CE54300 – Coastal Engineering (3cr)
Purdue University – West Lafayette
Fall 2023 (all sections)
Syllabus
08/21/2023

Course information

Sections	CE54300 (-001, -EPE, -OL1) – all sections
CRNs	19634, 28625, 28658
Times/Location:	MWF 12:30-1:20, MSEE B012
Modality:	Lectures, either in person or provided online
Pre-requisites:	CE34000 (Hydraulics) or equivalent first course in fluid mechanics

Instructor – Prof. Cary Troy

Position:	Associate Professor, Lyles School of Civil Engineering
Education:	B.S. Civil Eng. (University of Illinois); M.S., Ph.D. Civil and Env. Eng. (Stanford University)
Research:	Coastal engineering and physical processes of oceans and large lakes, particularly Lake Michigan.
Hometown:	Orland Park, IL
Happy Place:	Colorado Rockies
Hobbies:	Biking, hiking, ~~soccer~~, tennis, piano, gardening (I'm an outdoor cat)
Office:	HAMP 1101D (Hydraulics and Hydrology office area near the waterfall)
Email:	troy@purdue.edu
Webex:	https://purdue.webex.com/meet/troy
Website:	https://troylabpurdue.org/
Office hours:	Tentatively 7-8pm (Eastern), Mondays

Teaching Assistant

TA: Tasmiah Ahsan (ahsan3@purdue.edu) – Tasmiah is a M.S. graduate student conducting research on the response of Indiana shorelines to changing waves and water levels. She is an expert in GIS, LiDAR, and shoreline mapping. Office hours: TBD

Communication

Group communication: We will be using **Slack** to create a class discussion board – the channel is "Purdue – Coastal Engineering CE543" and links will be posted to enroll you. I recommend downloading the Slack app for your phone or computer, it works well. Please keep your Slack interactions positive and focused on the class. Use the discussion board to collaborate and ask/answer questions. Any inappropriate posts/persons may be removed from the board if needed.

Please post most questions on Slack, ideally to the entire class. This helps all students to learn from your answer. If the question is sensitive or you'd rather just email Tasmiah or me, send a DM over Slack (or email, but I am inundated by emails and am unable to respond to all emails). Tasmiah should be your first point of contact for most course-related questions, but I am always ready and willing to help.

Course Description (official catalog description)

An introduction to coastal engineering with emphasis on the interaction between oceanic dynamic processes (waves, currents, and tides) and coastal regions (beaches, harbors, structures, and estuaries) and on the engineering approaches necessary to prevent adverse effects caused by this interaction. Typically offered Fall.

Course Description (detailed)

Coastal engineers work to allow humans to safely live, work, and play in close proximity to the ocean. They defend coastlines against flooding and erosion; develop harbors, canals, and waterfront structures for human use; maintain and nourish beaches and marshes and the ecosystems they support; and many other functions.

Coastal engineers must understand (a) ocean (or lake) physics: waves, currents, and water levels; (b) the coastline and its composition, and how water attacks coastlines and moves sediment; and (c) design techniques

based on theory, computer models, experiments, and collective design experience. This course is designed to give students a broad introduction to the discipline, with a strong focus on coastal processes, and introductory exposure to coastal structure design techniques. Course assignments and projects are a combination of basic calculations, designs, and real-world case studies/projects.

This course is design to give students broad, preliminary exposure to the field of coastal engineering. Students interested in pursuing a career in coastal engineering should take additional, more technical coursework.

Course topics

- Introduction/overview of coastal engineering
- Coastal hydrodynamics
  - Water waves (wave descriptors, dispersion, classification, shoaling, refraction, breaking)
  - Water levels (spectrum of processes, tides, Great Lakes, sea level rise, storm surge)
- Coastal design
  - Information sources (models, buoys, tide gages)
  - Design conditions (waves, water levels, site constraints)
- Design of Coastal Structures
  - Types of structures; Armor stability; Wave run-up and overtopping, wave transmission and reflection
- Introduction to shoreline protection measures (Types of structures, basic design guidance and principles)

Topics in the second half of the course vary from semester to semester, depending on the design project for a particular semester.

Learning outcomes (assessment methods in parentheses) and assessment

By the end of the course, you will be able to:

O1 Calculate and interpret the significance of basic coastal hydrodynamic processes associated with water waves, water levels, and sediment transport. (homework, quizzes, projects, exams)

O2 Identify and describe coastal protection measures and methods and their design considerations (presentations, projects, quizzes, exams)

O3 Find, interpret, and utilize physical data and/or model output to support design (homeworks, projects, exams)

O4 Design elements of coastal protection measures within a simplified subset of design constraints (homeworks, projects, exams)

Course grading

Lecture Quizzes	14%	Short Brightspace quizzes are due for each lecture module
Homework	35%	Number of points dictates weighting of assignments/quizzes
Exams (Exam I, II)	30%	Equal weighting
Group design project	20%	Group design project worked on throughout semester
Slack engagement	1%	Participation in online forum – asking/answering questions

Draft Weekly schedule

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Weekly module released						
	In-person Class 12:30 (recorded lecture)		In-person Class 12:30 (recorded lecture)		In-person Class 12:30 (recorded lecture)	
	Prof. Troy Office hours, 7-8pm	HW from previous week due 11:59pm			Lecture quizzes due 11:59pm	

COURSE GRADING

Lectures and Lecture Quizzes (14%)

- Each week there are 2-5 short, online video lectures. As a bonus, each video has a handout you can use to take notes.
- Most videos have a short quiz on Brightspace, regardless of whether you are taking the class in person or online.
- All quizzes from a given week are due Friday at 11:59pm.
- In-person learners: It is your responsibility to complete all weekly quizzes, regardless of whether we cover all lectures during our in-class periods. As we shift to more quantitative work, I will be using class periods for more active learning, where you are expected to watch videos more on your own. I do this because it turns out to be quite boring to sit and watch me deliver powerpoint presentations that can be watched online, and it's way better if I help you individually with questions. You'll see.
- If you find a bug (e.g. wrong answer) in a quiz, let us know immediately so that other students don't suffer also.

Homework (35%)

- Homeworks will involve a combination of calculations as well as project-related exercises. These project-related questions are graded like a regular homework problem, but will later be useful for your projects.
- **Due day:** Tuesdays, unless otherwise indicated
- **Submission:** Assignments are generally submitted through Gradescope, which is linked in Brightspace. Assign pages to problems. We will also be using Variate for quantitative problems. Variate is an online system that creates and grades numeric problems.
- **Collaboration:** Work with classmates to understand assignments, but ultimately go your separate ways and write up your homework solutions in your own words and equations. Cheating will not be tolerated, and offending students will be referred to the Dean of Students.
- **Weighting:** Assignments are weighted in accordance with their total point total, which is set by the difficulty and length of the assignment.
- **Format:** Assignments should be formatted according to the instructions provided on each assignment.
    - Use the template provided to produce your solution.
    - All written (words, paragraphs, etc.) responses should be typed.
    - Equations can be typed or neatly hand-written and pasted into the document, or they can be typed.
    - We grade based on the work you show: show enough detail that another student in the class who did not understand the problem should be able to read your solution and understand how to solve the problem.
    - Points will be deducted for assignments that do not meet these formatting standards.

Exams (2 x 15%)

Exam I: Friday, October 13 (Friday after fall break)

Exam II: Friday, December 1 (Friday after Thanksgiving break)

Exam questions will be similar in difficulty and scope to homework and quiz questions. As such, if you can do the homework and quiz questions, you should be able to do well on the exam.

Details of these exams and how they will be proctored will be provided as these dates approach. In-person learners will have an in-person exam during the scheduled class period. Online learners will likely have digitally proctored exams during a set exam period. I appreciate time and schedule constraints for online learners and am willing to work with you to find a time that works.

Group design projects (20%)

- A group design project will be assigned to be completed by student teams, tentatively 3 persons per team
- Project work and deliverables will be scheduled throughout the semester, with a final report due at the end of the Quiet Period. (there is no final exam during the final exam period)
- Homework problems will involve questions related to the design projects
- Design groups will be determined in Week 2 of the course
- Details of the design project and its deliverables will be provided in Week 2 of the course

This year we will be designing a submerged breakwater that will be placed offshore of Beverly Shores, IN, in Lake Michigan, to help reduce wave energy that is causing erosion along the coast.

Discussion board (Slack) participation (1%)

You are expected to participate in the Slack discussion board. "Participation" means asking and answering questions, or responding to prompts like "Introduce yourself".

Late policy (all work)

Extensions are not allowed without an official, documented university excuse (documented illness, bereavement, etc.), and you must contact me prior to the due date in order to obtain an extension. Late extensions for online quizzes are not allowed due to the difficulty in changing the due date for individual students in Brightspace.

Grading scale

Grading will be done on a +/- system, with the below usual scale. In general, any curving will be done on individual assessments (homeworks, exams) so that you have an accurate perception of your standing in the course simply by adding up points in the Brightspace gradebook and weighting them accordingly.

A+	96.67 – 100	B+	86.67 – 90.00	C+	76.67 – 80	D+	66.67 – 70.00	F	< 60.00
A	93.33 – 96.67	B	83.33 – 86.67	C	73.33 – 76.67	D	63.33 – 66.67		
A-	90.00 – 93.33	B-	80.00 – 83.33	C-	70.00 – 73.33	D-	60.00 – 63.33		

How to succeed in this course

- **Attend/watch and participate!** Attend lecture (in-person) and/or watch lecture recordings. (at 1x speed) (not while watching Netflix on your phone)
- **Every lecture has a short quiz in Brightspace.** Think of it as a "lecture completion celebration activity". Do the quiz to reward yourself for watching the video.
- **Most lectures have a "gapped" handout where your notes are meant to be taken.** Actively participate in the lectures, either online or in person, by taking notes and completing example problems on the accompanying handout. The collection of handouts associated with lectures forms the backbone of your notes and learning materials for the course. Buy a 2-ring binder to file away all your handouts and stay organized. Note: the handouts should also be used for online students and are perhaps even more useful!!
- **Ask questions when you are stuck or confused. Ask in class or online.** Getting stuck is the most important part of learning (otherwise it wasn't really learning), and learn how to power through that moment. Help each other by answering questions (without just giving away the answers)
- **Complete and understand every homework** (Exams are worth lots of points, but exams are just collections of homework-like problems)
- **Work with classmates on homework and projects.** You will learn much more when you work with others, your engineering work will be much higher quality, and you will need to learn to work with others in order to succeed in your engineering careers.

Broad course schedule:

Fall 2023 – tentative schedule

WEEK	TOPIC	REGULAR STUFF DUE	BIGGER STUFF DUE
Week 01 (08/20)	Introduction to Coastal Engineering	Quizzes	
Week 02 (08/27)	Introduction to Water Waves	Quizzes, HW01	
Week 03 (09/03+LD)	Wave Transformation	Quizzes, HW02	
Week 04 (09/10)	Wave Routing and Breaking	Quizzes, HW03	
Week 05 (09/17)	Design Wave Characterization	Quizzes, HW04	
Week 06 (09/24)	Water Levels I	Quizzes, HW05	
Week 07 (10/1)	Water Levels II	Quizzes, HW06	
Week 08 (10/8+FB)	Fall Break (M/T); Exam I (Friday, October 13) (!!)		Exam I
Week 09 (10/15)	Design WL/BATHY Characterization	Quizzes	
Week 10 (10/22)	Introduction to Coastal Structures	Quizzes	PHASE I
Week 11 (10/29)	Coastal Structure Design I – Hydraulic Response (Trans., Runup)	Quizzes	
Week 12 (11/05)	Coastal Structure Design II – Armor Layer Stability +	Quizzes, HW11	
Week 13 (11/12)	Submerged Breakwater Design	Quizzes, HW12	
Week 14 (11/19)	Thanksgiving Break (W-F)	HW13	
Week 15 (11/26)	Advanced topics (TBD); Exam II (Friday, December 1)	TBD	Exam II
Week 16 (12/3)	Quiet Period (Mon through Sat)		FINAL REPORT
Week 17 (12/11+)	Finals Week		No final

Detailed schedule (tentative):

Week 1 – Course Introduction and Coastal Engineering Overview (08/20-08/26)	
Lecture /Quiz	Course syllabus and overview
Lecture / Quiz	Coastal Engineering Overview: Flood Protection
Lecture / Quiz	Coastal Engineering Overview: Navigation and Shipping
Lecture / Quiz	Coastal Engineering Overview: Shore Protection
HW 01 (due 8/29)	Hurricane Sandy and New York City coastal planning
Week 2 – Introduction to water waves (08/27-09/02)	
Lecture / Quiz	Surface Water Waves: An Introduction
Lecture / Quiz	Regular Water Wave Descriptors
Lecture / Quiz	Dispersion Relation
Lecture / Quiz	Wave Shoaling – 2D
HW 02 (due 9/05)	Wave Properties and Shoaling
Week 3 – Wave Transformation (09/03-09/09; Labor Day 09/04)	
Lecture / Quiz	Wave Shoaling – 2D Energy Conservation
Lecture / Quiz	Wave Shoaling – From Deep Water
Lecture / Quiz	Wave Refraction – Snell's Law
Lecture / Quiz	Wave Refraction – Wave Heights
HW 03 (due 9/12)	Wave Transformation
Week 4 – Wave Routing and Breaking (09/10-09/16)	
Lecture / Quiz	Wave Classification
Lecture / Quiz	Regular Wave Breaking
Lecture / Quiz	Breaking Wave Classification
Lecture / Quiz	Routing a Regular Wave to Breaking
HW 04 (due 9/19)	Wave Routing

Week 5 – Design Wave Characterization (9/17-9/23)	
Lecture / Quiz	Wave Information – Buoys and Models
Lecture / Quiz	Irregular wave descriptors – Wave Heights and Periods
Lecture / Quiz	Extreme wave height characterization
Lecture / Quiz	Extreme wave period characterization
HW 05 (due 9/26)	Design wave characterization
Week 6 – Water Levels I (09/24-09/30)	
Lecture / Quiz	Water Levels: Introduction
Lecture / Quiz	Tides and Currents Introduction
Lecture / Quiz	Spectrum of Water Level Fluctuations
Lecture / Quiz	Tides – Basics
Lecture / Quiz	Tidal Range Classification
HW 06 (due 10/03)	Water Level Processes I
Week 7 – Water Levels II (10/01-10/07)	
Lecture / Quiz	Tidal Periods – Classification
Lecture / Quiz	Storm Surge
Lecture / Quiz	Wind Setup
Lecture / Quiz	Great Lakes Water Levels
Lecture / Quiz	Sea Level Rise
HW 07 ("due" 10/10)	Water Level Processes II (optional) (but covered on Exam I)
Week 8 – Fall Break + Exam I (10/08-10/14)	
Fall Break	Monday, Tuesday
Review (Wednesday)	As needed
Exam I	Friday, October 13
Week 9 – Design Water Level and Bathymetric Characterization (10/15-10/21)	
Lecture / Quiz	Depths and Datums
Lecture / Quiz	Equilibrium Profile
Lecture	LiDAR and GIS tutorial
Week 10 – Introduction to Coastal Structures (10/22-10/28)	
Lecture / Quiz	Introduction to Coastal Structures
Lecture / Quiz	Rubble Mound Breakwater Design Overview
Lecture / Quiz	Guest Lecture?
PHASE I DUE	
Week 11 – Coastal Structure Design I: Hydraulic Response (10/29-11/04)	
Lecture / Quiz	Simple Wave Transmission
Lecture / Quiz	Wave Run-up
Lecture / Quiz	Wave Run-up for Rubble Mound Structures
HW 11 (due 11/7)	Hydraulic Response
Week 12 – Coastal Structure Design II: Armor Stability (11/05-11/11)	
Lecture / Quiz	Armor Layer Stability Introduction
Lecture / Quiz	Armor Layer Stability – Hudson's Equation
Lecture / Quiz	Rock Armor Layer Sizing Example
HW 12 (due 11/14)	Armor Layer Sizing
Week 13 – Submerged Breakwater Design (11/12-11/18)	
Lecture / Quiz	Reef breakwater stability
Lecture / Quiz	Goda Method of Foreshore Wave Routing
Lecture / Quiz	TBD
HW 13 (due 11/21)	Submerged breakwater design example calculations
Week 14 – Thanksgiving Break (11/19-11/25)	
HW 13 due 11/21	
Week 15 – Project work week (11/26-12/02)	
Special Topics, project and exam help as needed	Exam II: Friday, December 1
Week 16 – Quiet Period (12/03-12/10)	
Special topics, project and exam help as needed	**Final Project Due: Saturday, December 9, 11:59pm**
Final Exam Period	Nothing, you're done with this class

Learning Resources, Technology and Texts – all references can be accessed freely through Brightspace

1. Website – Brightspace

2. References (all available for free through Purdue Libraries/Brightspace)
    a. Coastal Engineering: Processes, Theory and Design Practice, 3rd Ed. (2018)
        Authors: Dominic Reeve, Andrew Chadwick, Christopher Fleming (CRC Press)
        Available in print or free online through Purdue Libraries (link)
        https://www.taylorfrancis.com/books/9781351165525

    b. The Rock Manual: The Use of Rock in Hydraulic Engineering, 2007 (https://www.kennisbank-waterbouw.nl/DesignCodes/rockmanual/)

    c. Coastal Engineering Manual (EM 1110-2-1100), "CEM"
        Author: U.S. Army Corps of Engineers (USACE)
        Available online through USACE and Purdue Libraries
        https://www.publications.usace.army.mil/USACE-Publications/Engineer-Manuals/
        Note that the "CEM" has 6 parts, each very long. You must download each part separately. Readings are referenced as, for example, CEM VI-5-13 (CEM Part VI, Chapter 5, Section 13).

3. Other texts
    a. Coastal processes with engineering applications. Dean, Robert G., and Robert A. Dalrymple. Cambridge University Press, 2004. (Available online through Purdue libraries here)

    b. Basic coastal engineering. Sorensen, Robert M. Springer Science & Business Media, 2005. (Available online through Purdue libraries here)

    c. EurOtop Overtopping Manual, 2018 (http://www.overtopping-manual.com/)

    d. Other references will be posted for various topics, but the above are the most-cited.

4. Web resources – will be posted on Brightspace

5. Required software – Microsoft Word; Microsoft Excel or Matlab; Web browser; Google Earth (desktop if possible)

Academic integrity

Students are expected to abide by the Purdue Honor Pledge. In this class, what is most important to me is that when you turn in assignments and exams, you are turning in your own work and sticking to any rules or guidelines that I've given you. This means: Present solutions in your own words, that reflect your understanding of the material. I encourage all students to work together, because you usually learn more this way, and it makes your whole educational experience more enjoyable. But at the end of the day, for individual assignments, you should go your separate ways to write up your homework solutions on your own, and in your own words. With respect to computer codes and spreadsheets, you should generally write your own, but help each other debug them. The work that you submit in all course assignments should accurately reflect your understanding of the material that you are presenting.

What I like:

- Bill and Mabel work together on their homework. At first, Bill has no clue what is going on with problem 5. But Mabel explains it to Bill, and he finally gets it to work. At 10pm, they go their separate ways, and write up their solutions in their own words.

- Bill and Mabel work together on their homework. At first, Bill has no clue what is going on with problem 5. Mabel explains it to Bill, and he still doesn't get it. At 10pm, they go their separate ways to write up their solutions. For Problem 5, Bill writes what he understands, but makes it clear he does not understand all of the problem. Prof. Troy gives him partial credit for the problem for the work he did, and works with Bill to understand the part he didn't initially get.

- Erica spent all day trying to write a Matlab code that would solve Problem 3. After hours of work, she's still getting an error message. She calls Tessa, who comes over and helps her debug her code. It finally works and they celebrate with a small dance. Just a small one.

What I don't like:

- Bill and Mabel divide and conquer. Bill does problems 1-3, and Mabel does problems 4 and 5. They trade problems and copy what the other one did. They get 100% on the assignment, but Bill never sleeps well from that day forward. Later, in his 40s, with several small children, he understands how important sleep is. If only he had followed Prof. Troy's advice!

If I catch you doing something that is academically dishonest in this class:

- Depending on the severity of the offense, penalties can range from receiving a warning, getting a zero on an assignment or exam, and/or being referred to the Dean of Students.
- Last semester, 5 students got zeros on exams for cheating while taking a remote exam.

Attendance Policy (for in-person students)

I would love it if you attend class, because I think that you will learn more in person. If you don't attend, I will take it personally, but there will be no effect on your grade unless there is an in-class quiz or assignment that you miss. It is up to you whether you attend class. At the end of the day what I care about most is whether you learn, and if you can magically learn the material without going to class, well then good for you.

If you do attend – *and I hope you do* - I ask that you:

- Stay off your phone unless we're doing something involving the internet.
- Stay off your laptops unless you are actually taking notes for this class. Please take notes on paper. Why? Because it's distracting to every student behind you. And then it's contagious… pretty soon everyone is on their laptop, tuned out.

Course Absence Information

- **If you are feeling sick, please do not come to class**, and follow Purdue guidelines with respect to medical care and quarantine. Attendance is not counted in this class and all work can be accomplished remotely.
- **If you are quarantined or medically unable to attend class, you should still be able to succeed in this class.** A significant fraction of the students in this class are already taking this course in an asynchronous modality online. If you have a severe medical condition that requires adjustment of course policies in order to accommodate your situation, please reach out to us.

Emergency information

In the event of a campus emergency, the above policies are subject to change, and communication will be carried out over email and through the Blackboard website. If you receive an urgent text message alert from the campus notification system during class, let me know immediately.

- In the event of a fire alarm, we will immediately evacuate the building together, using the nearest exit.
- In the event of a "shelter in place" alert, we will barricade and lock the doors, turn out the lights, and remain quiet in the room unless common sense dictates other actions.
- In the event of a tornado siren/event, we will go to the basement of the building.
- In the event of a prolonged campus emergency or closure, the course policies and logistics will be adjusted as needed.

Nondiscrimination policy

Purdue University is committed to maintaining a community which recognizes and values the inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect among its members; and encourages each individual to strive to reach his or her potential. In pursuit of its goal of academic excellence, the University seeks to develop and nurture diversity. The University believes that diversity among its many members strengthens the institution, stimulates creativity, promotes the exchange of ideas, and enriches campus life. A hyperlink to Purdue's full Nondiscrimination Policy Statement is included in our course Brightspace under University Policies. I strongly support Purdue's Nondiscrimination Policy.

Mental Health

Your mental health and well-being is very important, probably the most important thing you can maintain during the semester. These are stressful times even without some of the extraordinary stressors that can arise during a

semester. Don't take your mental health for granted; schedule time to relax, hang out with friends, and do what you need to do in order to stay okay.

What's one fun/random thing you're going to do this semester to maintain your sanity?

If you find yourself beginning to feel some stress, anxiety and/or feeling slightly overwhelmed, try WellTrack**.** Sign in and find information and tools at your fingertips, available to you at any time.

If you need support and information about options and resources, please contact or see the Office of the Dean of Students. Call 765-494-1747. Hours of operation are M-F, 8 am- 5 pm.

If you find yourself struggling to find a healthy balance between academics, social life, stress, etc. sign up for free one-on-one virtual or in-person sessions with a Purdue Wellness Coach at RecWell. Student coaches can help you navigate through barriers and challenges toward your goals throughout the semester. Sign up is completely free and can be done on BoilerConnect. If you have any questions, please contact Purdue Wellness at evans240@purdue.edu.

If you're struggling and need mental health services: Purdue University is committed to advancing the mental health and well-being of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of mental health support, services are available. For help, such individuals should contact Counseling and Psychological Services (CAPS) at 765-494-6995 during and after hours, on weekends and holidays, or by going to the CAPS office on the second floor of the Purdue University Student Health Center (PUSH) during business hours.

Accessibility If you need accommodations for this class (e.g. extra test time, etc.), please let me know as soon as possible so that I can work to provide these accomodations for you. Like Purdue, I'm committed to be making sure that every student has equal access and opportunity to learn.

Other University Policies
This course abides by and supports all other Purdue University syllabus policies and guidelines, which can be found on the Brightspace page under "University Policies".