

## METR 5243 Syllabus 08/22/06

**Class Day & Time:** TTr, 0830-0945

**Location:** National Weather Center, Room 5930

**Instructors:** Donald R. MacGorman & William H. Beasley

**Offices & Office Hrs:** DRM NWC Room 4352,  
WHB NWC Room 5650, almost any time, by appointment

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**Text:** The Electrical Nature of Storms, MacGorman and Rust, Oxford, 1998, ISBN 0-19-507337-1 (You may have to check Amazon.com, as the OU bookstore informs us the book is out of print from Oxford.)

### COURSE DESCRIPTION

This course will provide a broad overview of principal topics in atmospheric electrodynamics. Although the default mode is to follow the text fairly closely, we are open to expressions of particular interests by class members. We will begin with a review of basic principles of electromagnetic fields and waves and the behavior of electric charge and currents. To place the topics of thunderstorm electrification in context, we will also discuss the interaction of the earth with the solar wind and interplanetary medium, the global circuit, and fair-weather electricity. We will review the principles of operation of some of the instruments used to make observations of the electrical nature of storms. Finally, we will review the state of knowledge of how storm electrification and lightning are related to other more conventional meteorological observables and a brief introduction to the latest modeling efforts.

### EXPECTATIONS

**Background:** We assume that students entering this course are conversant with the topics that are common to undergraduate programs in meteorology, physics, and engineering. Therefore we will use tools as needed from calculus, differential equations, vector analysis, introductory classical physics (e.g., mechanics). We assume that students entering this course most likely will not have had extensive exposure to the subjects of electricity and magnetism beyond that which is generally seen in undergraduate physics courses, in other words, at best a once-over-lightly treatment of the Maxwell equations. Thus we will start with the Tutorial chapter of the text in order to provide a systematic review of the basic concepts that underlie the rest of the course.

Effort: This is a graduate course. That means that students are highly motivated and participatory. We expect that students will keep up with reading assignments and problem sets. We expect students to ask and to answer questions in class. We estimate that on average, students should expect to invest at least 3 hours for every 1 hour in class.

### Course Grade

Course grade will be determined as follows:

Item	% of grade
Exams (3 @ 20%)	60
Term Paper	30
Homework Problem Sets	10

To help you prepare for the exams, we will assign problem sets. We will collect the problem sets and check them over to see how you are doing, then return them with a solution sheet or guidelines as appropriate. The problem sets will be graded on an S/U basis, S reflecting what we judge to be an honest effort. Ultimately it will be up to you to determine whether you understand the problems in sufficient depth to withstand examination over similar problems. We will help when asked, but we do not plan to go over problem sets in detail except to address specific questions from you!

Attached to this syllabus is a list of possible topics and guidelines for term papers. You may also suggest a topic of your own. Early in the semester you will turn in an outline for your term paper, which we will review, comment upon as necessary, and return. Term papers will be due the last day of classes before the Thanksgiving holiday. (You will thank us for this at the end of the semester!)

### Academic Misconduct

Academic misconduct is defined as "any act that improperly affects the evaluation of a student's academic performance or achievement." All faculty at the University of Oklahoma expect academic integrity from each student. Misconduct such as plagiarism, submission of work for more than one class, fabrication, and fraud, as well as attempting to commit such act or assisting others in so doing, will not be tolerated. Students are responsible for knowing the OU Academic Code, which can be found at <http://www.ou.edu/studentcode>.

### Integrity Pledge (required on all work)

On my honor, I affirm that I have neither given nor received inappropriate aid in the completion of this exercise (quiz, examination, paper, etc.).

Name: \_\_\_\_\_ Date: \_\_\_\_\_

For background on the Integrity Pledge and the Honor Council, please go to <http://www.ou.edu/honorcouncil/>

### Reasonable Accommodation Policy

The University of Oklahoma is committed to providing reasonable accommodation for all students with disabilities. Students with disabilities who require accommodations in this course are requested to speak with the professor as early in the semester as possible. Students with disabilities must be registered with the Office of Disability Services prior to receiving accommodations in this course. The Office of Disability Services is located in Goddard Health Center, Suite 166, phone 405/325-3852 or TDD only 405/325-4173.

### **Term Paper Guidelines**

There are two options. You may do a review paper on a topic of your choice, or you may undertake a project, upon which you write a paper. In either case a thorough literature review is required. Think of the literature review as roughly equivalent to that which you would have to do for an MS thesis. You choose a topic that interests you and then you find everything you can in the reviewed literature on that topic, filter it and make judgments about what is germane and what is not. Then you write a coherent, logical exposition of what you have learned about the topic, and, in particular, what the outstanding questions are. If the paper is the end in itself, that is it. If the review is the prerequisite for a project it may be slightly less extensive, but it must provide the basis for the project itself. Here are the mechanical requirements:

One-Page Topical Outline, Due 09/12/06

Paper, Due 11/21/06, to be submitted electronically as WordPerfect or MS Word document

Style: research journal article (see JGR, JAS, JAM)

References: You must cite at least 20 reviewed journal articles relevant to your topic.

Page Limits: No fewer than 10 and no more than 20 pages including figures

Line Spacing: Double spaced

Margins: One inch all around

Font: Times New Roman, no smaller than 10 point and no larger than 12 point

### **Some Possible Topics and Projects**

Storm Electrification

Lightning in Severe Storms (pick a subtopic: tornadoes, hail, hurricanes, blizzards, etc.)

Lightning Prediction or Prediction of Conditions Favorable for Lightning

Lightning Initiation

Lightning Protection

How do Ground Rods Work?

How do the NLDN and the USPLN work?

Measurement and Comparison of lightning-strike currents with estimates by NLDN

Lightning Hazard Warning Decision Support

Global Circuit, Schumann Resonances, etc.

Terrestrial Gamma Flashes  
X-rays in Thunderstorms (variations: runaway breakdown, observations)  
Lightning as an example of fractal geometry  
Physics of lightning plasmas  
Transient Luminous Events above thunderstorms  
Lightning Detection and Location Systems  
Evaluation of small and hand-held lightning detection and warning devices  
Sequence of Events in CG flashes (animation project)  
Rayleigh Fountain  
Role of Ice in electrification  
Thunderstorm Models with Lightning Included

Or?