CE 54300 – COASTAL ENGINEERING, Spring 2017 – Syllabus
Prof. Cary D. Troy, Purdue University

~~~~~~← waves!

What is coastal engineering? Coastal Engineering deals with engineering projects pertaining to the world's coastlines, where much of the world's population lives. Coastal engineers work to allow humans to live in close proximity to a bountiful and dangerous resource: 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) the ocean (or lake): waves, currents, and water levels; (b) how waves and currents move sediment and impact shorelines and structures; and (c) how to put all of this together to design coastal projects. Coastal engineering projects require expertise in geotechnical engineering, geomorphology and sediment transport, structural engineering, environmental engineering, transportation, and even biology/ecology.

Course overview This course provides an introduction to key concepts and basic analysis and design techniques in Coastal Engineering. The course is generally structured as (1) coastal *processes* (water and sediment processes, including waves, currents, and sediment transport; (2) coastal *engineering* design and projects (design of traditional structures and exposure to softer coastal engineering techniques).

Course-level learning objectives After successfully passing this course, you will be able to:

- Explain and quantify ocean/lake wave processes including wave generation, propagation, refraction, shoaling, diffraction, and breaking.
- Explain and quantify ocean/lake wave properties important to coastal engineering, including wave heights, speeds, induced water velocities, pressures, making appropriate approximations for deep and shallow waters.
- Characterize and quantify basic coastal sediment transport processes and rates
- Analyze coastal sites to determine design waves by utilizing historical and bathymetric data.
- Estimate hydrodynamic (wave + current) forces on simple structures such as pilings, pipes, etc.
- Design simple coastal structures (e.g. breakwater, jetty, etc.).
- Identify different shoreline protection methods

Instructor – Prof. Cary D. Troy I am an associate professor in the School of Civil Engineering. I teach courses in the area of fluid mechanics, and my research focuses on physical oceanography and physical limnology (lakes), with a geographical focus on Lake Michigan. Our research group does a combination of computer modeling, field experiments (often using large ships), and laboratory experiments. I am always looking for hard-working, creative, bright students, as undergraduate researchers or graduate students.

Office: HAMP 1101D (Hydraulics and Hydrology office area) – office hours t.b.d. and by request
Phone: 765-494-3844
Email: troy@purdue.edu

Course logistics

Classroom meetings: HAMP 3153, MWF 11:30-12:20
Course website: Blackboard Learn

Textbooks and references (all freely available through the Purdue libraries or public websites)

1. *Basic coastal engineering*. Sorensen, Robert M. Vol. 10. Springer Science & Business Media, 2005. (Available online through Purdue libraries)
2. *Coastal processes with engineering applications*. Dean, Robert G., and Robert A. Dalrymple. Cambridge University Press, 2004. (Available online through Purdue libraries)
3. *Coastal Engineering Manual*, U.S. Army Corps of Engineers, 2006. (Available both through Purdue Libraries as well as various websites)
~~~~~~

Course grading

Homework	30% - due approximately every 1-2 weeks
Exam 1	20% - evening exam
Exam 2	20% - evening exam
Final Exam	20% - comprehensive
Quizzes	10% - typically online via Blackboard
Participation	Very Important

Homework (30%) - Homework will be assigned on an approximately weekly basis and will include (1) conceptual written questions (e.g., "Explain …"; "Find and describe and example of …"); (2) calculations and designs. Homeworks will be worth an amount that is in proportion to the required work effort, and students will be notified in advance of any homeworks with substantially different point totals.

Follow all formatting instructions; show all work such that I can follow your solution procedure, and aim to convince me with your solution that you understand what you are doing. Work together if you like, but turn in your own solution that demonstrates to me that you understand the problem. If asked to write a paragraph answer to a question, write in your best English and type your response; have a friend proofread your response. Solutions should be neatly presented in an organized, neat fashion, on engineering paper.

Late policy: Each student will be allowed to submit 1 late homework (must be received within 3 days of the official due date; please write "LATE" in large letters at the top). Beyond that one exception, I only accept late homeworks with an official, **documented** university excuse (documented illness, bereavement, etc.).

Academic dishonesty: All suspected academic dishonesty violations will be referred to the Dean of Students. I expect you to work together, but ultimately you are responsible for your own final assignment. If I cannot distinguish one student's work from another, both students will receive zero credit for that assignment.

Exams (60%; 2 evening exams; 1 semi-comprehensive final exam) - The topics and format of each exam will be discussed prior to each exam. Generally I give exams that include some short answer, conceptual questions (e.g. "Explain why waves always arrive parallel to the shore"), and some "calculator-type" questions (e.g. "If the wave period is XX, calculate YY"). The final exam will include both material covered since the second exam, as well as the basic concepts that I expect you to retain from the entire course.

Quizzes (10%) – Regular quizzes will be given online (through Blackboard), and these are short multiple-choice or calculator questions. Generally these quizzes are designed to test simple concepts or equations learned in class, or else to hold you accountable for assigned readings or videos. These quizzes are challenging to program in Blackboard, and as such, there can be errors in them. If you are doing a quiz and notice an error, or are banging your head against the wall because the quiz seems to have an error, email me!

Participation (priceless) – My teaching style is to lecture for a while, let you try something out, ask for feedback, and lecture some more. My teaching style revolves around the pedagogical philosophy of "active learning", which is basically the idea that _____ . I know you will work outside of class, but I also expect you to work inside of class. After an in-class exercise, I will call on "volunteers" at random, so be warned that you are accountable for working during these exercises.

Cell phones and laptops Please keep your phones and laptops away (out of sight) during class, unless we are doing an in-class activity involving them. I will track cell phone and laptop sitings in Blackboard; **for every three cell phone or laptop violations that I catch, your grade will drop by 1%.** Learn to "monotask", and you'll be extremely effective in your life.

Grades

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 Blackboard gradebook and weighting them accordingly.

In other words, if you get a 65% on an exam, you should assume a grade of D unless told otherwise (similarly, a 95% is an A!); I aim to create exams that test your ability to demonstrate the learning objectives that are given to you prior to the exam, not to test your ability to demonstrate brilliance during a high-stress, hour-long period (this is an engineering exam, not Mission Impossible). As such, if you know the material, and can execute your answers in a timely fashion you should score well. My exams do tend to be on the long side, because they are generally straightforward.

A+	96.67 – 100	B+	86.67 – 90.00	C+	76.67 – 80	D+	66.67 – 70.00
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

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 (you will not be penalized for this!).

- In the event of a fire alarm, we will immediately evacuate the building together, and meet outside on the lawn next to the building.
- 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, we will go to the basement of the building.

TENTATIVE LIST OF TOPICS (subject to modification)
(Ch.#) denotes corresponding chapter in "Basic Coastal Engineering" by Sorensen (3nd Ed)

Introduction to coastal engineering (Ch.1)

Basic engineering water wave characteristics (Ch.2)
- Overview – importance of waves to coastal engineering
- Wave classifications (capillary→tides)
- Engineering wave properties: linear, progressive, monochromatic waves
  - Dispersion; wave velocities; shallow vs. deep waves; water velocities, pressures

Wave transformation and breaking (Ch.2, Ch.4)
- Standing waves / seiches (rectangular basins; irregular geometry)
- Wave shoaling, breaking, runup
- Wave refraction
- Wave diffraction

Wind generation of waves (Ch.6)

Coastal Water Level Fluctuations (Ch.5)

Coastal structures (Ch.7)
- Forces on piles, pipelines, and cables
- Other structures: breakwaters, walls, etc.
- Design of simple coastal structures

Coastal zone processes and sediment transport (Ch.8)

Coastal sediment transport
- Overview
- Cross-shore transport
- Alongshore transport

Basic shore processes
- Nearshore currents
- Beaches
- Estimation of transport rates

Special topics (to be determined)

Sample possible special topics: Marina and harbor design; iconic coastal engineering projects or systems (Sand Engine; Palm Islands, Dubai; Wind farms)