University of Alaska Fairbanks **Fall 2015**

Physics 650

Aeronomy and Auroral Physics
3 Credits

Instructor – Dr. Mark Conde

http://www.esa.int/var/esa/storage/images/esa_multimedia/images/2014/07/artist_s_view_of_atv-5_reentry/14605700-2-eng-GB/Artist_s_view_of_ATV-5_reentry.jpg

Overview

Description

This will be a graduate level introduction into the physics of Earth's upper atmosphere, and the auroral phenomena that occur within it. Topics to be covered will include:

- Basic properties of the upper atmosphere, and how it differs from layers below
- Radiative transfer in the upper atmosphere
- Kinetic theory
- Fluid dynamical description
- Waves and tides
- The ionosphere
- Space weather influences
- Survey of auroral phenomena
- Solar, interplanetary, and magnetospheric origins of the aurora
- Optics and spectroscopy of the aurora
- Auroral forecasting
- Tools and techniques for studying aeronomy and the aurora
- Aeronomy and auroral physics on other planets
- Recent research topics

The course will be mostly focused on giving students a practical working understanding of these topics, rather than developing detailed high-level theoretical descriptions.

Course goals and student learning outcomes

Upon completion of this course students will:

- Understand the nature of Earth's upper atmosphere, ionosphere, and aurora
- Understand the societal relevance of these topics
- Be familiar with the tools and techniques used to study them
- Be aware of recent research directions in these fields

My goal as an instructor is to provide every student with maximum possible opportunity for success. This means that I try to be as flexible as possible with the course requirements, to avoid creating needless hurdles. Nevertheless, some penalties for missed or late work are necessary; my policies in this regard are outlined in subsequent sections.

Instructor information

Instructor: Dr. Mark Conde
Email: mark.conde@gi.alaska.edu
Office locations: Reichardt room 110 and Elvey room 706F.
Office Phone: 474-7741

Office hours: TBD, but likely 9:00 AM – 11:15 AM Tuesday and Thursday. I will be in Room 110 of the Reichardt building at these times.

Target schedule

Week	*Dates*	*Topics*	*Comments*
1	Aug 31 - Sep 04	Class introduction, Basic properties	
2	Sep 07 - Sep 11	Radiative transfer	
3	Sep 14 - Sep 18	Kinetic Theory.	HW 1 Assigned; Project proposals due
4	Sep 21 - Sep 25	Fluid Dynamics	
5	Sep 28 - Oct 02	Fluid Dynamics	HW 2 Assigned
6	Oct 05 - Oct 09	Waves and Tides	
7	Oct 12 - Oct 16	The Ionosphere	HW 3 Assigned
8	Oct 19 - Oct 23	Space Weather in the Upper Atmosphere	
9	Oct 26 - Oct 30	Aurora - Survey	HW 4 Assigned
10	Nov 02 - Nov 06	Solar, Interplanetary, & Magnetospheric Drivers	Mid Term Exam
11	Nov 09 - Nov 13	Optics and Spectroscopy	HW 5 Assigned
12	Nov 16 - Nov 20	Auroral Forecasting	
13	Nov 23 - Nov 27	Thanksgiving week, Tools & Techniques	HW 6 Assigned
14	Nov 30 - Dec 04	Tools and Techniques	
15	Dec 07 - Dec 11	Other Planets	Project is due
16	Dec 14 - Dec 18	Finals week	
17	Dec 21 - Dec 25	Grades posted by Dec 23	

Note that this is a just a guess; I do not yet know exactly how long each topic will take.

Course components and instructional methods

Instructional materials

Material for this course will be prepared electronically and will be available *over the web via the "Blackboard"[1] system* at http://classes.uaf.edu. Material to be posted this way includes:

- Course syllabus (this document)
- Lecture notes (see comments below)
- Homework problem sets
- Supplementary handouts
- Online student grades

Note that I will not be distributing homework or exam solutions to the web. These will instead be posted in the glass cabinets in the physics departmental area of the Reichardt building.

Lectures

I will be presenting lectures mostly using a computer, although I will supplement this with additional informal diagrams etc drawn on the blackboard. I intend to post printable versions of the electronic lecture notes online ahead of time.

[1] All students should have access to Blackboard. Please let me know if you have difficulties with this.

Lectures are currently scheduled for 9:45 – 11:15 on Tuesdays and Thursdays in room 207 of the Reichardt building. This is an unattractive time for me because I have a 1.5 hour long Astronomy class immediately afterward. We will discuss options for rescheduling during the first lecture. (The first lecture will be held at the scheduled time.)

Once skies get dark enough, we will likely spend some time each lecture discussing auroral activity over the preceding night(s), and trying to predict what might happen over the next day or two.

Homework

Homework will be assigned every second week during the Thursday lecture, and will be due at the Thursday lecture two weeks later. Turn in your homework by handing it to me at the lecture. You may work with others on the homework problems, but you are prohibited from simply copying other's work. Homework will count significantly toward your final grade, as well as provide me with feedback regarding your understanding of the material.

Please realize that even if you submit a correct solution to a problem, I may not recognize it as correct if it's poorly presented. To maximize your chance of scoring well, your homework must:

- Be neatly laid out
- Be largely free from crossing out and over-writing
- Use grammatically correct English and be well enough written that the grader can understand what you're trying to say

Project

The reason I'm only assigning Homework every second week is to allow you time to work on a student project. This can be either an essay on a topic of current relevance, or else a review of a recent and substantial scientific paper on Aeronomy or the aurora. It is up to you to propose a topic or Journal article of interest to you that will become the basis for your project. You will need to discuss your proposal with me and, by then of our third week (Sep 18) we should have agreed upon a project topic for you. Projects should be roughly 10 -15 pages of single-spaced text, plus figures. Journal-standard referencing is required.

Exams

There will be one 90-minute mid-term exam during the semester and one two-hour final exam. The preliminary dates for these are

- Mid-term: Week of Nov 2 – 6, exact date TBD
- Final: 8-10 a.m., Saturday, Dec. 19.

No textbooks or printed material will be allowed in the exams, but you may bring in any amount of your own original (not photocopied) handwritten notes. You should bring a calculator.

Course policies

Grading

The course grade will consist of the following components

- Homework: 30%
- Project 25%
- Mid-term exam: 20%
- Final exam: 25%

I will post all grades online, using the UAF's "Blackboard" system (http://classes.uaf.edu). All registered students have access to this system for checking their grades. Please do *check that we have posted all your grades correctly*, and let me know if you think there is an error. Also, please retain all work that we return after grading, in case an error does appear. Returned graded work is proof of your scores.

Final grades will be returned as letter grades with plus/minus modifiers. These will be derived from your overall percentage grade. The approximate conversions for each letter grade will be as follows. A: ≥90%; B: 75% to 90%; C: 60% to 75%; D: 50% to 60%; F: <50%. Plus/minus modifiers will subdivide each main grade into three equally spaced sub-levels.

Attendance

UAF policy[2] states that "you are expected to adhere to the class attendance policies set by your instructors." In general, I expect at least 90% attendance from all students. In this small class absences will not go unnoticed.

Class participation

There is no requirement for you to participate actively in class by asking questions or joining discussions, and there is no grade component based on this. Nevertheless, you are of course free to ask questions at any time during the lectures. Because we have a large amount of material to cover, I may defer answering lengthy or numerous questions until after class.

[2]See http://www.uaf.edu/catalog/current/academics/regs2.html#Attendance, which states that:-"You are expected to regularly attend classes; unexcused absences may result in a failing grade. You are responsible for conferring with your instructor concerning absences and the possibility of arranging to make up missed work."

Missed or late work

Problem sets will generally not be accepted after the due date, without evidence of illness or genuine emergency. Students having documented clashes with other UAF commitments may pre-arrange alternate homework submission deadlines with me. All decisions regarding late homework or alternate deadlines will be at the discretion of the instructor.

Student conduct and academic honesty

It is the responsibility for each student to be informed about the policies for student conduct and safety at the University of Alaska. You are encouraged to read these policies at http://www.uaf.edu/usa/student-resources/conduct/#condu. It should go without saying that students are expected to do their own original work for all assignments. Any deviation from this may be considered academic misconduct and may result in a failing grade and referral to university authorities for possible disciplinary action.

Course requirements and materials

Prerequisites

Enrolment in a Natural Sciences graduate degree program.

Textbooks

Required: None

Recommended: Aeronomy, by Banks & Kockarts; Aurora, by Vallance-Jones

Both of these are out of print. But you can likely find them in the library or online.

Calculators

You will need access to a calculator to complete some of the homework problems. Calculators will also be permitted during exams. Remember that it is much more important to present the correct reasoning for solving a problem than it is to arrive at the correct numerical value. Please, explain your reasoning when presenting solutions to homework and exam problems. I will award partial points for correct reasoning, if presented, even if the final answer is incorrect or incomplete.

Support Services

Complaints and concerns

You are always welcome to discuss your concerns with me. However, if you have a concern that you feel cannot be resolved by discussion with me, you may wish to contact the Physics Department chair, Dr. Wackerbauer. The University also has an Academic Advising Center on the 5th floor of the Gruening building, open Monday to Friday, 8 am to 5 pm and contactable via phone at 907-474-6396. The advising center can help with all student matters, from study tips to help with understanding the University's formal mechanisms for academic appeals. (See also http://www.uaf.edu/advising/)

Student Health and Counseling Center

The University provides health and counseling services through its Student Health and Counseling Center, which is located at 612 N. Chandalar Drive, on the 2nd floor of the Whitaker Building (the same building as Fire and Police, across from the bus turn around.) Their web site is at http://www.uaf.edu/chc/. The center will see students on an appointment basis. The number to call for an appointment is 474-7043. It is best to do so at 8:00 AM in the morning, because they are scheduled daily on a first come first serve basis.

Disabled students

Disability services are provided free of charge, and are available to any student who qualifies as a person with a disability. Student seeking special accommodations for a disability must first discuss their needs with Disability Services. Call 474-5655 to schedule an appointment.

UAF Disability Services is located in the Whitaker Building, room 208. Extensive support is available, as described at http://www.uaf.edu/disability/