

# METEOROLOGICAL INSTRUMENTS

## ATMS 320

### FALL 2022

#### 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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Office hours: Via virtual meetings through Google Meet on **Tuesdays 4:45–5:45 p.m.** and **Thursdays 10:00-11:00 a.m.**, 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. Check Moodle for the Google Meet link.

#### CLASS INFORMATION

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Meeting times: MW 2:00–3:15 p.m.

Location: Robinson Hall, room 238

Required text: Brock, F. V., and S. J. Richardson, 2001: *Meteorological Measurement Systems*. Oxford University Press, 290 pp. (ISBN: 0-19-513451-6)

Website: <http://www.atms.unca.edu/cgodfrey/courses/atms320/>

» Please visit <http://www.atms.unca.edu/slos.shtml> 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 on Google Meet during scheduled office hours. Just drop in. If at any other time you have a question, you are more than welcome to call me or send me an email. E-mail 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 for a virtual meeting. 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 Statics* 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

Monday, 29 August 2022	Draft research plan due	5:00 p.m.
Wednesday, 14 September 2022	Final research plan due	5:00 p.m.
26 September – 12 November 2022	Field project deployment window	
Wednesday, 28 September 2022	<b>Exam I</b>	In class
Monday, 31 October 2022	<b>Exam II</b>	3:15–4:30 p.m. via Moodle
Monday, 28 November 2022	Field project final report due	5:00 p.m.
Wednesday, 7 December 2022	<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

Given the uncertainties associated with the evolving state of the COVID-19 pandemic, I may choose to hold some classes remotely. Any remote classes will be offered synchronously via Zoom. Unless indicated otherwise, assume for now that most classes will be held in person. I reserve the right to offer the course using the “occasional hybrid” mode to reduce our in-person interactions as needed. I will give as much notice as possible prior to any classes offered remotely. Exams may take place via Moodle. **Please carefully note the pre-scheduled online classes in red in the schedule below.** This course schedule is approximate and subject to modifications.

Date	Topic	Reading
15 August	Elements of modern measurement systems, <b>Lab: Foundations</b>	Chapter 1, Section 13.4
17 August	Site selection	
22 August	<b>Lab: Site survey @ UNCA meteorological tower</b>	Lab materials
24 August	Basic electronics	Appendix D
29 August	Basic electronics	
31 August	<b>Lab: Basic electronics</b>	Lab materials
5 September	<b>Labor Day–No class</b>	
7 September	Barometry	Chapter 2
12 September	CRBasic programming, LoggerNet	
14 September	Static performance characteristics	Chapter 3
19 September	Static performance characteristics	
21 September	Static performance characteristics	
26 September	<b>Lab: Sensor wiring, datalogger programming, tower construction</b>	Lab materials
28 September	<b>Exam I</b>	
3 October	<b>Fall Break–No class</b>	
5 October	Thermometry	Chapter 4
10 October	Thermometry	
12 October	Thermometry	Appendix B
17 October	Precipitation measurements	Chapter 9
19 October	Hygrometry	Chapter 5
24 October	<b>Lab: Rain gauge calibration</b>	Lab materials
26 October	Dynamic performance characteristics	Chapter 6
31 October	<b>Exam II</b>	
2 November	Dynamic performance characteristics	
7 November	Dynamic performance characteristics	
9 November	Upper-air measurements	Chapter 12
14 November	<b>Lab: Atmospheric soundings</b>	Lab materials
16 November	Anemometry	Chapter 7
21 November	Anemometry	
23 November	<b>Thanksgiving–No class</b>	
28 November	Radiation	Chapter 10
7 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.

## 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, 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.

## 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 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).

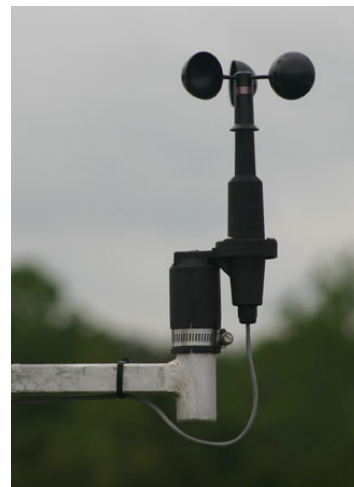
**There will be no opportunities for make-up exams.** Exams must be taken on the scheduled date and at the scheduled time. If you miss the exam, you miss the grade. The *only* exceptions to this rule are: (1) serious medical condition (illness or injury) of you or an immediate family member; (2) University excused absence; (3) jury duty; or (4) military orders. 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 are due at 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	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.



## **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.

## **COVID-19 ADDENDUM**

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While there is currently no mask mandate at UNC Asheville with the exception of healthcare settings and University shuttles, I request that you continue to wear a mask in my classroom out of respect for me, your fellow students, and our families. **Eating and drinking are not permitted** in the classroom. While I will always happily entertain your questions from a distance during class and during virtual office hours, please **do not physically approach me** with questions before or after class. I ask for your patience and flexibility as we all navigate a global pandemic.

Ideas (perhaps for an in-person non-pandemic year):

- Have the students keep a journal of their research experience! They can write about unexpected problems, fixes, surprises, challenges, etc.

- See the original IMAGINE proposal syllabus. I had to gut several great items because this course is online.

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Wednesday, 30 September 2020

Tripod setup and pizza night

5:30 – 9:30 p.m.

- 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, tipping bucket rain gauges, and a soil moisture probe, all with supporting hardware and accessories. Please plan to attend the gathering on September 30, where each group will set up a tripod mast and install and wire the sensors in preparation for field deployment. The department will provide a pizza dinner.