湖北工業大學
HUBEI UNIVERSITY OF TECHNOLOGY

Course Title	Coastal and Offshore Engineering I: Wave Mechanics and Hydrodynamics
Course Code	GENG 5513
Semester	Winter 2027
Course Length	8 Weeks, 60 Contact Hours
Credits	4
Instructor	TBA
Office	TBA
Email	TBA
Prerequisite(s)	Admission to the Master of Professional Engineering, Master of Offshore and Coastal Engineering, or an engineering honours program; basic fluid mechanics or hydraulics is recommended.
Antirequisite	GENG 5511 Coastal and Offshore Engineering I: Wave Mechanics and Hydrodynamics (4 Weeks)

Course Description:

This course is the first part of a two-part sequence in coastal and offshore engineering. It establishes the fluid mechanics and wave theory foundations needed to understand and analyse the marine environment. Students examine the physical behaviour of ocean waves, progressing from linear and nonlinear wave theories through wave transformation, random wave spectra, wave statistics and forecasting, and the design wave, and conclude with the prediction of wave forces on offshore structures.

The course balances analytical derivation with engineering application. For each method, students examine the governing equations, the underlying assumptions, and the range of conditions over which it remains valid, so that they can apply it with engineering judgement rather than as an isolated formula. Worked examples and workshop calculations are used throughout to connect theory with realistic engineering problems.

Through worked examples, workshop calculations, and structured assignments, students develop quantitative problem-solving skills and clear technical communication. The course prepares them for the second course in the sequence, which covers structural response, nearshore hydrodynamic processes, sediment transport, and the design of coastal and offshore structures.

Course Goals:

Students who successfully complete this course will demonstrate competency in the following general education core goals:

- **Critical Thinking Skills** - Students will engage in analytical thinking, demonstrating the ability to critically evaluate, synthesize, and apply knowledge to complex problems, and construct well-reasoned solutions and arguments.
- **Independent Research and Inquiry** - Students will conduct independent research, utilizing academic resources to explore relevant topics, formulating research questions, analyzing data, and presenting findings in a coherent, scholarly manner.
- **Problem-Solving and Application** - Students will apply theoretical concepts and methodologies learned in the course to real-world problems, demonstrating the ability to develop practical solutions informed by academic inquiry.
- **Global and Cultural Awareness** - Students will gain awareness of the global and cultural contexts relevant to the course, appreciating diverse perspectives and considering the implications of their studies in a broader, international context.

Student Learning Outcomes:

Upon completion of this course, students will be able to:

- Apply fluid mechanics principles to marine and wave problems.
- Choose and apply appropriate wave theories (analytical and numerical) for different engineering conditions.
- Analyse wave transformation, including shoaling, refraction, diffraction, reflection, and breaking.
- Describe random sea states using wave spectra and wave statistics.
- Use wave forecasting and extreme value analysis to determine design waves.
- Predict wave loading on offshore structures using the Morison equation and diffraction theory.
- Communicate quantitative engineering results clearly through calculations and reports.

Textbooks:

- Dean, R. G., & Dalrymple, R. A. (1991). *Water wave mechanics for engineers and scientists* (2nd ed.). World Scientific.
- Kamphuis, J. W. (2010). *Introduction to coastal engineering and management* (2nd ed.). World Scientific.
- Reeve, D., Chadwick, A., & Fleming, C. (2018). *Coastal engineering: Processes, theory and design practice* (3rd ed.). CRC Press.
- Goda, Y. (2010). *Random seas and design of maritime structures* (3rd ed.). World Scientific.
- Sorensen, R. M. (2006). *Basic coastal engineering* (3rd ed.). Springer.
- Sarpkaya, T., & Isaacson, M. (1981). *Mechanics of wave forces on offshore structures*. Van Nostrand Reinhold.

Course Requirements:

Assignment 1: Wave Mechanics Problems (15%)
Students will complete a set of quantitative problems covering fluid foundations and the properties of linear and nonlinear waves. Solutions must show the governing equations, full working, and correct units, and should demonstrate understanding of the assumptions behind each theory.

Assignment 2: Wave Transformation & Spectral Analysis (15%)
Students will solve problems on shoaling, refraction, diffraction, and the description of random waves using spectra and short-term statistics. The exercise tests the ability to follow wave energy from deep water into the surf zone and to interpret a sea state quantitatively.

Assignment 3: Wave Force Calculations (20%)
Students will calculate the wave loading on offshore members, applying the Morison equation and distinguishing the drag and inertia components, and will identify the conditions under which diffraction theory is required instead. The assignment should include:

- Identification of the structure as slender or large relative to the wave length.
- Selection of appropriate drag and inertia coefficients.
- Calculation of drag and inertia forces and their combination.
- A comparison with the diffraction-based approach for large bodies.
- Clear statements of assumptions, units, and the design basis.

Final Examination (50%)
A closed-book examination covering wave theory, wave transformation, random waves and spectra, wave forecasting and extreme analysis, and the prediction of wave forces. The examination includes both conceptual questions and quantitative problems.

Assessments: Activity	**Percent Contribution**
Assignment 1: Wave Mechanics Problems	15%
Assignment 2: Wave Transformation & Spectral Analysis	15%
Assignment 3: Wave Force Calculations	20%
Final Examination	50%

Grading:

Final grades will be based on the sum of all possible course points as noted above.

Grade	**Percentage of available points**
A	94-100
A-	90-93
B+	87-89
B	84-86
B-	80-83
C+	77-79

C	74-76
C-	70-73
D	64-69
D-	60-63
F	0-59

Course Schedule:
The schedule of activities is subject to change at the reasonable discretion of the instructor. Minor changes will be announced in class, major ones provided in writing.

GENG 5513 Schedule		
Lecture	Topic	Readings
L1	Introduction to Coastal and Offshore Engineering	Reeve, D., Chadwick, A., & Fleming, C. (2018). *Coastal engineering: Processes, theory and design practice* (3rd ed.). CRC Press, Chapter 1.
L2	The Marine Environment and Engineering Challenges	Kamphuis, J. W. (2010). *Introduction to coastal engineering and management* (2nd ed.). World Scientific, Chapters 1–2.
L3	Fluid Properties and Hydrostatics	Dean, R. G., & Dalrymple, R. A. (1991). *Water wave mechanics for engineers and scientists* (2nd ed.). World Scientific, Chapter 1.
L4	Fluid Kinematics and Conservation Laws	Dean, R. G., & Dalrymple, R. A. (1991). *Water wave mechanics for engineers and scientists* (2nd ed.). World Scientific, Chapter 2.
L5	Flow Dynamics and the Bernoulli Equation	Sorensen, R. M. (2006). *Basic coastal engineering* (3rd ed.). Springer, Chapter 1.
L6	Boundary Layers and Viscous Effects	Sarpkaya, T., & Isaacson, M. (1981). *Mechanics of wave forces on offshore structures*. Van Nostrand Reinhold.
L7	Small Amplitude (Airy) Wave Theory	Dean, R. G., & Dalrymple, R. A. (1991). *Water wave mechanics for engineers and scientists* (2nd ed.). World Scientific, Chapter 3.
L8	Wave Kinematics: Velocities, Accelerations and Orbits	Dean, R. G., & Dalrymple, R. A. (1991). *Water wave mechanics for engineers and scientists* (2nd ed.). World Scientific, Chapter 3.
L9	Dynamic Pressure, Wave Energy and Power	Kamphuis, J. W. (2010). *Introduction to coastal engineering and management* (2nd ed.). World Scientific.
L10	Finite Amplitude Waves: Stokes Theory	Dean, R. G., & Dalrymple, R. A. (1991). *Water wave mechanics for engineers and scientists* (2nd ed.). World Scientific, Chapter 4.
L11	Cnoidal and Solitary Wave Theories	Sorensen, R. M. (2006). *Basic coastal engineering* (3rd ed.). Springer, Chapter 2.
L12	Selection and Validity of Wave Theories	Kamphuis, J. W. (2010). *Introduction to coastal engineering and management* (2nd ed.). World Scientific.
L13	Shoaling and Waves in Shallow Water	Reeve, D., Chadwick, A., & Fleming, C. (2018). *Coastal engineering: Processes, theory and design practice* (3rd ed.). CRC Press, Chapter 2.

L14	Refraction and Diffraction	Sorensen, R. M. (2006). *Basic coastal engineering* (3rd ed.). Springer, Chapters 3–4.
L15	Reflection, Wave Breaking and Energy Dissipation	Kamphuis, J. W. (2010). *Introduction to coastal engineering and management* (2nd ed.). World Scientific.
L16	Random Waves and the Description of Sea States	Goda, Y. (2010). *Random seas and design of maritime structures* (3rd ed.). World Scientific, Chapter 2.
L17	Wave Spectra and Spectral Analysis	Goda, Y. (2010). *Random seas and design of maritime structures* (3rd ed.). World Scientific, Chapter 3.
L18	Short-Term Wave Statistics and Distributions	Goda, Y. (2010). *Random seas and design of maritime structures* (3rd ed.). World Scientific, Chapter 4.
L19	Wind Wave Generation and Wave Forecasting	Reeve, D., Chadwick, A., & Fleming, C. (2018). *Coastal engineering: Processes, theory and design practice* (3rd ed.). CRC Press, Chapter 3.
L20	Extreme Value Analysis and Return Periods	Goda, Y. (2010). *Random seas and design of maritime structures* (3rd ed.). World Scientific, Chapter 5.
L21	Design Wave and Design Water Level	Reeve, D., Chadwick, A., & Fleming, C. (2018). *Coastal engineering: Processes, theory and design practice* (3rd ed.). CRC Press, Chapter 3.
L22	Morison Equation for Slender Structures	Morison, J. R., O'Brien, M. P., Johnson, J. W., & Schaaf, S. A. (1950). The force exerted by surface waves on piles. *Petroleum Transactions, AIME, 189*, 149–154; and Sarpkaya, T., & Isaacson, M. (1981). *Mechanics of wave forces on offshore structures*. Van Nostrand Reinhold.
L23	Drag and Inertia Coefficients	Sarpkaya, T., & Isaacson, M. (1981). *Mechanics of wave forces on offshore structures*. Van Nostrand Reinhold.
L24	Diffraction Theory and Forces on Large Bodies	Dean, R. G., & Dalrymple, R. A. (1991). *Water wave mechanics for engineers and scientists* (2nd ed.). World Scientific.
L25	Final Examination	Review all materials.

Accommodation Statement:

Academic accommodations may be made for any student who notifies the instructor of the need for an accommodation. It is imperative that you take the initiative to bring such needs to the instructor's attention. Students who may require assistance in emergency evacuations should contact the instructor as to the most appropriate procedures to follow.

Academic Integrity Statement

Each student is expected to maintain the highest standards of honesty and integrity in academic and professional matters. The University reserves the right to take disciplinary action, up to and including dismissal, against any student who is found

guilty of academic dishonesty or otherwise fails to meet the standards. Any student judged to have engaged in academic dishonesty in coursework may receive a reduced or failing grade for the work in question and/or for the course.

Academic dishonesty includes, but is not limited to, dishonesty in quizzes, tests, or assignments; claiming credit for work not done or done by others; hindering the academic work of other students; misrepresenting academic or professional qualifications within or without the University; and nondisclosure or misrepresentation in filling out applications or other University records.

Other Items:

Attendance and Expectations
All students are required to attend every class, except in cases of illness, serious family concerns, or other major problems. We expect that students will arrive on time, be prepared to listen and participate as appropriate, and stay for the duration of a meeting rather than drift in or out casually. In short, we anticipate that students will show professors and fellow students maximum consideration by minimizing the disturbances that cause interruptions in the learning process. This means that punctuality is a must, that cellular phones be turned off, and that courtesy is the guiding principle in all exchanges among students and faculty. You will be responsible for the materials and ideas presented in the lecture.

Assignment Due Dates
All written assignments must be turned in at the time specified. Late assignments will not be accepted unless prior information has been obtained from the instructor. If you believe you have extenuating circumstances, please contact the instructor as soon as possible.

Make-Up Work
The instructor will not provide students with class information or make-up assignments/quizzes/exams missed due to an unexcused absence. Absences will be excused and assignments/quizzes/exams may be made up only with written documentation of an authorized absence. Every effort should be made to avoid scheduling appointments during class. An excused student is responsible for requesting any missed information from the instructor and setting up any necessary appointments outside of class.

Access, Special Needs, and Disabilities
Please notify the instructor at the start of the semester if you have any documented disabilities, a medical issue, or any special circumstances that require attention, and the school will be happy to assist.