DALHOUSIE UNIVERSITY

Faculty of Science Course Syllabus (Section A) (revised April 2022)
Department of Oceanography
OCEA 4311/5311 Fluid Dynamics I
(Cross listed with PHYC 5311/4311)
Fall 2022

Dalhousie University is located in Mi'kma'ki, the ancestral and unceded territory of the Mi'kmaq. We are all Treaty people.

We acknowledge the histories, contributions, and legacies of the African Nova Scotian people and communities who have been here for over 400 years.

Instructor(s): Alex Hay alex.hay@dal.ca Office Hours: TBA

Lectures: TBA

Course delivery: Lectures will be delivered in-person. Virtual office hours will be held weekly with the purpose of covering questions and to ensure some time for unstructured discussion on the material. Additional problems may be worked during this time. Students who are unable to attend scheduled lectures will be required to attend office hours to ensure some face-to-face time with the instructor.

Students are encouraged to contact the instructor with any questions or concerns, or if they anticipate problems with attendance of either lectures or office hours.

Course Description

An introduction to the theory of fluid dynamics, with some emphasis on geophysically important aspects. Contents: tensor mathematics, flow kinematics, equations of motion, viscous flow, potential flow, convection, turbulence, and basic aerodynamics. Occasional reference will be made to current research topics, especially those in Physical Oceanography.

Course Prerequisites

Intended for first-year graduate students in physical oceanography, but graduate students or senior undergraduates in Mathematics or Physics are invited to take it (subject to instructor approval). Familiarity with vectors, vector calculus, ordinary differential equations, partial differential equations, complex variables and classical mechanics required

Course Exclusion

As per the calendar

Learning Objectives

The students should expect to gain a theoretical and phenomenological basis of basic fluid dynamics as a foundation for advanced courses in atmospheric science, physical oceanography, and ocean engineering. The course content will be skewed towards problems relevant to oceanography, and focus mainly on analytical methods.

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Course Materials

None are required, however the following books are recommended.

Textbook: Kundu, P. and I. M. Cohen, 2004. *Fluid Mechanics*. Elsevier Academic Press.

Complimentary and alternate: Batchelor, G.K. 2000. *An Introduction to Fluid Dynamics*. Cambridge University Press

Reference: Arfken, G.B. *Mathematical Methods for Physicists*

Course Assessment

Assessment	Weight (% of final grade)	Date
Assignments[1]	10 (60%)	Weekly
Tests/quizzes[2,5]	1 (15%)	Week 5
Final exam [3,4,5]	(25%)	*(Scheduled exam period)*

Other course requirements

10 weekly assignments will account for 60% of the total grade. They will become available on Monday of each week, and will be due the following Monday. Scanned (or photographed) copies of neatly written solutions will be acceptable, though LaTeX is preferable. Late assignments will be given a reduced grade.

Two exams will account for the remaining 40% of the total grade. A mid-term exam will be scheduled for week 5 (October 10-14) and will account for 15% of the final grade. The second exam will be scheduled during the exam week (December 9-20) and will account for 25% of the final grade.

Participation in either lectures or during office hours will be required.

If a student is unable to complete an assignment, or to attend the mid-term or final, the student is expected to contact the instructor to make appropriate arrangements to complete the work.

Conversion of numerical grades to Final Letter Grades follows the Dalhousie Common Grade Scale

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

Course Policies on Missed or Late Academic Requirements

Late assignments will only be accepted under the most extenuating circumstances. There is no option to make up missed oral examinations.

Course Policies related to Academic Integrity

This course is governed by the academic rules and regulations set forth in the University Calendar and the Senate. https://academiccalendar.dal.ca/Catalog/ViewCatalog.aspx?pageid=viewcatalog

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Course Content

Week	Content
1	Coordinate system, vector and Cartesian tensor notation, conservation of mass, material derivative
2	Continuum approximation, conservation of a scalar, molecular diffusivity,
3	Stress and strain, molecular viscosity, Newtonian fluid, conservation of momentum, Navier-Stokes equation
4	Vorticity, irrotational flow, velocity potential, stream function
5	Potential flow, sources and sinks, flow past a cylinder
6	Bernoulli equation
7	Reynolds number, Viscous flow
8	Boundary layers
9	Gravity waves
10	Turbulence
11	Instabilities