

"Estuary, Coast and Shelf Dynamics" Syllabus

Department of Oceanography

OCEA4222 Fall 2025

Dalhousie University acknowledges that we are in Mi'kma'ki, the ancestral and unceded territory of the Mi'kmaq People and pays respect to the Indigenous knowledges held by the Mi'kmaq People, and to the wisdom of their Elders past and present. The Mi'kmaq People signed Peace and Friendship Treaties with the Crown, and section 35 of the Constitution Act, 1982 recognizes and affirms Aboriginal and Treaty rights. We are all Treaty people.

Dalhousie University also acknowledges the histories, contributions, and legacies of African Nova Scotians, who have been here for over 400 years.

Course Instructor(s)

Name	Email	Office Hours
Jinyu Sheng	Jinyu.Sheng@dal.ca	Wed and Fri, 14:00-17:00 Room 5676, Oceanography

Course Description

Course description from the Academic Calendar:

Coastal and estuarine waters play a very special role in the global economy. It is estimated that half of the global population currently lives in the coastal zone. This coastal zone population is expected to increase steadily with time in future. Better understanding of estuary, coastal and shelf circulation will therefore lead to a more effective management of coastal natural resources. This class takes an analytical approach to describe coastal-trapped waves with wavelengths much greater water depth, tidal circulation and tidal mixing, and three-dimensional circulation over the coastal and shelf regions. Topics to be discussed also include estuary circulation, thermohaline circulation, coastal upwelling, and instability of coastal currents.

Course Prerequisites:

Introductory classes in fluid mechanics and physical oceanography are helpful.

Course Exclusions:

None

Student Resources

List and describe the additional resources available to students (e.g., office hours, resource centers, etc.). Make sure to include when, where and how students can access these resources.

Course Structure

Course Delivery

Coastal and estuarine waters play a very special role in the global economy. It is estimated that half of the global population currently lives in the coastal zone. This coastal zone population is expected to increase steadily with time in future. Better understanding of estuary, coastal and shelf circulation will therefore lead to a more effective management of coastal natural resources. This class takes an analytical approach to describe coastal-trapped waves with wavelengths much greater water depth, tidal circulation and tidal mixing, and three-dimensional circulation over the coastal and shelf regions. Topics to be discussed also include estuary circulation, thermohaline circulation, coastal upwelling, and instability of coastal currents.

Lectures

13:05-14:25 on Tuesday and Thursday in LSC-OCEANOGRAPH 03652

Laboratories

None

Tutorials

Wednesday and Friday, 14:00-17:00 in Room 5676, Department of Oceanography

Course Materials

The main objective of this course is to assist graduate students (a) to understand important physical processes operative on the coastal and continental shelf and (b) to master appropriate skills required for predicting marine environmental conditions.

Students will gain in depth knowledge of hydrodynamics over coastal and shelf waters after competing the course.

Course contents:

Chapter 1: Introduction

- 1.1 Distinctive Features of Coastal and Estuarine Waters
- 1.2 Their Practical Significance

Chapter 2: Review of Basic Equations

- 2.1 Three Types of Basic Equations
- 2.2 Review of Three Approximate Systems
 - 2.2.1 Geostrophic Currents
 - 2.2.2 Ekman Theory
 - 2.2.3 Shallow Water Equation

Chapter 3: Shelf Waves with Long Wavelengths

- 3.1 Basic Characteristics of Long Waves
- 3.2 Long Wave Approximations
 - 3.2.1 Kelvin Waves
 - 3.2.2 Sverdrup Waves
 - 3.2.3 Poincare Waves
- 3.3 Planetary and Topographic Waves
- 3.4 Numerical Simulations of SWE

Chapter 4: Tides and Tidal Mixing

- 4.1 Tidal forces
- 4.2 Equilibrium Tides
- 4.3 Dynamical Tide Theory
- 4.4 Tidal Analysis
- 4.5 Tidal Mixing and Dissipation

Chapter 5: Estuary Circulation

- 5.1 Classification of Estuaries
 - 5.1.1 Classification by Topography
 - 5.1.2 Classification on Salinity Structure
 - 5.1.3 Classification using Stratification
- 5.2 Salt Balance in Estuaries
- 5.3 Dynamic Balance and Flushing Time

Chapter 6: Three-Dimensional Shelf Circulation

- 6.1 Steady-State Circulation Driven by Wind and Pressure Gradients
- 6.2 Barotropic Waves Generated by Storms Moving Rapidly over Coastal Waters
- 6.3 Wind-Induced Inertial Circulations in the Mixed Layer
- 6.4 Baroclinic Shelf Response to Wind Forcing

Reference books for this course are:

1. The Open University, *Waves, Tides and Shallow-Water Processes*, Butterworth-Heinemann, 227 pp., 1999. (GC 211.2 W38).
2. Bowden, K. F., *Physical Oceanography of Coastal Waters*, John Wiley, 302 pp., 1983. {GC 150.5 B69}.
3. Dyer, K. R., *Estuaries: A Physical Introduction*, John Wiley, 140 pp., 1973. (GC97 D93).
4. Hill, E., Chapter 2. Buoyancy Effects in Coastal and Shelf Seas, *The Sea*, Volume 10, 1998 (GC 11 S43).
5. Csanady, G. T., *Circulation in the Coastal Ocean*, Reidel, 264 pp., 1982. (GC 228.5 C74).
6. Gill, A. E., *Atmosphere-Ocean Dynamics*, Academic Press, 662 pp., 1982. (GC 190 G54). Chapter 6: sections 1-13; Chapter 7: sections 1-7; Chapter 8: sections 1-6; Chapter 9: sections 1-11; Chapter 10: sections 1-13.

Assessment

Component	Weight (% of final grade)	Date
Assignments	40	(TBA)
Mid-Term	10	(TBA)
Class Interactions	20	(TBA)
Final Exam	30	(TBA)

Other course requirements

None

Conversion of numerical grades to final letter grades follows the Dalhousie Grade Scale

A+ (90-100)	B+ (77-79)	C+ (65-69)	D (50-54)
A (85-89)	B (73-76)	C (60-64)	F (0-49)
A- (80-84)	B- (70-72)	C- (55-59)	

Course Policies on Missed or Late Academic Requirements

Outline your policies on missed or late academic requirements, including late or missed assignments, labs, tests, or exams. Indicate what students should do if they miss or are late with an assessment (e.g., exam, assignment, lab), and the consequence(s) of missing or being late (e.g., late penalties, alternate evaluation schemes). Indicate if students are expected to use the Student Declaration of Absence form for late or missed requirements during the term, and if so, how many times they may use the form in your course.

Course Policies related to Academic Integrity

Explain your policy on collaboration (for individual and group assignments or projects) – state explicitly whether students are allowed to work together on assignments. Indicate if and how plagiarism software (e.g., [Ouriginal](#)) will be used in the course. **It is recommended that you include a statement about your expectations around generative AI and large language models (e.g., ChatGPT).**

University Policies and Statements

Recognition of Mi'kmaq Territory

Dalhousie University would like to acknowledge that the University is on Traditional Mi'kmaq Territory. The Elders in Residence program provides students with access to First Nations elders for guidance, counsel, and support. Visit or e-mail the Indigenous Student Centre at 1321 Edward St or elders@dal.ca. Additional information regarding the Indigenous Student Centre can be found at: https://www.dal.ca/campus_life/communities/indigenous.html

Internationalization

At Dalhousie, 'thinking and acting globally' enhances the quality and impact of education, supporting learning that is "interdisciplinary, cross-cultural, global in reach, and orientated toward solving problems that extend across national borders." Additional internationalization information can be found at: <https://www.dal.ca/about-dal/internationalization.html>

Academic Integrity

At Dalhousie University, we are guided in all our work by the values of academic integrity: honesty, trust, fairness, responsibility, and respect. As a student, you are required to demonstrate these values in all the work you do. The University provides policies and procedures that every member of the university community is required to follow to ensure academic integrity. Additional academic integrity information can be found at: https://www.dal.ca/dept/university_secretariat/academic-integrity.html

Accessibility

The Student Accessibility Centre is Dalhousie's centre of expertise for matters related to student accessibility and accommodation. If there are aspects of the design, instruction, and/or experiences within this course (online or in-person) that result in barriers to your inclusion, please contact the Student Accessibility Centre (https://www.dal.ca/campus_life/academic-support/accessibility.html) for all courses offered by Dalhousie with the exception of Truro. For courses offered by the Faculty of Agriculture, please contact the Student Success Centre in Truro (<https://www.dal.ca/about-dal/agricultural-campus/student-success-centre.html>)

Conduct in the Classroom – Culture of Respect

Substantial and constructive dialogue on challenging issues is an important part of academic inquiry and exchange. It requires willingness to listen and tolerance of opposing points of view. Consideration of individual differences and alternative viewpoints is required of all class members, towards each other, towards instructors, and towards guest speakers. While expressions of differing perspectives are welcome and encouraged, the words and language used should remain within acceptable bounds of civility and respect.

Diversity and Inclusion – Culture of Respect

Every person at Dalhousie has a right to be respected and safe. We believe inclusiveness is fundamental to education. We stand for equality. Dalhousie is strengthened in our diversity. We are a respectful and inclusive community. We are committed to being a place where everyone feels welcome and supported, which is why our Strategic Direction prioritizes fostering a culture of diversity and inclusiveness (Strategic Priority 5.2). Additional diversity and inclusion information can be found at: <http://www.dal.ca/cultureofrespect.html>

Student Code of Conduct

Everyone at Dalhousie is expected to treat others with dignity and respect. The Code of Student Conduct allows Dalhousie to take disciplinary action if students don't follow this community expectation. When appropriate, violations of the code can be resolved in a reasonable and informal manner - perhaps through a restorative justice process. If an informal resolution can't be reached, or would be inappropriate, procedures exist for formal dispute resolution. The full Code of Student Conduct can be found at:

https://www.dal.ca/dept/university_secretariat/policies/student-life/code-of-student-conduct.html

Fair Dealing Policy

The Dalhousie University Fair Dealing Policy provides guidance for the limited use of copyright protected material without the risk of infringement and without having to seek the permission of copyright owners. It is intended to provide a balance between the rights of creators and the rights of users at Dalhousie. Additional information regarding the Fair Dealing Policy can be found at: https://www.dal.ca/dept/university_secretariat/policies/academic/fair-dealing-policy-.html

Originality Checking Software

The course instructor may use Dalhousie's approved originality checking software and Google to check the originality of any work submitted for credit, in accordance with the Student Submission of Assignments and Use of Originality Checking Software Policy. Students are free, without penalty of grade, to choose an alternative method of attesting to the authenticity of their work and must inform the instructor no later than the last day to add/drop classes of their intent to choose an alternate method. Additional information regarding Originality Checking Software can be found at: <https://www.dal.ca/about/leadership-governance/academic-integrity/faculty-resources/ouriginal-plagiarism-detection.html>

Student Use of Course Materials

Course materials are designed for use as part of this course at Dalhousie University and are the property of the instructor unless otherwise stated. Third party copyrighted materials (such as books, journal articles, music, videos, etc.) have either been licensed for use in this course or fall under an exception or limitation in Canadian Copyright law. Copying this course material for distribution (e.g. uploading to a commercial third-party website) may lead to a violation of Copyright law.