

# METEOROLOGICAL INSTRUMENTS

## ATMS 320

### FALL 2024 – Post-Helene Revision

#### PURPOSE

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Observations provide the backbone for the science of meteorology. Regardless of your intended path in the atmospheric sciences, observations of the atmosphere will surely influence your career. So that you can properly interpret observations in your endeavors, you must understand the physics and limitations of common instrumentation.

#### OBJECTIVES

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This course is designed to balance theoretical topics with practical applications. Throughout the course, you will demonstrate knowledge of the elements of modern instrumentation by meeting several course objectives. You will 1) design an instrumentation system to address unique needs, 2) gain practical, hands-on experience with datalogger programming, wiring, and hardware installation, 3) evaluate the utility of certain instruments in a variety of situations, 4) assess the positive and negative characteristics of instrumentation sites, 5) demonstrate knowledge of concepts involved in making careful measurements, 6) interpret instrumentation specifications, and 7) identify sensor limitations and major error sources.



#### PROFESSOR

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Dr. Christopher Godfrey  
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**Remote office hours: During the regular class meeting time or by appointment.** You may call my office (it bounces to my cell phone) during regular business hours. You may send me as many email messages as you wish. If my door is open at any other time, please drop in.

#### CLASS INFORMATION

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Meeting times: MW 2:00–3:15 p.m.  
Location: **Online via Moodle**  
Required text: Brock, F. V., and S. J. Richardson, 2001: *Meteorological Measurement Systems*. Oxford University Press, 290 pp. (ISBN: 0-19-513451-6)  
Website: <https://www.atms.unca.edu/cgodfrey/courses/atms320/>

» Please visit <https://weather.unca.edu> for a list of the student learning outcomes for the Department of Atmospheric Sciences.

#### GETTING QUESTIONS ANSWERED

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**I will be available to answer questions via Zoom during the regular class meeting time. I will remain there until either 3:15 p.m. or until the last of the initial synchronous attendees leaves the online meeting, whichever comes earlier.** Otherwise, email is by far the best way to reach me and you will usually get a speedy reply. You may also schedule an appointment with me. Please don't hesitate to ask questions about class, other coursework, or the stresses of college life whenever the need arises.



## PREREQUISITES

Prerequisites include either ATMS 103 or 113. The *Atmospheric Thermodynamics and Hydrostatics* course (ATMS 305) is a pre- or corequisite for this course. Many of the topics in this course will build upon the concepts covered in ATMS 305. I also recommend concurrent enrollment in PHYS 222 if you have not completed *Physics II* already, but this is not required.

## IMPORTANT DATES

Wednesday, 4 September 2024	Draft research plan due	5:00 p.m.
Wednesday, 18 September 2024	Final research plan due	5:00 p.m.
Monday, 4 November 2024	<b>Exam I</b>	2:00–3:15 p.m. via Moodle
Monday, 25 November 2024	<b>Exam II</b>	2:00–3:15 p.m. via Moodle
Wednesday, 11 December 2024	<b>Final Exam*</b>	11:30–2:00 p.m.

\*No student, including graduating seniors, may take the final exam at an earlier time.

## COURSE SCHEDULE

This course schedule is approximate and subject to modifications. **I warned you.**

Date	Topic	Reading
19 August	Elements of modern measurement systems, <b>Lab: Foundations</b>	Chapter 1, Section 13.4
21 August	Site selection	
26 August	Basic electronics	Appendix D
28 August	<b>Lab: Site survey @ UNCA meteorological tower</b>	Lab materials
2 September	<b>Labor Day–No class</b>	
4 September	Basic electronics	
9 September	Barometry	Chapter 2
11 September	<b>Lab: Basic electronics</b>	Lab materials
16 September	CRBasic programming, LoggerNet	
18 September	<b>Lab: Datalogger programming and sensor wiring</b>	Lab materials
23 September	Static performance characteristics	Chapter 3
25 September	Static performance characteristics	
30 Sep–23 Oct	<b>Helene disaster–No class</b>	
28 October	Error, Precipitation measurements	Chapter 9
30 October	<b>Virtual lab: Rain gauge calibration</b>	Lab materials
4 November	<b>Exam I</b>	
6 November	Thermometry	Chapter 4
11 November	Thermometry	
13 November	Thermometry, Hygrometry	Appendix B, Chapter 5
18 November	Dynamic performance characteristics	Chapter 6
20 November	Dynamic performance characteristics	
25 November	<b>Exam II</b>	
27 November	Upper-air measurements, <b>Virtual lab: Atmospheric soundings</b>	Chapter 12, Lab Materials
2 December	Anemometry	Chapter 7
4 December	Radiation	Chapter 10
11 December	<b>Final Exam</b>	11:30–2:00 p.m.



## LABORATORY EXERCISES

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On the course schedule, you will note several laboratory exercises. The first requires stepping through an online tutorial and completing a quiz at the end. The remaining exercises are designed to be hands-on learning experiences. On these five dates, please plan for the possibility that the class may take a bit longer than usual, depending on how fast you work. I will provide instructions for each laboratory exercise, outlining the procedures and requirements for your lab reports. You must **read these instructions before you come to class** so that you can ask relevant questions and make the most efficient use of your time. **Complete the post-Helene virtual lab exercises after reviewing the relevant instructional videos available on Moodle.**

## FIELD PROJECT

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~~The Department of Atmospheric Sciences is the recipient of an IMAGINE Educational Grant from Campbell Scientific, Inc. With additional support from the North Carolina State Climate Office and the Department of Atmospheric Sciences, we have an array of new instrumentation and accessories valued at over \$30,000 designated specifically for this class. As a result, this course will provide you with a hands-on educational experience with writing your own research plan and building and deploying a sensor suite to meet your short-term research goals. In addition to the sensors and data from the North Carolina ECONet tower on campus, you have access to thermometers, relative humidity probes, pyranometers, anemometers, barometers, tipping bucket rain gauges, and a soil moisture probe, all with supporting hardware and accessories. Please plan to gather with your project team on a mutually agreeable date to set up a tripod mast and install and wire the sensors for field deployment at your chosen location. Complete project instructions are described in separate documents. Please see the list of important dates above for specific deadlines related to the field project.~~

**I recognize the work that you have already completed on the field project. However, only one group installed weather stations in the field in September and those weather stations were damaged during the storm after collecting data for only one week. In the absence of a complete field data collection campaign and the compressed academic schedule for many of your classes, it seems in your best interest to cancel the field project. You will have an opportunity to conduct research and write a scientific paper in ATMS 464. I also welcome your ideas for personal undergraduate research projects involving our high-quality instrumentation.**

## WEATHER STATION

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**The installation of a weather station is an important hands-on component of this course. To give you an opportunity to gain practical, hands-on experience with datalogger programming, wiring, and hardware installation, we will meet on a mutually-agreeable date to build your weather station if you have not done so already.**

## EVALUATION

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There will be two preliminary exams and a comprehensive final exam to assess your progress through the semester. The preliminary exams will take place **via Moodle** during the regular class meeting times. Several problem sets will strengthen your skills and reinforce the lecture and reading material. Five class periods will be devoted to laboratory exercises, with a laboratory report due 5–7 days later. ~~A semester-long field project will allow you to put it all together (again, complete project instructions will be described separately).~~

**There will be no opportunities for make-up exams.** Exams must be taken on the scheduled date and at the scheduled time. If you miss the exam, you miss the grade. The *only* exceptions to this rule are: (1) serious medical condition (illness or injury) of you or an immediate family member; (2) University excused absence; (3) jury duty; (4) military orders; **or (5) persistent Internet connectivity problems that you have notified me about in advance.** Only in such instances will an item be dropped or rescheduled depending on your best interests, but *only if I am notified at least 24 hours in advance.* Except under the circumstances described above, **problem sets and lab reports must be uploaded to Moodle as legible and printable PDF documents by 5:00 p.m.** on the scheduled due date. I will accept assignments up to 24 hours late (5:00 p.m. the following day) for a 50% late penalty. *Assignments more than 24 hours late will not be graded.* In the event of an unforeseen circumstance that causes you to miss an exam, lab, or problem set due date, *you must notify me by phone or e-mail within 24 hours of the event.* Appropriate documentation must accompany any excused absence and should be attached to a late assignment.

## GRADING

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Preliminary Exams	25%
Labs	20%
Problem Sets	25%
Field Project/Weather Station	15%
Final Exam	15%

Final grades are not negotiable. If you see a problem with any other grade, you may plead your case no later than 14 days from the date I return the assignment to the class. I do make mistakes. Under no circumstances will your grade be *lower* if you see me with a question.



## LECTURE AND PROBLEM SET TIMING

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All course lecture videos for the remainder of the semester are available on Moodle. Each lecture appears under a header to indicate the date on which you are responsible for learning the corresponding material. The deadlines for the remaining problem sets are November 13, 20, and December 4 for problem sets 4, 5, and 6, respectively. The rain gauge calibration lab report is due November 11 and the atmospheric soundings lab report is due December 6 (i.e., two days after the last day of class). Look for these assignments on Moodle soon. I will provide these course materials for you so that you can work at your own pace, provided you meet the assignment deadlines. You may work ahead, but do not fall behind!

## EXAMS, CLASS TIME, AND OFFICE HOURS

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Exams will take place via Moodle during the regular class meeting time. Please prepare accordingly and have your equation sheet, calculator, blank paper, and computer ready. You will need to scan your handwritten work and submit it via Moodle after you complete the exam. If you need an exception to the timing of an exam, please notify me in advance.

I recommend that you watch the lecture videos during the regular class time and join a synchronous Zoom meeting to ask questions about the material. This way, you will have your professor available for immediate help and you will benefit from your classmates' questions, but you can review the lecture videos and take notes at your own pace. This synchronous meeting will effectively serve as my office hours, so you are also welcome to ask questions about the problem sets and lab exercises during this time. After each of the exams, we will use this time to conduct a formal exam review, which will be recorded and shared. Please note that attendance at synchronous Zoom meetings is not required, but I strongly recommend attending if you are able.

## ACADEMIC INTEGRITY

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Since the point of this or any class is to learn, you may collaborate on assignments, but *you absolutely must make sure that you hand in your own work and that you understand the material*. Copying your friend's answers will not only be obvious to me, but will result in both of you sharing the credit for that answer. For example, if you do a fantastic job on the assignment and then let three of your friends copy *any part of it*, you will each receive a maximum grade of 25% for the assignment. Any collaboration on exams is simply cheating. I have zero tolerance for academic misconduct and will deal with the problem by immediately filing charges through the regular University channels.

## NOTES

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University of North Carolina at Asheville is committed to making courses, programs and activities accessible to persons with documented disabilities. Students requesting accommodations and/or academic adjustments must do so through the Office of Academic Accessibility and may be required to provide supporting documentation. All information provided will remain confidential. For more information, please contact the Office of Academic Accessibility at (828) 232-5050 or [academicaccess@unca.edu](mailto:academicaccess@unca.edu) or visit them in the Academic Success Center.