

Syllabus
Atmospheric Dynamics
(Physics 8250)
Fall Semester 2022

Instructor Information:

Instructor:	Prof. Jens Oberheide http://globaldynamics.sites.clemson.edu/index.html
Office:	103 Kinard Lab
Department:	Dept. of Physics and Astronomy, CU
Phone:	864-656-5163
Email:	joberhe@clemson.edu
Office Hours:	Wednesday 11:00 – 12:00; I have an open door policy. Students are encouraged to come to my office on an as needed basis any time.
Class Hours:	MWF 10:10 – 11:00, Kinard TBD; you may leave class if Prof. Oberheide has not arrived after 15 minutes

Course Mode of Delivery

This is a traditional physics class. I will work out the physics on the board and will discuss its meaning with the class. Powerpoint will be used as needed but as little as possible.

Doing problems is critically important to understand the material. As such, **regular homework** will be assigned. You will get feedback on your assignments and (most) solutions will be made available.

This is an in-person class and in-person attendance is expected for students without an online-only accommodation. The class will not be recorded, except if warranted by special circumstances.

There will be one midterm exam (tentatively the October 10-14 week) and one final exam (probably the December 5-9 week before the fall AGU meeting to accommodate attendees).

Course Information

Course Rationale: This course on atmospheric dynamics is to provide the students with an in-depth, graduate-level understanding of the physics and fluid dynamical phenomena in stratified, rotating reference frames. The focus is on middle and upper atmosphere dynamics, including the general circulation, atmospheric waves, instabilities, and wave-mean flow interactions. The course will be guided by Richard Lindzen’s “Dynamics of the Atmosphere” lecture, but with some modifications to highlight contemporary developments and Earth’s near-space environment in the thermosphere.

Objectives and Learning Outcomes:

1. Advance to a full understanding of the Navier-Stokes equation and the energy equation for the rotating atmosphere.
2. Be able to apply linearization methods to derive the wave equations for the various common atmospheric modes.
3. A theoretical understanding of the gravity wave dispersion relation.
4. Be able to distinguish between barotropic, baroclinic, convective and dynamic instabilities.
5. Advance to a graduate-level understanding of various wave-mean flow interaction phenomena.

Course Outline: Lindzen's lecture notes include 13 chapters and it is impossible to cover all of them in one semester. The course will thus focus on the chapters that are most relevant to meet the objectives and learning outcomes, plus additional material necessary for the thermosphere.

- **Class:** In each lesson, you will learn the key topics from the course material in the lecture notes from Lindzen (or other sources as announced). You are expected to read the relevant text *before each class*.
- **Homework:** These assignments will give you the chance to apply what you have learned and to demonstrate development of your skills related to the course content. You will turn in handwritten solution during class. Typed homework solutions are a waste of time and will not be accepted. Each assignment will include questions related to the course material. These assignments will be your homework grade and will be done *on a weekly or bi-weekly basis*.
- **Canvas:** We are not going to use Canvas a lot but I will post homework solutions and other docs (like the syllabus) there.

Method of Teaching: This is a lecture course based upon the notes of one of the most distinguished scientists in atmospheric dynamics. You should prepare by reading the chapters and try to solve as many problems as possible. Exams will be administered in class.

Grading: Assignments in this course are divided into these general categories, which carry the following weight in your final grade calculations:

Category	Weight
Written Homework	40%
Midterm exam	30%
Final exam	30%

There will be *one midterm exam* (tentatively in the 10-14 October week) and one *final exam* (tentatively in the 5-9 December week, because of AGU).

Late homework won't be accepted if you do not give me a very good reason.

You are treated as a professional in the course. Accordingly, the grading is strict, but fair. Reading the directions and grading criteria provided for each assignment is the key to understanding how you will be graded.

Letter grade: A: 85-100%; B: 70-85%; C: 55-70%; F:<55%; no D grade and no +- grades.

Required Textbook:

- *Dynamics of the Atmosphere* by Richard Lindzen, [MIT Open Courseware](#)

Recommended Textbooks:

- *Upper atmosphere dynamics and energetics*, AGU Geophysical Monograph 261, 2021, available in the atmos grad student office (do not remove) AND through the Cooper Library (1 copy).
- *Introduction to Geophysical Fluid Dynamics* by Cushman-Roisin, available in the atmos grad student office (do not remove)
- *An Introduction to Dynamic Meteorology*, 5th edition, by Jim Holton and Greg Hakim, available in the grad student office (do not remove)
- *Middle atmosphere dynamics*, by Andrews, Holton, Leovy, available in my (J. Oberheide) office for 1-day loan.

Web Sites: The course web site is on Canvas, accessible at <https://clemons.instructure.com/courses/175072> It will be used to post homework solutions and some needed material such as the syllabus – so, essentially a file repository.

Course Policies

The following policies are the standard syllabus material. Please read completely.

Prerequisites: Undergraduate atmospheric physics (Physics 4200), or consent of instructor.

Attendance Policy: This course is designed for active in-person learning and engagement. Attendance and active participation in this course will provide the most benefit for learning. Since you are treated as professionals in the course, ***attendance is not required but highly recommended. I reserve the right to drop any student from the course who stops attending/participating for extended periods of time***

Any exam that was scheduled at the time of a class cancellation due to inclement weather will be given at the next class meeting unless contacted by the instructor. Any assignments due at the time of a class cancellation due to inclement weather will be due at the next class meeting unless contacted by the instructor. Any extension or postponement of assignments or exams must be granted by the instructor via email or other means of communication within 24 hours of the weather-related cancellation.

University Policies

Academic Integrity: The Clemson University statement on academic integrity reads: “As members of the Clemson University community, we have inherited Thomas Green Clemson's vision of this institution as a “high seminary of learning.” Fundamental to this vision is a mutual commitment to truthfulness, honor and responsibility, without which we cannot earn the trust and respect of others. Furthermore, we recognize that academic dishonesty detracts from the value of a Clemson degree. Therefore, we shall not tolerate lying, cheating or stealing in any form.”

Student Accessibility Statement: Clemson University values the diversity of our student body as a strength and a critical component of our dynamic community. Students with disabilities or temporary injuries/conditions may require accommodations due to barriers in the structure of facilities, course design, technology used for curricular purposes, or other campus resources. Students who experience a barrier to full access to a class should let the professor know, and make an appointment to meet with a staff member in Student Accessibility Services as soon as possible. You can make an appointment by calling 864-656-6848 or by emailing studentaccess@lists.clemson.edu. Students who receive Academic Access Letters are strongly encouraged to request, obtain and present these to their professors as early in the semester as possible so that accommodations can be made in a timely manner. It is the student’s responsibility to follow this process each semester. You can access further information here: <http://www.clemson.edu/campus-life/campus-services/sds/>.

Clemson University Title IX Statement: Title IX Policy: Clemson University is committed to a policy of equal opportunity for all persons and does not discriminate on the basis of race, color, religion, sex, sexual orientation, gender, pregnancy, national origin, age, disability, veteran’s status, genetic information or protected activity (e.g., opposition to prohibited discrimination or participation in any complaint process, etc.) in employment, educational programs and activities, admissions and financial aid. This includes a prohibition against sexual harassment and sexual violence as mandated by Title IX of the Education Amendments of 1972. The University is committed to combatting sexual harassment and sexual violence. As a result, you should know that University faculty and staff members who work directly with students are required to report any instances of sexual harassment and sexual violence, to the University’s Title IX Coordinator. What this means is that as your professor, I am required to report any incidents of sexual harassment, sexual violence or misconduct, stalking, domestic and/or relationship violence that are directly reported to me, or of which I am somehow made aware.

This policy is located at <http://www.clemson.edu/campus-life/campus-services/access/title-ix/>. Ms. Alesia Smith is the Executive Director for Equity Compliance and the Title IX Coordinator. Her office is located at 223 Holtzendorff Hall, phone number is 864.656.3181, and email address is alesias@clemson.edu.

Clemson University is committed to providing a safe campus environment for students, faculty, staff, and visitors. As members of the community, we encourage you to take the following actions to be better prepared in case of an emergency: (a) Ensure you are signed

up for emergency alerts (<https://www.getrave.com/login/clemson>), (b) Download the Rave Guardian app to your phone (<https://www.clemson.edu/cusafety/cupd/rave-guardian/>), (c) Learn what you can do to prepare yourself in the event of an active threat (<http://www.clemson.edu/cusafety/EmergencyManagement/>)