Physics 4300: Advanced Physical Oceanography
Fall 2025
Prerequisite: Physics 3300 and 3820

INSTRUCTOR: Dr. Entcho Demirov, C-4051; email: entcho@mun.ca
LECTURES: Slot 17, Tuesday and Thursday, 9:00 am - 10:15 am, C2045
COURSE WEBSITE: D2L course page, (online.mun.ca)

The course covers the basics of ocean dynamics. Topics include equations of ocean dynamics, theory and observations of general circulation, physics of ocean waves, instabilities, eddies, and mixing.

Course Outline

Oceans, their structures and geometry. History of ocean evolution.
The seawater.
Equation of state. Seawater density, sound speed, buoyancy frequency.
Forcing the ocean circulation: winds, heat, evaporation, precipitation, gravitational (tidal) force, friction force.
Ocean stratification.
Planetary Rotation. Equations of ocean dynamics.
Geostrophic balance.
Ekman balance. Ekman transport.
Ocean wind-driven currents. Western boundary currents.
Thermohaline ocean circulation.
Ocean waves. Wind waves and tides. Kelvin, inertia-gravity, planetary waves.
Instability of ocean flow. Mesoscale eddies, fronts, jets.
Ocean turbulence.

Textbook:

Benoit Cushman-Roisin, Jean-Marie Beckers, 2011. Introduction to geophysical fluid dynamics: physical and numerical aspects. Academic Press.

Complimentary and alternate*:*

R. Stewart, 2008. Introduction to physical oceanography. Open textbook library (https://open.umn.edu/opentextbooks/textbooks/20)

J. Marshall and P.A. Plumb, 2008. Atmosphere, ocean and climate dynamics : An Introductory Text, Academic Press.

I. Robinson, 2010, Discovering the ocean from space. The unique applications of satellite oceanography, Springer-Verlag.

C. Wunsch, 2015, Modern observational physical oceanography. Understanding the global ocean, Princeton University Press.

D. Olbers, J. Willebrand, C. Eden, 2012. Ocean dynamics, Springer-Verlag.

Office hours:
The office hours will be scheduled during our first class.

Marking scheme:

Presentations	20%
Assignments (5-6)	20%
Term Paper	30%
Final examination	30%

Assignments

Assignments will be posted on d2l. They will include analytical and numerical problems. Some of them will require use of computer codes and software. The solutions should be submitted electronically to d2l.

Important general information from the University

It is the student's responsibility to acquaint themselves with these items. Please read.

Missed Work: Students who cannot complete assignments or midterm tests need to speak to the instructor and consult the University Calendar, University Regulations.

Section 6.7.5: Exemptions from Parts of the Evaluation: Exemptions

Student Code of Conduct: Code of Conduct

6.8.2 Exemptions From Final Examinations
http://www.mun.ca/regoff/calendar/sectionNo=REGS-0628

Use of Recording Devices in Classrooms

The lectures and displays (and all material) delivered or provided in this course are subject to copyright owned by Dr. Demirov. It is prohibited to record or copy by any means, in any format, openly or surreptitiously, in whole or in part – in the absence of express written permission from Dr. Demirov - any of the lectures or materials provided during or from the course.

Communication and Course Continuity

In the case of a class disruption or cancellation, and in the case of revisions to evaluation methods, the instructor or the Head of the department will notify all students registered in the course via the course shell in Brightspace. Any necessary revisions to the evaluation methods will be made in consultation with the students registered in this course. If a student demonstrates that they would be disadvantaged by the change, then, as per 6.7.4 of the University Calendar, accommodations will be made.

6.12 Academic Misconduct
http://www.mun.ca/regoff/calendar/sectionNo=REGS-0748

Accommodations for Students with Disabilities
Memorial University of Newfoundland is committed to supporting inclusive education based on the principles of equity, accessibility and collaboration. Accommodations are provided within the scope of the University Policies for the Accommodations for Students with Disabilities. Students who may need an academic accommodation are asked to initiate the request with the Glenn Roy Blundon Centre at the earliest opportunity. (http://www.mun.ca/blundon/accommodations/)

Wellness and Student Support:
Your mental well-being is important. Don't hesitate to make use of available support:
Student Support: http://www.mun.ca/currentstudents/student/
Wellness and Counselling: http://www.mun.ca/currentstudents/wellness/
Academic Support: http://www.mun.ca/currentstudents/academic/

Generative Artificial Intelligence (GAI):

The submission of work that has been created by generative artificial intelligence (GAI) tools and presented as a student's original work is considered an academic offence in this course. Students may not use GAI in any of the following ways:

(i) Submitting an assignment presented as their own. This includes but is not limited to essays, research papers, computer code, and solutions to mathematical problem.

(ii) Using GAI as an aid to completing an assignment, such as paraphrasing from GAI content.

(iii) Submitting answers to any quiz, test, or exam question using GAI solutions. For more information review the library's Academic integrity page: https://www.library.mun.ca/researchtools/guides/integrity/