METU, Department of Civil Engineering

CE 492 – COASTAL ENGINEERING II

2024-2025 Fall Semester

Instructor & Teaching Assistant	Office	E-mail	Office Hours
Dr. Hasan Gökhan Güler	K5-011	goguler {at} metu.edu.tr	By appointment
Barış Ufuk Şentürk	K5-107	ufuk {at} metu.edu.tr	By appointment
Course Schedule: Tuesdays between 13.40-16.30 @ TH7		**Course Webpage:** ODTUCLASS	

Course objectives: The aim of this course is to enhance understanding of coastal erosion, storm surge, and sea level rise as critical and emerging issues for coastal environments, driven by climate change and human activities. The course will cover methods essential for addressing these challenges. Students will have the opportunity to learn about the hydrodynamics of random sea waves, sea level variations, and principles of coastal sediment transport, and to apply their knowledge to analyze coastal engineering problems using numerical modeling tools.

TENTATIVE COURSE OUTLINE

1. Introduction
1.1. Field of coastal engineering
1.2. Description of course content and policy

2. Hydrodynamics of random sea waves
2.1. Basic wave parameters
2.2. Fundamentals of surface wave problem
2.3. Statistical properties of sea waves
2.4. Nearshore wave transformation: Shoaling, refraction, breaking, diffraction.
2.5. Wave statistics: Long-term & extreme-term

3. Tides, sea level variations and currents
3.1. Astronomical tide generation and characteristics
3.2. Global tidal environments
3.3. Coastal impact of tides and classifications
3.4. Sea level variations
3.5. Nearshore currents

4. Principles of coastal sediment transport
4.1. Sediment properties: Grain size, density, settling velocity
4.2. Initiation of motion: Shields curve
4.3. Modes of sediment transport: Bed-load, suspended, sheet flow
4.4. Bed features

5. Cross-shore sediment transport
5.1. Equilibrium beach profile
5.2. Cross-shore beach morphodynamics

6. Longshore sediment transport
6.1. Sediment budget concept
6.2. Longshore sediment transport
6.3. Calculation of shoreline position (One-line theory)
6.4. Shore response to coastal structures

7. Design of coastal protection measures
7.1. Coastal protection strategies and methods
7.2. Design of structures influencing longshore transport rates: Hard and soft measures
7.3. Design of structures protecting against storm-induced erosion and storm-surge: Serviceability and stability
7.4. Design of artificial beach nourishment

8. Nature-based solutions
8.1. Principles of building with nature and natural systems understanding in engineering designs
8.2. Salt marshes, coral reefs, mangrove forests, oyster beds
8.3. Hybrid solutions

9. Climate change adaptations; resilience and sustainability of coastal environments
9.1. Climate change impacts on coastal environments and adaptation measures
9.2. Building resilient coastal communities: Recent engineering practices and case studies
9.3. Sustainability of coastal environments: Recent engineering practices and case studies

TEXTBOOKS

- Bosboom, J. & Stive, M.J.F. (2021). *Coastal Dynamics*. Delft University of Technology, Delft, The Netherlands. *(freely available at https://textbooks.open.tudelft.nl/textbooks/catalog/book/37).*
- Ergin, A. (2019). *Coastal Engineering (2nd Edition).* METU Press. *(can be found at METU Bookstore).*

ESSENTIAL REFERENCES

- Kamphius, J.W. (2000). *Introduction to Coastal Engineering and Management.* World Scientific.
- Sorensen, R.M. (2006). *Basic Coastal Engineering (3rd Edition).* Springer.
- Fredsoe, J. & Deigaard, R. (1992). *Mechanics of Coastal Sediment Transport.* World Scientific.
- Soulsby, R. (1997). *Dynamics of Marine Sands: A manual for practical applications.* Thomas Telford Publications.
- Slinger, J. (2021). *Building with Nature & Beyond.* Delft University of Technology, Delft, The Netherlands. *(freely available at https://textbooks.open.tudelft.nl/textbooks/catalog/book/45).*
- AYGM (2015). *Technical Guideline for Planning and Design of Coastal Structures.* Republic of Turkey, Ministry of Transport, Maritime, Affairs and Communications, Directorate General of Infrastructure Investments. (in Turkish).
- EurOtop (2018). *Manual on wave overtopping of sea defences and related structures. An overtopping manual largely based on European research, but for worldwide application (2nd Edition). (freely avaiable at www.overtopping-manual.com).*

GRADING POLICY

Attendance and participation (6%), Homework (9%), Design work (30%), Midterm (25%), Final (30%)

GENERAL RULES

- The information given in this syllabus is tentative. Your instructor will let you know any changes during the semester.
- It is your responsibility to follow the course website and e-mails sent by your instructor or teaching assistant.
- Every week, all the course materials, including the lecture notes, will be uploaded to the course website.
- Attendance in the classes is highly recommended. Students that attend less than 70% of the course will be graded NA.
- Homework and design work constitute an essential part of the course. You should submit polished reports and your reports must include a detailed discussions section. Assignments and design work submitted after the deadline will lose 5 points every 24 hours.
- A make-up will be given after the final exam. If you miss both the midterm and the final, the make-up exam will be counted only for the final exam.
- Please make sure you read the “METU Academic Integrity Guide for Students”.

Course Learning Outcomes		Program Student Outcomes						
	Definition	**1**	**2**	**3**	**4**	**5**	**6**	**7**
1	**Describe the fundamentals of the random sea wave hydrodynamics.**	X						
	How will be measured?	Midterm; Final; Homework; Design Project						
	When will be measured?	Throughout the entire course.						
2	**Describe the principles of coastal sediment transport.**	X	X					
	How will be measured?	Midterm; Final; Homework; Design Project						
	When will be measured?	Throughout the entire course.						
3	**Calculate net longshore sediment budget.**	X	X					X
	How will be measured?	Final; Homework; Design Project						
	When will be measured?	During the second half of semester.						
4	**Design of coastal protection structures (hard measures).**	X	X			X		X
	How will be measured?	Final; Homework; Design Project						
	When will be measured?	During the second half of semester.						
5	**Design of soft coastal protection measures.**	X	X			X		X
	How will be measured?	Final; Homework; Design Project						
	When will be measured?	During the second half of semester.						
6	**Identify nature-based solution alternatives for coastal protection problems.**	X	X		X	X		X
	How will be measured?	Final; Homework; Design Project						
	When will be measured?	During the second half of semester.						

Civil Engineering Program Student Outcomes

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.