

EAS475/587: Dynamics of the Atmosphere and Ocean

Fall Term, 2023

Instructor: B. R. Sutherland

Office: CCIS 3-269

Email: bruce.sutherland@ualberta.ca

Web Page: www.ualberta.ca/~bsuther/courses/eas475.html

Office Hours: by appointment

Lecture Room & Time: 2:00-3:20 TR, ESB 1-33

COURSE CONTENT

Course Description:

- Overview of the structure and dynamics of the atmosphere and ocean
- Equations of motion: Euler and Lagrange descriptions, mass conservation, momentum conservation (pressure, Coriolis, buoyancy), internal energy conservation (thermodynamics), Boussinesq and anelastic approximations.
- Approximation methods, synoptic scale flows, geostrophic balance, thermal wind balance, Ekman pumping and transport, Sverdrup balance and transport, Rossby and Ekman numbers, Taylor-Proudman effect
- Surface waves in deep and shallow water, surface waves influenced by rotation: inertial (Poincaré) waves, Kelvin waves and Rossby waves, surface waves at the equator.
- Waves in stratified fluid: interfacial waves and waves in uniform stratification, Boussinesq and anelastic internal waves.
- Transition to turbulence: Kelvin-Helmholtz instability, Hölmboe instability, Taylor-Caulfield instability.

Course Prerequisites:

EAS212 and EAS 371, or consent of instructor. EAS587 is concurrent with EAS475 and is not available to students with credit in EAS 475.

Course Objectives and Expected Learning Outcomes:

Students will develop a proficiency in understanding key variables characterizing the atmosphere and ocean and will develop skills in solving diagnostic and prognostic equations that characterize and predict the evolution of currents and waves in the atmosphere and ocean.

LEARNING RESOURCES

Major Course Materials:

- There is no required textbook for this course.
- Lectures notes are posted on the website given above.
- Also see the course website (above) for assignments and their solutions (posted after each assignment is handed in), practise exams and other course-related material.

Optional Learning Resources:

The following textbooks may be used for reference:

- “*Atmospheric and Oceanic Fluid Dynamics*”, G. K. Vallis, Cambridge University Press
- “*Atmosphere-Ocean Dynamics*”, A.E. Gill, Academic Press
- “*Internal Gravity Waves*”, B.R. Sutherland, Cambridge University Press

Seminar:

The seminar time (SEM E01) is scheduled for Thursdays 11:00-12:20, but it will not be weekly, and the day and time may change (with agreement from the class) to accommodate students with conflicts. The seminar will be used on three occasions during term to demonstrate in the experimental lab (CCIS 3-257) fluid phenomena (Ekman pumping, Taylor columns, waves, etc) that are discussed in lectures.

The Academic Success Centre (www.ualberta.ca/current-students/academic-success-centre/) provides professional academic support to help students strengthen their academic skills and achieve their academic goals. Individual advising, appointments, and group workshops are available year round in the areas of Accessibility, Communication, Learning, and Writing Resources. Modest fees apply for some services.

GRADE EVALUATION

Marking Scheme:

For students enrolled in EAS475, grades will be determined by 4 assignments (equally weighted at 15% each) and the final exam.

- EAS475 grade breakdown: 60% Assignments; 40% Final Exam

For students enrolled in EAS587, grades will be determined by 4 assignments (equally weighted at 10% each), an oral presentation (to be given in class on Tuesday, December 7), and the final exam.

- EAS587 grade breakdown: 40% Assignments; 20% Oral Presentation; 40% Final Exam

Assignments:

There will be four homework assignments, each worth equal weight (15% or 10% each of final grade depending upon enrollment in EAS475 or EAS587, as specified above).

Assignments will be handed out in class and also posted on the course website (above). Solutions will be posted on the course website shortly after the time the assignment is due.

Important Dates:

Final Exam: 9am-noon, Monday, December 20, in ESB 1-33

Deferred Exam: TBA

Students must verify the final exam date on BearTracks when the Final Exam Schedule is posted. Grades are unofficial until approved by the Department and/or Faculty offering the course.

Re-examination:

A student who writes the final examination and fails the course may apply for a re-examination. Re-examinations are rarely granted in the Faculty of Science. Re-examinations are governed by university-wide Academic Regulations and Faculty of Science Academic Regulations. Misrepresentation of Facts to gain a re-examination is a serious breach of the Code of Student Behaviour.

POLICIES FOR LATE AND MISSED WORK

Late Policies:

Missed Term Work or Final Exam Due to Non-medical Protected Grounds:

When a term assessment or final exam presents a conflict based on non-medical protected grounds (e.g. religious beliefs), students must apply to the Academic Success Centre for accommodations via their Register for Accommodations website. Students can review their eligibility and choose the application process specific for Accommodations Based on Non-medical Protected Grounds.

It is imperative that students review the dates of all course assessments upon receipt of the course syllabus, and apply AS SOON AS POSSIBLE to ensure the timely application of the accommodation. Students who apply later in the term may experience unavoidable delays in the processing of the application, which can affect the accommodation.

Missed Assignments:

No late assignments will be accepted. Failure to complete an assignment on time for any reason will result in a mark of zero.

Deferred Final Examination:

A student who cannot write the final examination due to incapacitating illness, severe domestic affliction or other compelling reasons can apply for a deferred final examination. Such an application must be made to the student's Faculty office within two working days of the missed examination and must be supported by appropriate documentation or a Statutory Declaration (see calendar on Attendance). Deferred examinations are a privilege and not a right; there is no guarantee that a deferred examination will be granted. The Faculty may deny deferral requests in cases where less than 50% of term work has been completed. Misrepresentation of facts to gain a deferred examination is a serious breach of the Code of Student Behaviour.

STUDENT RESPONSIBILITIES

Academic Integrity and Student Conduct:

The University of Alberta is committed to the highest standards of academic integrity and honesty, as well as maintaining a learning environment that fosters the safety, security, and the inherent dignity of each member of the community, ensuring students conduct themselves accordingly. Students are expected to be familiar with the standards of academic honesty and appropriate student conduct, and to uphold the policies of the University in this respect. Students are particularly urged to familiarize themselves with the provisions of the Code of Student Behaviour and the Student Conduct Policy, and avoid any behaviour that could potentially result in suspicions of academic misconduct (e.g., cheating, plagiarism, misrepresentation of facts) and non-academic misconduct (e.g., discrimination, harassment, physical assault). Academic and non-academic misconduct are taken very seriously and can result in suspension or expulsion from the University.

All students are expected to consult the Academic Integrity website for clarification on the various academic offences. All forms of academic dishonesty are unacceptable at the University. Any suspected academic offence in this course will be reported to the College of Natural and Applied Sciences. Suspected cases of non-academic misconduct will be reported to the Dean of Students. The College, the Faculty of Science, and the Dean of Students are committed to student rights and responsibilities, and adhere to due process and administrative fairness, as outlined in the Code of Student Behaviour and the Student Conduct Policy. Anyone who is found in violation is likely to receive a sanction. Typical sanctions for academic misconduct include conduct probation, a mark reduction or a mark of 0 on an assessment, a grade reduction or a grade of F in a course, a remark on the transcript, and a recommendation for suspension or expulsion. Sanctions for non-academic misconduct include conduct conditions, fines, suspension of essential or non-essential University services and resources, and suspension or expulsion from the University.

Exam Conduct:

- Students will not be allowed to begin an examination after it has been in progress for 30 minutes. Students must remain in the exam room until at least 30 minutes has elapsed.
- All cell phones must be turned off and stored in your bags.

Cell Phones:

Cell phones are to be turned off during lectures, labs and seminars.

Students Eligible for Accessibility-Related Accommodations:

In accordance with the University of Alberta's Discrimination, Harassment, and Duty to Accommodate policy, accommodation support is available to eligible students who encounter limitations or restrictions to their ability to perform the daily activities necessary to pursue studies at a post-secondary level due to medical conditions and/or non-medical protected grounds. Accommodations are coordinated through the Academic Success Centre, and students can learn more about eligibility on the Register for Accommodations website.

It is recommended that students apply as early as possible in order to ensure sufficient time to complete accommodation registration and coordination. Students are advised to review and adhere to published deadlines for accommodation approval and for specific accommodation requests (e.g., exam registration submission deadlines). Students who request accommodations less than a month in advance of the academic term for which they require accommodations may experience unavoidable delays or consequences in their academic programs, and may need to consider alternative academic schedules.

Recording and/or Distribution of Course Materials:

Audio or video recording, digital or otherwise, of lectures, labs, seminars or any other teaching environment by students is allowed only with the prior written consent of the instructor or as a part of an approved accommodation plan. Student or instructor content, digital or otherwise, created and/or used within the context of the course is to be used solely for personal study, and is not to be used or distributed for any other purpose without prior written consent from the content author(s).

Learning and Working Environment:

The Faculty of Science is committed to ensuring that all students, faculty and staff are able to work and study in an environment that is safe and free from discrimination, harassment, and violence of any kind. It does not tolerate behaviour that undermines that environment. This includes virtual environments and platforms.

If you are experiencing harassment, discrimination, fraud, theft or any other issue and would like to get confidential advice, please contact any of these campus services:

- Office of Safe Disclosure & Human Rights: A safe, neutral and confidential space to disclose concerns about how the University of Alberta policies, procedures or ethical standards are being

applied. They provide strategic advice and referral on matters such as discrimination, harassment, duty to accommodate and wrong-doings. Disclosures can be made in person or online using the Online Reporting Tool.

- University of Alberta Protective Services: Peace officers dedicated to ensuring the safety and security of U of A campuses and community. Staff or students can contact UAPS to make a report if they feel unsafe, threatened, or targeted on campus or by another member of the university community.
- Office of the Student Ombuds: A confidential and free service that strives to ensure that university processes related to students operate as fairly as possible. They offer information, advice, and support to students, faculty, and staff as they deal with academic, discipline, interpersonal, and financial issues related to student programs.
- Office of the Dean of Students: They can assist students in navigating services to ensure they receive appropriate and timely resources. For students who are unsure of the support they may need, are concerned about how to access services on campus, or feel like they may need interim support while you wait to access a service, the Dean of Students office is here to help.

Feeling Stressed, Anxious, or Upset?

It's normal for us to have different mental health experiences throughout the year. Know that there are people who want to help. You can reach out to your friends and access a variety of supports available on and off campus at the Need Help Now webpage or by calling the 24-hour Distress Line: 780-482-4357 (HELP).

Student Self-Care Guide:

This Self-Care Guide, originally designed by the Faculty of Native Studies, has broader application for use during students' learning. It provides some ideas and strategies to consider that can help navigate emotionally challenging or triggering material.

Policy about course outlines can be found in Course Requirements, Evaluations Procedures and Grading of the University Calendar.

Land Acknowledgement:

The University of Alberta respectfully acknowledges that we are situated on Treaty 6 territory, traditional lands of First Nations and Métis people.

Disclaimer:

Any typographical errors in this Course Outline are subject to change and will be announced in class. The date of the final examination is set by the Registrar and takes precedence over the final examination date reported in this syllabus.

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Dr. Bruce R. Sutherland, Departments of Physics and of Earth & Atmospheric Sciences, Faculty of Science, University of Alberta (2023).