OCE512/OCG512 Ocean waves and storm surge modeling – Spring 2022
Tues and Thurs, 12:30-1:45

1. Instructor: Dr. Tetsu Hara, Professor of GSO
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Office Hours: Immediately following lectures or by appointment

2. Prerequisite: Pre-requisite OCE408 or equivalent

3. Handouts: Lecture notes will be available online ahead of each lecture

4. Course Description

This course is designed to provide a student with basic physical understanding of ocean waves (wind wave generation, evolution, dissipation, wave-current interaction) and storm surge, as well as information about state-of-the-art modeling and observations of these processes.

By completing the final project a student will also acquire a hands-on experience of wind waves and/or storm surge modeling.

This course is suitable as an elective course for senior level Ocean Engineering students.

5. Learning Outcomes

By taking this class, a student will be able to

(1) understand the basic physics behind the operational waves and storm surge models,

(2) properly assess the capability and limitations of these models,

(3) understand how these models have evolved and how they will likely improve in the near future, as our physical understanding of these processes increases and improved computational resources become available.

6. Expectations

The students taking this course are expected to attend the lectures, do the homework sets, take the mid-term examination, and perform the final project.

7. Grading:

The grading will be administered as follows:

Homework sets 30%

Mid-term examination	40%
Final project	30%
TOTAL	100%

Homework sets will be due 1 week from the date assigned. These will be open book exercises designed to sharpen your skills as well as to cover material that we could not cover in detail in class.

The mid-term exam (75 min) will be open book. This is designed to test your creativity in problem solving and how well you have synthesized the material.

The final project is designed to provide you with modeling experience of ocean waves and/or storm surge. First, a student is required to make a short presentation (10-15 min) of his/her final project during the last 2 classes. Second, a student is required to submit a written final project report (5-10 pages in a pdf format) by the due date.

8. Course Calendar (tentative):

1/25 Introduction
1/27 Basic fluid dynamics
2/1 Small amplitude wave theory
2/3 Wave momentum and energy
2/8 Generation of wind waves, wind forcing
Homework Set 1 due
2/10 Nonlinear interaction of surface waves
2/15 Statistical description of ocean surface waves (wave spectrum)
2/17 Conservation of wave action. Observation of wave spectrum
2/22 Interaction between waves and currents
Homework Set 2 due
2/24 Interaction between waves, currents, and varying depth
3/1 NO CLASS (Ocean Sciences Meeting)
3/3 NO CLASS (Ocean Sciences Meeting)
3/8 Statistics of wave breaking
3/10 Observation of breaking waves
Homework Set 3 due
3/15 NO CLASS (Spring Break)
3/17 NO CLASS (Spring Break)
3/22 Wave spectrum at high frequencies (equilibrium and saturation spectra)
3/24 Midterm Examination
3/29 Governing equations of 3D storm surge model
3/31 Linear 2D storm surge model
Homework Set 4 due
4/5 Bottom friction and atmospheric forcing
4/7 Wave set down
Homework Set 5 due
4/12 Wave set up

4/14 Inundation
4/19 Operational wave and storm surge models
4/21 Coupled atmosphere-wave-ocean modeling
4/26 Final project presentations
4/28 Final project presentations

5/5 Final Project Report due (at 5pm)

9. Supplementary texts:

Dynamics and Modelling of Ocean Waves
G. J. Komen et al.
Cambridge University Press