PHYSICS OF WEATHER
PHYS 2400

Syllabus – Spring Semester 2020

Instructor: Prof. Jens Oberheide, 103 Kinard, Dept. of Physics and Astronomy, Tel. 864-656-5163, Email: joberhe@clemson.edu

Class Hours & Location: Tuesday and Thursday, 11:00 - 12:15, Kinard 116. Students are expected to wait 15 minutes if the instructor is late for class.

Office Hours: Tuesday and Thursday, after class until 2 pm. During the semester the schedule time may change occasionally due to schedule conflicts. Changes will be announced at least one day in advance. Students are encouraged to make use of the office hours or to arrange (via email) for a meeting outside the office hours if needed.

Email response time: I will usually respond to emails within 12 hours. This response time excludes weekends and official University holidays. I do not respond to emails after 7 pm!

Course start date: Thursday, Jan. 9, 2020

Course end date: Day of the final exam – see https://www.clemson.edu/registrar/student-menu/exam-spring.html . As of now, this seems to be Wed, April 29, 3-5:30 pm.

Attendance Policy: Attendance is ***required***, since additional material will be presented in class not contained in the textbook. Attendance will be checked through participation in the in-class quizzes. ***A student who misses more than four classes without a valid excuse may be dropped from the course.*** See also Announcements – General Policies.

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 Canvas within 24 hours of the weather related cancellation.

Required Materials: Smartphone with Canvas App or laptop to do the in-class quizzes (***must bring to each class***). Laptop with reliable internet access (***must bring for exams***).

Required Textbooks:

- *Understanding Weather & Climate* (Seventh Edition) by Aguado and Burt
  eText: ISBN-13 **9780133943641**
  Print: ISBN-13 **9780321987303**

- *Weather Studies eInvestigations Manual 2019-2020 edition*
  eText: ISBN-13 **9781944970475**

Note that the textbook by Aguado and Burt is available in both print and digital format. Either format is acceptable but make sure that you have the 7th edition. The course will follow the text by Aguado and Burt. There is an option to rent, i.e., get a subscription for the digital version for 180 days, which is sufficient to complete the course. Alternatively, you can pay more to get permanent access to the text. Some of the versions are offered with *Mastering Meteorology* included. *Mastering Meteorology* is not required for the course.

The eInvestigations Manual 2019-2020 published by the American Meteorological Society is only available in digital format and is required for homework. A digital version of the manual can be ordered at the URL: https://edubooks.ametsoc.org/WXIM-19 AMS is offering digital versions and a package that includes a softcover version and a webBook version, if you prefer a printed copy.

The digital versions of both course texts are less expensive and in some cases more convenient than the print versions. Please be sure that you want to take the course before deciding to purchase digital versions of the books since there are no refunds for the digital editions.

Web sites: The main course web site is on Canvas, accessible at https://clemson.instructure.com/courses/92136 Chapter notes/slides, announcements, and assignments will be posted there. Exams during the semester and the final exam will be taken through the course Canvas web site.

In addition to the main course web site, we will use the American Meteorological Society web site that is a companion to the *eInvestigations Manual* used in the course. The site (called RealTime Weather Portal) is accessible at https://edubooks.ametsoc.org/user/anonymous You will need to login in with your eInvestigations Manual credentials. That site has information about current weather, links to current meteorological data in the format used by meteorologists and forecasters, and links to other web sites with resource material that may be useful or of general interest. The site also has online quizzes that you can take for practice or to help you in learning terminology and course-related information.

Course Rationale: The course is designed (1) to give the students an appreciation of the broad variety of phenomena that occur in the atmosphere, (2) to give the students a basic understanding of the physical phenomena responsible for those phenomena, and (3) to use the atmospheric phenomena as an illustration of the principles of physics in a broader context. The course has relatively little math, but you are expected to be able to apply physical principles and scientific reasoning to explain various atmospheric phenomena and effects.

Catalog Description: Descriptive introduction to meteorology. Includes atmospheric thermodynamics, solar radiation, heat budget, atmospheric circulation, force laws governing air motion, fronts, precipitation, synoptic prediction. Special topics of current interest, such as the effect of environmental pollution on weather and the effect of weather on health, are included.

Course Objectives: The atmosphere is an extremely important physical system that strongly influences everything in our daily activities and both the short-term and long-term future of our society. It creates effects that range from minor inconveniences, in the form of inclement weather,

to hazards, in the form of severe weather. Some of the most beautiful phenomena in nature occur in the atmosphere and are related to atmospheric optics effects and other types of physics. Specific objectives are to:

- Understand the structure of the atmosphere and the physical processes responsible for the structure.
- Assess the role of solar radiation and the Earth's orbital parameters and rotation in creating the seasons and large-scale climate zones.
- Describe the processes responsible for the planetary circulation.
- Understand weather systems, including the high and low pressure systems that constitute what is referred to as synoptic meteorology, as physical systems.
- Describe and analyze mesoscale weather systems, including thunderstorms and tornadoes.
- Explain the physical processes that lead to atmospheric electrification and lightning.
- Describe the processes that lead to atmospheric pollution and the effects of pollution on weather, climate, and health.
- Understand the physics of atmospheric optical phenomena.
- Understand basic techniques used in forecasting, primarily as a means of improving our understanding of how the atmosphere works.
- Describe the major climate cycle variations over decadal, century, and geological time scales and the mechanisms responsible for each. – This is only a secondary objective as it is the focus of PHYS 2450 – Physics of Global Climate Change (offered each fall semester).

All course assignments are closely aligned to and assess the student's mastery of these objectives.

Course Content: This course contains fourteen modules (see Course Outline below), each consisting of the following components:

- Class: In each lesson, you will learn the key topics from the course materials in the two required texts. You are expected to read the relevant chapter(s) before a new module starts.
- Individual Assignments: 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 complete a two-part assignment on Canvas for each module to demonstrate your mastery of the module material. Each assignment will include questions related to the *Understanding Weather and Climate* textbook material, as well as an exercise from the *eInvestigations Manual* that uses real-world data and illustrates the concepts described in the text material.
- In addition, both the MyMeteorologyLab web site provided by the text publisher and the American Meteorological Society web site associated with the *eInvestigations Manual* have interactive demonstrations that help to illustrate the concepts developed in each of the course modules.

Directions for completing course assignments are provided in the Modules area of the course Canvas site.

Course Outline: Chapter numbers refer to the text by Aguado and Burt, each bullet is one module:

- Composition and structure of the atmosphere (Chapter 1)
- Solar radiation and seasons (Chapter 2)
- Energy balance and temperature (Chapter 3)
- Atmospheric pressure and wind (Chapter 4)
- Atmospheric moisture (Chapter 5)
- Cloud systems (Chapter 6)
- Precipitation processes (Chapter 7)
- Atmospheric circulation (Chapter 8)
- Midlatitude cyclones (highs and lows) and fronts (Chapters 9 & 10)
- Lightning, thunder, and tornadoes (Chapter 11)
- Tropical storms and hurricanes (Chapter 12)
- Weather forecasting and analysis (Chapter 13)
- Climate (Chapters 15 & 16) – optional, only if time allows
- Atmospheric optics (Chapter 17) – optional, only if time allows

Course Navigation: The primary menu items in the course menu on Canvas provide access to these content areas:

- Announcements: Includes updates and reminders
- Syllabus: Explains the course objectives, grading criteria, student responsibilities, and other items of interest.
- Modules: Provides notes and assignment information to prepare students for assignments.
- Pages: various content with information relevant to the course material or management of the course.
- Discussions: Provides forums for interacting with the instructor and/or other students in the course.
- Grades: Displays module and quiz scores as well as instructor feedback.

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

Category	Weight
Attendance/short quizzes	15%
Module (homework) assignments	40%
Midterm exams	30%
Final exam	15%

- There will be three midterm exams during the semester (taken online at home) and a final exam (taken in-class). Each of the three midterm exams has the same weight and the same approximate length and format. The lowest of the three midterm exam scores will be dropped, and the remaining two scores will constitute 30% of the course grade, i.e., 15% each for the highest two quiz scores. The final exam is comprehensive and constitutes 15% of the course grade.
- Attendance will be taken during class in the form of short graded quizzes. The four lowest scores will be dropped, and the remaining scores will constitute 15% of the course grade.
- A total of approximately 12 weekly homework exercises, corresponding to the course outline topics above, will make up the remaining 40% of the course grade. The two lowest scores will be dropped.

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. Following those directions is the key to doing well.

Midterm Exams and Final Exam

There will be three 60-minute quizzes (a.k.a. midterm exams) during the semester and a longer comprehensive exam on the day of the final exam. See Grading for weights and format. The quizzes (midterm exams) will be made available and taken online at home. In general, there will be a 12-hour window on the date of the quiz when the quiz will be available online. You will have 60 minutes to complete the quiz after you start taking it. The questions are presented one at a time with no option for backtracking. You are expected to complete the quizzes independently with no outside help, either from resources on the web or from other individuals. You can, however, use your own written notes, printed course slides and the book (but note that the Respondus browser is needed, so you would need to print-out the digital book to use it).

The Respondus Lock-Down Browser will be required when taking the quizzes. Additional information about accessing and installing the Respondus browser will be posted at least a week prior to the date of the first quiz.

The final exam will be taken in-class (but online) without the Respondus browser. It's open book and you can use your notes, slides, etc. However, web resources (such as google) are not permitted.

Module Assignments (Weekly Homework)

Homework will be assigned on a weekly basis. There will be approximately 12 weekly homework assignments. The two lowest scores will be dropped for the calculation of the final course grade. The homework assignments will be completed online at the course web site.

Important: Completing and submitting the assigned homework exercises no later than the assignment deadline is required as part of the course grade. *Late homework will not be accepted*

without a very good excuse, at the discretion of the instructor. You are required to notify the instructor one day prior to the deadline if a homework assignment will not be submitted. Failure to do so will result in a zero grade on the homework assignment.

You are welcome to discuss general aspects of the homework assignments with the instructor or with other students, but the homework that you submit should represent your own independent work. Copying from other students or from web material or other reference material is not acceptable. Students should adhere to the University's honor code and the ethics and academic integrity standards (see Academic Integrity Policy below, particularly the plagiarism definition)

Grading Scale

- A = 90-100%, B = 80-89%, C = 70-79%, D = 60-69%, F = 0-59%
- A = 90 to 100% The student has demonstrated exemplary performance in meeting the course
- B = 80 to 89% The student has demonstrated superior performance in meeting the course
- C = 70 to 79% The student has adequately met the objectives established for the course.
- D = 60 to 69% The student has minimally met the objectives established for the course.
- F = 0 to 59% The student has failed to meet the objectives established for the course.

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, by emailing studentaccess@lists.clemson.edu , or by visiting Suite 239 in the Academic Success Center building. Appointments are strongly encouraged – drop-ins will be seen if possible, but there could be a significant wait due to scheduled appointments. 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/ .

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Academic Continuity Plan

In the event the physical classroom facility becomes unavailable, as determined by the University's administration, class will be conducted in a virtual (online) format. The University issues official disruption notifications through email /www /text notification/social media. When notified, use one of the following links to navigate to Clemson Canvas where you will find important information about conducting class:

- Primary access link: www.clemson.edu/canvas
- Secondary access link, if needed: https://clemson.instructure.com/
- You can also use the Canvas Student App.

On **E-Learning Day, Feb. 19, 2020**, a real-time test of the Academic Continuity Plan will be conducted. For further information, see the Academic Continuity Guide https://clemson.app.box.com/s/8kpa22p36dvwavecr6avbfcykeeflmeo , and the Academic Continuity webpage http://www.clemson.edu/online/elearning/index.html .

Academic Integrity Policy

The Clemson University statement on academic integrity applies. It 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*.

Important: A simple definition of plagiarism is when someone presents another person's words, visuals, or ideas as his or her own. The instructor will deal with plagiarism on a case-by-case basis. The most serious offense within this category occurs when a student copies text from the Internet or from a collective file. This type of academic dishonesty is a serious offense that will result in the filing of a formal written charge to the University.

See the Undergraduate Academic Integrity Policy website for additional information about academic integrity and Clemson procedures and policies regarding scholastic dishonesty.

The Clemson University Title IX (Sexual Harassment) Statement

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. To locate information on the Title IX policy, visit http://www.clemson.edu/campus- life/campus-services/access/title-ix/. Ms. Alesia Smith is the Clemson University Title IX Coordinator, and is also the Executive Director of Equity

Compliance. Her office is located at 110 Holtzendorrf Hall, 864.656.3181 (voice) or 864.565.0899 (TDD).