrairieLearn. Here is a [link to enroll in PrairieLearn for CEE 452]

On-line Discussion Forum:

This term we will be using the Discussions tool in Canvas for class discussion. Rather than emailing questions to the teaching staff, I encourage you to post your questions on *Discussions*. If you send class-related questions to the instructors via e-mail we will re-direct you to *Discussions* so that your classmates can benefit from the discussion and so that you have the opportunity to respond (and thereby learn) from the discussion. Naturally, if you have a personal or sensitive issue, you should use email rather than *Discussions*.

Course Topics

A detailed account of topics to be covered in the course is presented at the end of this document (Table 5), and a topic summary is presented in Table 2 below.

Table 2.—Overview of Course Topics

<table>
<tr><th>Review of Fluid Mechanics</th><th>Pressurized flow systems, cont'd.</th></tr>
<tr><td>Fluid properties
Hydrostatics
Hydrodynamics
Conservation of mass
Conservation of momentum
Conservation of energy</td><td>Other Components
Storage
Valves
Simulation of water distribution system</td></tr>
<tr><th>Pressurized flow systems</th><th>Free-surface flow systems</th></tr>
<tr><td>Flow in pipes
Head losses
Simple networks
Network equations
Pumps
Pump types
Pump performance
Pump selection</td><td>Open-channel flow
Steady, uniform flow
Steady, non-uniform flow
Control structures
Alluvial channels
Channel scour
Stilling basins
Simulation of free-surface system</td></tr>
</table>

Course Expectations

Students are expected to:

1. Arrive on time and contribute actively to classroom discussions. On-line students are expected to watch the on-line lectures no later than midnight on the day after the scheduled lecture date and to contribute actively to meetings and discussions of their project team.
2. Attend each lecture, lab, in-class homework session, and project team session.
3. Contribute actively to your project team. On-line students are expected to use on-line tools to continue to actively contribute to your project team. This includes *In-class exercises, homework*, and work on your semester project deliverable. The details of the on-line tools will be provided in the first session of this class.
4. Refrain from distracting practices, e.g., conversations with classmates, watching movies, working on homework, texting, or browsing on your computer during lectures. These activities hinder your ability to learn the material and impact the learning of your classmates.
5. Communicate ideas, questions, and concerns promptly to the instructor. This will help you as well as other students in the class.

The instructors are committed to:

1. Arrive on time and contribute actively to classroom discussions.
2. Being well prepared on course subject materials.
3. Provide clear explanations and examples.
4. Help to assess each student's abilities and areas of growth.

5. Provide relevant and challenging homework and in-class exercises, quizzes, and exams.
6. Maximize the potential for learning by giving useful and timely feedback. The instructors will provide additional resources (e.g., on-line office hours, supplemental videos) to provide on-line as well as in-person students with timely feedback to questions.
7. Start and finish class on time.
8. Maintain a positive, respectful learning environment.

Class Format

This course has scheduled meeting times for approximately four hours per week (Tu/Th 3:00 to 4:50). These class sessions will include some lecture/discussion to present key topics, coupled with time for students to work on:

- In-class exercises;
- Homework;
- Computer lab sessions; and
- Semester project activities.

The in-class work times are designed so that students can work on a variety of problems with the instructor available to answer questions and provide mentoring. Table 5 at the end of the document provides a weekly breakup of class activities. Note that this schedule is tentative and subject to change to maximize students' learning. Project lab sessions will demonstrate and train students on the required software packages that will be needed for the semester project. Team project activities include regular time for students to work on their project teams and guest speakers. The instructors and TA will also be available during these sessions to provide guidance.

For online students, the course format will be a mix of synchronous and asynchronous on-line instruction. Feedback from other courses indicates that many students prefer synchronous instruction and the options this provides to ask questions during the lecture. However, many students also have other obligations and may not be able to participate in synchronous on-line discussions. Links to the *Zoom* meetings for course lecture/discussion sessions are available in *Canvas*. These discussions will be recorded and posted to the *Illinois MediaSpace* server and linked from *Canvas*. (link in the course homepage on *Canvas*). For assignments that allow group/team submission, I will enable breakout rooms in *Zoom* to facilitate team collaboration on in-class work. Some of the specialized software used in the course is available in the Mechanical Engineering Workstation Lab. Much of the software also is available for *Windows* users to download and install on their computers.

Student Hours (Free-form coaching that someone already paid for; some call this *Office Hours*):
I strongly believe that a key to learning is to give problems and then provide coaching to the students as they work through these problems. This provides opportunity for individualized instruction on the issues that are most challenging to you. I plan to use the Ben Yen Library (2008 CEEB, which is the conference room at west end of the 2nd floor of the CEE Building) for these meetings.

Zoom. All lectures and office hours for this course will also have a *Zoom* session enabled to allow on-line students access. The Zoom session links are imbedded within the *Canvas* course web site. Using your Illinois e-mail address, login to *Canvas* and go to the *Zoom* Link on the course Homepage to locate the appropriate *Zoom* link (listed by date for each class session). Be sure to update your *Zoom* software regularly, so you can take advantage of all the latest features.

Here is link and information to join Zoom meeting:

https://illinois.zoom.us/j/81004750523?pwd=Atpq5xVtqo0yNbn837X3BPa0T9N3MK.1

Meeting ID: 810 0475 0523

Password: CEE452

Required Technology: All students should have high-speed, reliable Internet connections and a computer that can handle the course software. Some of the software used in this course only runs on Windows computers. We will try to ensure that all project teams have some team members with Windows computers.

The URL for the Zoom Help Center is https://support.zoom.us/hc/en-us.

Evaluation and Grading

Student evaluation will be based on homework exercises, quizzes, two exams, an integrated design project, and in-class activities. The relative weights assigned to each of these components is shown in Table 3.

Table 3.—Course Evaluation and Weights for Grades

Homework	25%
All About Me Video	3%
Mastery exercises	(4% extra credit)
Quizzes (Best 8 of 10)	16%
Exams (2)	24%
Design Projects	32%
Total	**100%**

Homework

This class is going to have two types of 'homework' exercises: *<u>Homework</u>* and *Mastery* exercises. Both serve to give the students an opportunity to develop their technical competency on the lectures and reading materials. The *Homework* exercises provide an opportunity for you to practice and demonstrate your competence on the concepts taught in class. . The *Mastery* exercises are not a required part of your grade but will allow you to earn extra credit points (up to 4% of total semester grade). The *Mastery exercises* will be the same exercises as the *Homework* exercises but will be available throughout the semester to allow you to individually practice these exercises until you have mastered them. The *Mastery* exercises will allow unlimited attempts without penalty. In order to get the full potential credit for the *Mastery exercises,* you will have to successfully complete each exercise at least two times Most of the homework exercises will use the *PrairieLearn* platform because *PrairieLearn* allows students multiple attempts at randomly generated variants of the problem, which helps to develop mastery of each exercise

Homework assignments will be posted at the beginning of class and will be due *at the beginning of class* on the date mentioned on the assignment. While teams are strongly encouraged to work together to learn the concepts of each exercise, all students are expected to **<u>individually</u>** submit their solution to each exercise. Because *PrairieLearn* will generate a unique problem variant for each student, the solution approach will be the same for all students, but each student will have a unique problem variant and solution. **As in professional practice, submissions submitted after the deadline will not be accepted.**

Please note that both the in-class and take-home exercises count towards 25% of the final grade, but each individual exercise contributes a different amount depending on the relative points assigned. Typically, in-class assignments will be weighted as 50% of the value of take-home exercises, but we may have some take-home exercises that are worth more or less points, depending on the difficulty of the assignment.

***All About Me Video Introduction**:* Creating community is a vitally important aspect of meaningful and enjoyable learning. Being a part of a learning community helps students feel more involved and connected, and thus, helps them want to learn the course content more deeply. The goal of the *All About Me* assignment is to help build community in CEE 452 by sharing a little about yourself with your classmates and the instructor. In this assignment you will produce a short video (2 to 4 minutes) in which you tell us a little bit about yourself. Be sure to include your name, where you are from or where you live, what you are currently doing (e.g., 'I'm a junior specializing in WRES with secondary in EWES', 'I'm an on-line M.S. student and work full time at a water-resources consulting company', etc.,), how you got interested in studying Civil & Environmental Engineering, and 3 things you love to do. You will upload your video to the *Media Gallery* on the course *Canvas* website. You are encouraged to watch the videos posted by the instructor and your classmates. The *All About Me* assignment is worth 3% of your final grade.

Quizzes

This class will include multiple quizzes that cover the material presented in lectures and readings. These are due 19 hours after the scheduled end of that day's class time (noon Wednesday or Friday). The objectives of these quizzes are to: 1) promote regular lecture attendance, and 2) encourage students to keep up with lecture material and assigned readings. **We will drop your lowest two quiz scores** in calculating your overall quiz grade. Therefore, there will be **no make-up quizzes, even for valid excuses**. Most of the quizzes will be presented using *PrairieLearn* and often will allow students to re-attempt a problem for partial credit.

Exams

This course will have two exams over the course of the semester. The exams will cover lecture material, content from the on-line course site, handouts, and assigned readings. The format of the exams will be a combination of short answer and worked problems. Any questions regarding your exam score must be discussed with the instructor within one weeks after the exam score is returned to you. Any student registered with the Division of Rehabilitation Services must self identify with the instructor at least one week prior to the first exam.

Exams will be open-book, open-notes, take-home exams provided on-line. These are to be your work alone—you are not to work with or discuss your work with anyone but the instructor! The exams may be a combination of responses to *PrairieLearn* questions and written responses (including spreadsheets, and model results) to more detailed questions. For the latter, students will need to convert/scan their final response to a PDF and return this to me electronically. Supplemental material (spreadsheets, figures, model results) can be other formats that can be delivered electronically, provided you clear the format with the instructor in advance. Please check your submission for completeness and legibility. The exams will be available for a **90-minute to 120-minute window during the scheduled dates of the exam**. Electronic exam submissions need to be received during the exam window and no later than the end time specified on the due date of the exam. In the unlikely event of problems with the on-line course website system, you can email your submission to me with an explanation of the problem you encountered.. Because the end time for the exam is fixed, students need to ensure that they have sufficient time after completing the exam to scan their hand-written work, upload all the files to Canvas, and submit the exam before Canvas closes the submission. The last exam will be scheduled during the final exam period.

Any questions regarding your exam score must be discussed with the instructor *within one week* after the exam score is returned to you. Any student registered with the **Division of Rehabilitation Services** must self-identify with the instructor at least one week prior to the first exam.

Design Projects

This semester you will have two open-ended projects to design a hydraulic system to meet a set of stakeholder criteria. For each project, specific design criteria will be presented in the assignment. However, as an engineer, you need to identify and address additional stakeholder criteria. These may be regulatory criteria that must be met or stakeholder preferences that you should try to consider. However, you may find competing stakeholder criteria. Therefore, you will have to select a preferred alternative among competing possible alternatives.

One of the challenges of a course like this is that we will cover the concepts that you will need to develop your design at the same time you are working on the project. This means that **you will have to do some of your own independent learning** and also **ask me a lot of questions** in order to learn the tools and concepts needed for your design. While this will be frustrating at times, this is often the case in engineering design. In practice you will routinely find that you must do a lot of independent learning to master new concepts necessary for the project you are working on.

Each project will have three deliverables: A *Preliminary Response*, an *Interim Report*, and a *Final Design Report.* The *Preliminary Response* will include a *Team Charter* that identifies the team members, their agreed upon objectives, and their agreed upon code of conduct for the team. The *Preliminary Response* will also include an analysis of the current conditions, a discussion of the stakeholders and their values. The *Interim Report* should have a near final design that I can review and provide feedback on and also a draft cost estimate.

The first half of the semester you and your team will design a potable water distribution system. This design will be to provide water supply for a small development. This project is built on the water distribution system for Magnetic Island, which is part of the city of Townsville in Queensland, Australia. This system is one of the only EPANET input files in the public domain. I have modified the existing model to deliberately build in some deficiencies that you will need to identify and address. However, to make this more interesting, I have added both growth to the local population and a proposed new water user that will further stress the system. You will need to do some research to determine reasonable, data-based estimates of the future demands on the system. This project should provide an interesting set of challenges and possibilities. You will have to determine the specifications for the components needed (pipes, pumps, storage, valves) and the layout of these components. While there are many layouts that will provide the necessary flows and pressures, the challenge is to meet other criteria (cost, resilience, capacity for future growth, etc). In engineering practice we rarely start with a 'blank slate'. The majority of engineering projects involve existing infrastructure that has or is expected to soon have some deficiencies. Our role as engineers is how to design the necessary improvements to the infrastructure and then how to implement these in light of the realities of budgetary and other constraints.

The second half of the semester you will design an open-channel flow facility. This is based on a real-world problem that one of my former students analyzed for an independent study. This project is a meandering stream in Ontario, Canada that is threatening to wash out an adjacent roadway. You will do an analysis of the existing condition, propose a design to protect the existing roadway, and develop a numerical model to project the impact of your proposed design.

Project will be done in self-selected teams of about` four students After each final project deliverable, each team member will be asked to complete a team assessment where they assign each team member (including themselves) a percentage of contributed work. These self-assessments by the team members will be considered in assigning students' project grades.

Project teams are first expected to resolve disputes and perceived inequality in the work completed by each team member. Since learning team functioning skills is part of this course, the instructor will be available to facilitate resolution of unresolvable issues. In addition, if peer assessments indicate a problem within a team, I will meet with the individuals and the team to try to facilitate a resolution to the issues. If a student consistently contributes significantly less than their teammates, their project grade may be reduced to reflect the unequal effort.

The format of the project deliverables is a major requirement. As an aspiring professional engineer your design reports should be well organized and formatted; accurately convey your design approach, assumptions, and results; and facilitate the reviewing process. In CEE 452 all deliverables must be communicated *professionally*[1]. Neatness and organization are important, with a penalty assessed for work that cannot be read, understood, or interpreted. Graphs should have captions that clearly indicate what is

[1] I have provided documents in Canvas about preparing professionally formatted reports and technical memoranda. Please read and follow these guidelines.

being shown, axes and significant points should be clearly labeled, units of measurement should be specified in the axis labels, and a legend clearly showing the meaning of symbols, line styles, etc. should be included when more than one relation is included in the figure. When you include a figure, graph, or table, it must be numbered and given a title that must be referred to in the text (e.g., 'Figure 3 shows the plan and profile of the proposed water main.').

Pay attention to neatness, consistency and page layout when using spreadsheets, word processing software, model results, and other computer tools. Be especially careful when printing results from a spreadsheet, as students very often neglect to document (in words and/or equations) their approach and findings and often forget to highlight their final solution. It is often good practice to put the results from software output in an Appendix and then produce a well-formatted table or figure summarizing the results in the text. Also, if you present the results from a spreadsheet, be careful to present only enough *significant digits* to be reasonable from an engineering perspective (e.g., reporting the estimated cost as $1,302,356.75 is not reasonable if the uncertainty is ±$10,000). Similarly, when presenting results from numerical models or analysis packages, do not simply paste figures from the software. A display figure from a model often does not translate directly into a good report illustration.

In professional practice, submissions received after the deadline often are not accepted. If you cannot turn your assignment in on time and feel you have a valid reason for the delay, please see the instructors ***well before the due date*** about making alternate arrangements for submitting your assignment.

Grading

Based on the weighted score of each student obtained through the rubric in Table 3, semester grades will be assigned as shown in Table 4.

Table 4.—Grade Distribution

A+	98%+	C+	78 - <80%
A	92 - <98%	C	72 - <78%
A-	90 - <92%	C-	70 - <72%
B+	88 - <90%	D+	68 - <70%
B	82 - <88%	D	62 - <68%
B-	80 - <82%	D-	60 - <62%

Grades will not be curved. It is possible that everyone earns an "A." Collaboration with team members is encouraged, but final grades are based on individual performance except for the team activities.

Classroom and Course Behavior

Classroom lectures will be informal, and you are encouraged to ask questions, comment, and participate in relevant discussion before, during and after class as well as in office hours. Making a favorable or unfavorable impression through your classroom etiquette could influence your grade enough to change a borderline grade and influence future recommendations from the instructors. **It is strongly encouraged to discuss academic or personal matters that may affect performance in the course with the instructors as soon as possible and not the last week of class.**

Students will be expected to respect and to maintain the university policy on academic integrity. For a discussion of academic integrity, please refer to the *Code on Campus Affairs and Regulations Applying to All Students*. If you are uncertain as to whether a certain action constitutes an infraction of academic integrity, please discuss it with the instructor before carrying out that action. Cheating on quizzes, homework, or exams will result in an automatic zero and reporting to the FAIR system.

Absence Policy: The University requires an absence/attendance policy, so here goes: You are all responsible adults. You are experienced enough to realize that learning is a privilege and that your success in learning is related to your active participation in course discussions and exercises. In addition, your contributions to classroom discussions are important to us and valuable to enhance your learning as well as that of your classmate. We hope that you will enhance this class by regularly sharing your observations and ideas in course discussions and in working with your classmates on exercises. Hence, we strongly encourage you to attend in-person lectures to the extent it is possible. All lecture slides will be available on *Canvas* and all lectures are recorded and available in *MediaSpace*, so if you are unable to attend lecture you can still see the material, although you will miss out on the opportunity for in-class discussion. When possible, please let the instructional team know in advance of your missing lecture as this helps us plan in-class activities.

CEE Honor Code

To foster and promote integrity among students, the CEE Honor Code was developed with input from several CEE undergraduate organizations, the CEE Graduate Student Advisory Committee, and the CEE Graduate Affairs Committee. You (the student) commit to honor the code each time you sign an exam or quiz, and implicitly whenever you turn in the class project assignments. The CEE Honor Code pledge is the following:

> I pledge to uphold the highest levels of professional and personal integrity in all of my actions, including 1) never assisting or receiving unfair assistance during exams, 2) never assisting or receiving assistance on class assignments beyond that specified by an instructor, and 3) always fully contributing to group activities that are part of a course activity.

Statement of Academic Integrity: The Code of Policies and Regulations Applying to All Students will be applied in all instances of academic misconduct committed by CEE 415/453 students. This applies to all exams, assignments, and on-line materials distributed or used in this course. [return to top]

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.

*This statement is approved by the University of Illinois Counseling Center

Students with Disabilities

To obtain disability-related academic adjustments and/or auxiliary aids, students with disabilities must contact the course instructor as soon as possible and provide the instructor with a Letter of Academic Accommodations from Disability Resources and Educational Services (DRES). To ensure that disability-related concerns are properly addressed from the beginning, students with disabilities who require assistance to participate in this class should apply for services with DRES and see the instructor as soon as possible. If you need accommodations for any sort of disability, please speak to the instructors after class, or make an appointment to see us. DRES provides students with academic accommodations, access, and support services. To contact DRES, you may visit 1207 S. Oak St., Champaign, call 217-333-1970, e-mail disability@illinois.edu or visit the DRES website at http://www.disability.illinois.edu/.

Here is the direct link to apply for services at DRES:
https://www.disability.illinois.edu/applying-services.

CEE 452 COURSE OUTLINE

Table 5.—Course Schedule and Topic Outline

Lecture No.	Day	Date	Topic	Reading
	Tu	20-Jan	MLK Day (all-campus holiday)	
1	Tu	20-Jan	Course Intro, Present projects, Review: water properties	Course notes: pp 20-23 (not page numbers but 20th to 23rd page in the PDF). Read writeup on significant digits, dimensions, units, and constants.
2	Th	22-Jan	Review: Hydrostatics, pressure and piezometric head	pages 23 - 30 (23rd to 30th page in the PDF).
3	Tu	27-Jan	Review: Continuity, momentum	Dynamic Conservation Equations from Chin (2000) Conservation Laws from Chaudry (2008)
4	Th	29-Jan	Review: Momentum, Energy	Mays, L.W., (2001). pages 34-39, pages 52-56 Read Momentum from Reynolds Transport
5	Tu	3-Feb	Pipe Flow, friction losses	Chapter 2 of AWWA 2012:"Water Transmission and DIstribuition"
6	Th	5-Feb	Minor or form losses; Flow in simple conduits	Read: Mays (2000), § 2.6 ; 2.6.2 - 2.6.4 - (Hydraulics of Pressurized Flow) For more general background read Mays (2001) Chapter 4 , page numbers 52-71
7	Tu	10-Feb	Flow in simple networks (System curve)	read Mays (2001) Chapter 4 , page numbers 72-79
8	Th	12-Feb	Wrap up Simple Pipe, Start Network	Simpson (2013), Ch.9 § 9.1, § 9.3 - 9.6, § 9.10
9	Tu	17-Feb	, Intro to pumps	Skim Julien (2022), Ch. 4 for overview
10	Th	19-Feb	Pumps: Pump types,Operating characteristics	Read Mays (2001) Chapter 12 § 12.3 -12.5.1
11	Tu	24-Feb	Design Charette for project	
12	Th	26-Feb	Pumps: Characteristic Curves, Affinity laws, specific speed,	Cooper and Tchobanoglous (2008) 10.9 - 10.14 (top)
13	Tu	3-Mar	Pumps: Cavitation, NPSH, Operating point, pumps in parallel and series	
14	Th	5-Mar	Finish Pumps, Distribution System, Valves, Tanks	Read: Brandt et al (2017) System Design, especially § 15.3, 15.9, & 15.15
15	Tu	10-Mar	EPANET Model	

Lecture No.	Day	Date	Topic	Reading
16	Th	12-Mar	Possible Field trip to Chicago	
	Tu	17-Mar	Spring Break (no class)	
	Th	19-Mar	Spring Break (no class)	
17	Tu	24-Mar	Introduction to free-surface Hydraulics (Flow classification, free-surface vs pressurized, specific energy)	
18	Th	26-Mar	Specific Energy (Channel transitions and choking)	Read from Sturm (2001) "Open Channel Hydraulics" pp 21-28
19	Tu	31-Mar	Specific Energy, critical flow, weirs/orifices	Read Mays (2001) "Water Resources Engineering" pp 123-135
20	Th	2-Apr	Hydraulic jump: energy dissipation	Read: Sturm § 3.1 - 3.2Download Sturm § 3.1 - 3.2 pp 71-84
21	Tu	7-Apr	Steady, Uniform (Normal) flow, resistance to flow	Read Mays (1999) § 3.1
22	Th	9-Apr	Uniform flow--composite and compound channels	Read from Yen (2002) pp 25-30 See Also Yen 1992 pp25 - 33 and Yen 1992 pp 60-70
23	Tu	14-Apr	Non-uniform grdually varied flow	Read from Bedient et al (2017) (Ch. 7) pp 239-250
24	Th	16-Apr	Gradually varied flow calculations	Read Mays (1999) § 3.5
25	Tu	21-Apr	Channel scour and erosion	TBD
26	Th	23-Apr	Hydraulic Structures Bank Protection	TBD
27	Tu	28-Apr	Hydraulic Structures: River training structures	TBD
28	Th	30-Apr	Hydraulic structures: Training structures, cont'd	TBD
29	Tu	5-May	Stilling Basins and Energy Dissipators; **Exam 2 opens**	TBD
30	Th	7-May	**Reading Day**	
	Tu	13-May	**Exam 2 closes**	
	Th	15-May	**Final project due**	

Tu

Th