

**Florida International University**  
**Department of Civil and Environmental Engineering**  
**CGN 4930/5930- Coastal Hazards Engineering**  
**Fall 2025**

**Instructor:** Dr. Navid Tahvildari  
Associate Professor  
Department of Civil and Environmental Engineering  
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**Class Meetings:** Mondays 5:00-7:40 pm

**Location:** EC 1113

**Teaching Assistant:** TBD

**Office Hours:** By appointment (In person or Zoom)

**Pre-requisites:** Fluid Mechanics (CWR 3201) or equivalent

**Course Description:**

Coastal areas are increasingly subject to hurricanes, which drive intense surge and waves and cause substantial damage to coastal infrastructure. In a longer time scale, sea level rise causes coastal erosion and exacerbates the impacts of hurricane surge and waves. This course discusses these short- and long-term coastal hazards and the engineering solutions to mitigate them. The first half of the course focuses on water waves, laying out the theory behind linear water waves, wave generation processes, wave transformation in the coastal environment, and engineering properties of water waves, the theoretical background of storm surge and tides. Statistical and probabilistic methods for short- and long-term analysis to calculate design waves will be discussed. The second half the course will cover wave-induced processes and engineering solutions for coastal hazards, focusing specifically on longshore and cross-shore currents and coastal sediment transport. Finally, the evolution of beaches in response to storms and sea level rise, beach nourishment design, nature-based solutions for mitigating erosion due to waves, and other contemporary considerations in coastal zone management will be covered.

**Course Objective:**

The objective of this course is to introduce students in engineering and science to the basics of coastal engineering, required for engineering design in coastal areas, and methods to protect the coastlines. As the primary ocean-driven hazards are storm surge and waves, the focus will be placed on mechanics of water waves, analysis of wave records, fundamentals of tides and storm surge, sea level rise, wave-generated processes in the nearshore environment. Common methods to mitigate coastal hazards, namely structural approaches, beach nourishment, and nature-based solutions will also be introduced.

**Learning Objectives:**

- Derive linear wave theory, engineering properties of waves, and wave transformation
- Analyze a wave field using time-domain and frequency domain methods
- Calculate design wave conditions given long-term data
- Formulate storm surge and astronomical tides
- Calculate and interpret statistics of coastal sediment sizes
- Derive wave-induced processes and their effect on sediment transport

- Describe beach response to short- and long-term coastal forces
- Design a beach nourishment profile given environmental conditions
- Describe contemporary coastal adaptation methods

### **Relationship of Course to Civil Engineering Program Outcomes:**

This is an elective course and its contents relate to the following ABET student outcome: (SO1) Ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

### **Textbook and other References:**

The material of this course is drawn from various sources, mainly A, B, and C, listed below. Most of the topics can also be found in other sources, some of which are also listed below, at varying level of details. While not strictly required, it is highly recommended that students obtain at least one textbook for future reference, items A and B have a broad focus and are highly recommended for this purpose. The instructor will provide electronic copies of relevant reading materials.

#### *Primary References:*

- (A) *Introduction to Coastal Engineering and Management* (2010), William J. Kamphuis, World Scientific (2<sup>nd</sup> Edition)
- (B) *Coastal Processes with Engineering Applications* (2002) by Robert G. Dean and Robert A. Dalrymple, Cambridge University Press.
- (C) *Water Wave Mechanics for Engineers and Scientists* (1991), Robert G. Dean and Robert A. Dalrymple, World Scientific.

#### *Additional References:*

- (D) *Basic Coastal Engineering* (1978), Robert M. Sorensen, John Wiley & Sons.
- (E) *Coastal Engineering Manual* (2002), U.S. Army Corp of Engineers, downloadable from the link: <https://www.publications.usace.army.mil/USACE-Publications/Engineer-Manuals/u43544q/636F617374616C20656E67696E656572696E67206D616E75616C/>
- (F) *Beach Processes and Sedimentation* (1997), Paul D. Komar, (2nd Edition).
- (G) *Introduction to Nearshore Hydrodynamics* (2006), Ib A. Svendsen, World Scientific.

### **Course Materials and Communications:**

- Lecture notes, recorded lecture videos, supplementary materials, homework assignments, grades, discussions, and announcements will be posted on Canvas (<https://canvas.fiu.edu/>).
- Students can directly email the instructor, send message through Canvas, or meet the instructor during office hours. Please allow 24 hours to receive response to an email or message before following up.
- If you need help with communicating through Canvas, refer to [Canvas Conversations Tutorial](#) or [Canvas Guide](#).

### **Homework:**

- There will be five homework assignments.
- Late homework will have a 10% penalty each day after the due date and will not be graded after three days.
- Group work is accepted but blind copying is not allowed.

### **Exams:**

- There will be a midterm and a final exam.

- Be prepared to present your ID during the exam if requested.
- Missing an exam means an automatic zero for that exam. If a student is not able to make an exam, they should take it at a different date. A valid reason with documentation (if applicable) should be presented to the instructor.

**Grade Evaluation:**

Homework 30%, Mid-term exam 30%, Final exam 35%, Attendance and Attitude 5%

**Grading Scale:**

Letter	Range (%)
A	90 or above
A-	85 - 89
B+	80 - 84
B	75 - 79
B-	70 - 74
C+	65 - 69
C	60 - 64
D	50 - 59
F	50 or less

**Tentative Course Schedule:**

Wk	Date	Topics	Read
1	Aug. 25	Course logistics and Introduction, Examples of coastal engineering projects, Introduction to water waves, Mathematical description of waves	A1,2
2	Sep. 1	<b>Labor day- No Class</b>	
3	Sep. 8	Linear wave theory, Dispersion relationship, Pressure and particle location, velocity, and acceleration under linear waves ( <b>HW#1 Distributed</b> )	A2, B3
4	Sep. 15	Wave energy, Energy flux, Group velocity, Wave reflection, Standing waves	B4
5	Sep. 22	Wave transformation and Dissipation, Shoaling, Refraction, Diffraction, Breaking ( <b>HW#1 Due, HW#2 Distributed</b> )	A6
6	Sep. 29	Random waves, Short-term waves analysis: Time domain analysis, Rayleigh distribution for wave heights; Frequency domain analysis; Wave spectrum	A3, B7
7	Oct. 6	Long-term wave analysis: Peak-over-Threshold method; Return period; Calculation of design waves ( <b>HW#2 Due, HW#3 Distributed</b> )	A5
8	Oct. 13	Wave generation: Wind wave generation; Fetch; Wave hindcasting and forecasting, Midterm review	A4
9	Oct. 20	<b>Midterm Exam in Class</b>	
10	Oct. 27	Tides, Storm Surge, Sea Level Rise ( <b>HW#3 Due, HW#4 Distributed</b> )	B4
11	Nov. 3	Wave Setup, Longshore Currents, Cross-shore currents	B5
12	Nov. 10	Response of beach profile to sea level rise; Depth of closure; Longshore and cross-shore sediment transport; Equilibrium beach profile ( <b>HW#4 Due</b> )	B7,8

13	Nov. 17	Design of beach nourishment ( <b>HW#5 Distributed</b> )	B11
14	Nov. 24	Nature-based solutions for coastal protection: wave-vegetation interaction, hybrid solutions	Notes
15	Dec. 1	Overview of coastal protection alternatives; Contemporary considerations in coastal management; Final Exam review ( <b>HW#5 Due</b> )	A11, 17

### **Attendance and Etiquette:**

Class attendance and participation in class discussion is highly encouraged. A portion of the course grade (5%) will be given to attendance and adherence to proper classroom etiquette, but a student's active engagement and etiquette or lack thereof can affect the course grade, particularly if the grade is at borderline.

- Class attendance is documented by signing the class roll or completing quizzes on Canvas.
- Respect the classroom environment: Listen attentively when the professor is speaking or a student is asking a question, adhere to the rules and expectations set by the professor, use respectful language and tone, avoid side conversations.
- Engage in class discussions.
- No distractions: silence your cell phone, no cell phone or laptop use for non-class matters.

### **Academic Misconduct:**

Students are expected to uphold the standards of academic integrity and the policies of the University regarding conduct. Cheating and plagiarism will not be tolerated; these offenses could result in failing the course, and suspension or expulsion from the University. All work submitted on this course must be your own. Contributions from anyone else or AI sources are not acceptable. Refer to the FIU Student Code of Conduct (<https://regulations.fiu.edu/docs=338>) for full details on what constitutes academic dishonesty and misconduct, as well as the procedures for resolution of pertaining matters within the University judiciary procedures.

### **Principles of this Course:**

This course is designed to serve all students, regardless of their background, by fostering collaboration and encouraging open participation. In alignment with FIU's endorsement of the Florida Board of Governors' Statement of Free Expression, this course supports full and open discourse. Civil and respectful discussion is fundamental to critical thinking, both within the classroom and in broader university events, and is highly encouraged.

### **Accessibility and Accommodation:**

The Disability Resource Center provides FIU students with disabilities with the necessary support. If you need academic accommodation, please contact DRC at 305-348-3532 or visit them at the Graham Center GC 190. For additional information visit [Disability Resource Center](#).

### **Nondiscrimination Statement:**

The Office of Civil Rights Compliance and Accessibility (CRCA) is responsible for ensuring that FIU maintains a workplace and learning environment free from discrimination. If any student, employee, or applicant has a sincere and reasonable belief that they have been discriminated against or harassed based on age, color, disability, gender, marital status, ethnic or national origin, race, religion, retaliation, sex, or any other protected category, they can report their concerns to CRCA through [report.fiu.edu](http://report.fiu.edu).