Atmospheric Radiation - Fall 2019

ATM F613/F413; PHYS F613/413 **Atmospheric Radiation** (3)

Fundamentals of blackbody radiation theory and radiative properties of atmospheric constituents. Discussion of gaseous absorption including line absorption, broadening effects and radiative transfer. Includes scattering, radiative properties of clouds, and radiation climatology. (ATM413: Prerequisites/Co-requisites: ATM F401. Stacked with ATM F613). (ATM613: Prerequisites/co-requisites: ATM F601; graduate standing. Stacked with ATM F413). (3+0).

Instructor:	Xiangdong Zhang	xzhang9@alaska.edu
	313 Akasofu	(907) 474-2675
Class:	Tuesday and Thursday,2:30 pm – 4:00pm, 230 Margaret Murie Building	
Office Hours:	Friday 9 – 11 am 313 Akasofu, or by appointment.	

Required Text

A first course in atmospheric radiation

Petty, G. W., Sundog Publishing 2006. ISBN: 0972903313 (Second Edition)

Recommended Texts on Reserve at Mather Library:

Fundamentals of atmospheric radiation: an introduction with 400 problems

Bohren, C. F., and E. E. Clothiaux, Wiley-VCH, 2006. ISBN: 3527405038

Absorption and scattering of light by small particles

Bohren, C. F., and D. R. Huffman, Wiley, 1983. ISBN: 0471293407

Light scattering by small particles

Van de Hulst, H. C., 1981. Dover, ISBN: 0486642283

An introduction to atmospheric radiation

Liou, K.-N., Academic Press, 2002. ISBN: 0124514510

Radiative processes in meteorology and climatology

Paltridge, G. W., and C. M. R. Platt, Elsevier Scientific Pub. Co., 1976. ISBN: 0444414444

Description

This course meets core requirements for Atmospheric Science M.S. and Ph.D. degrees. However, interested students from other areas of science and engineering are welcome. Course will follow elements from recommended text and review articles. Grades will be based on homework, exams and a term paper-project. This class focuses on the fundamental study and quantitative measurement of the interactions of solar and terrestrial radiation with molecules, aerosols and cloud particles in planetary atmospheres. The goal of the course is to give students a foundation in the principles of atmospheric radiation. Lectures will include material not found in the texts. Where possible we will try to explore concepts from a data driven perspective. The topics to be covered include;

1. Introduction and overview of Earth's radiation budget and balance
2. Principles and practices of describing radiation
3. The Sun and solar radiation.
4. Long-wave radiation
5. Radiative Transfer
6. Aerosols and clouds
7. Radiation and observed atmospheric thermal structure

Students completing the course should have an understanding of the key concepts in the interaction of radiation with the atmosphere. They should have developed a foundation for research in atmospheric sciences, geography, environmental sciences and remote sensing.

Grading

The class grade will be based on homework, final exam, a term paper-project, and participation as follows;

Homework	30%
Final Exam	30%
Term Paper-Project	35%
Participation	5%

Grades will be assigned in accordance with UAF policy (see current catalog). A student who scores greater than 95% on their submitted body of work is guaranteed an A+. A student who scores greater than 90% on their submitted body of work is guaranteed an A-. A student who scores greater than 82.5% on their submitted body of work is guaranteed a B+. A student who scores greater than 75% on their submitted body of work is guaranteed a B-. A student who scores greater than 67.5% on their submitted body of work is guaranteed a C+. A student who scores greater than 60% on their submitted body of work is guaranteed a C-. A student who scores greater than 55% on their submitted body of work is guaranteed a D+. A student who scores greater than 50% on their submitted body of work is guaranteed a D-.

Homework

Homework problems will be assigned bi-weekly and must be turned in on/before the stated deadline. No late homework will be accepted without a suitable excuse. You are encouraged to work in study groups. However, the work you hand in should be your own effort (not merely a copy of another student's work). You are welcome to use the scheduled office hours for tutorial assistance with the homework. If you have questions about a homework problem outside of office hours, contact the instructor by e-mail. Homework assignments are expected to be neat and legible. Students are expected to complete the reading assignments.

Final Exam

There will be final exam. The exam will last 90 minutes. Students may refer to a single double-sided cheat-sheet (standard 8.5x11) in the exam.

Term Paper-Project

There will be a term paper-project required of each student based on a topic selected by the student. The paper should be present a review of several (minimum of four) while the project can present a smaller number of research articles and conduct an analysis The preparation of the term paper will be staged over the semester. An outline (~1 page) outlining the topic to be addressed, with list of possible papers, is due in October. A detailed outline citing the references to be used and giving a brief description of each paper and/or method is due in November. The instructor requires each student to meet with the instructor to discuss the paper project. The final paper-project report is due on the last class. Each student is required to make a PowerPoint® presentation with handout (15 min presentation, with 5 min for discussion) to the class. The grade for the paper-project will be based on both the paper and the presentation. Class members and the instructor will complete evaluation sheets for each presentation, and the grade for the presentation will be based on both the peer and instructor evaluations. Attendance and participation is mandatory in order to pass the class.

Participation

Participation is based on regular attendance, submitting a full body of work (i.e., attempting all homework assignments, reading assignments, exam, and term paper), participating in class discussion, and participating in the paper-project presentations and evaluations. Students are expected to come to class prepared, with assigned reading done.

ATM413 and ATM613

The same grading scheme will be applied for ATM413 and ATM613. Students taking ATM415 and ATM615 are expected and encouraged to participate equally in classroom discussion. However, the scope and demand of the assignments differs. Students taking ATM413 are required to review one research article (rather than a term paper based on multiple papers) for the term paper. The homework assignments for ATM413 will have fewer problems and less extensive problems than those assigned for ATM613. ATM413 students may attempt the

extra ATM613 problems for extra credit. The exam for ATM413 and ATM613 will draw on the class assignments and therefore differ accordingly.

Students with Disabilities

The instructor will work with the UAF Disability Services Program (http://www.uaf.edu/disability/) to accommodate students with disabilities. Please inform the instructor on the first day of classes if you are seeking an accommodation through Disability Services.

Attendance

Class attendance is mandatory in accordance with UAF student services and responsibilities (http://www.uaf.edu/schedule/services/). Material not in the text may be introduced at random intervals. If you miss a class, extras of handouts are available outside the instructor's office. Students who miss class without prior-explanation or appropriate excuse (i.e., personal emergency) will receive a lower participation grade. Students will be expected for one or two meetings outside of scheduled class time to meet with the instructor to discuss their term papers. Students traveling to attend scientific meetings should inform the instructor on the first day of class. Classes may be rescheduled as appropriate to accommodate these important events.

e-Access

Class will use Blackboard http://classes.uaf.edu/ and corse materials will be uploaded to Blackboard.

Academic Honesty and Plagiarism

You are expected you to do your own work in accordance with the UAF Student Code of Conduct (http://www.uaf.edu/schedule/conduct/#condu). Cheating and plagiarism are very serious offenses, and will not be tolerated. Plagiarism may be defined as using what another person's work and presenting it as your own. Plagiarism is never acceptable. Any exam or homework that contains plagiarized material will receive a grade of zero for that exam or homework. A repeated offense may result in formal disciplinary action by the University.

Notes and Questions

Introduction to Atmospheric Radiation: An Overview	Properties of Radiation
Properties of Radiation (Cont.) HW#1 assigned	Thermodynamic Equilibrium and Blackbody Radiation
Absorption and Emission in the Atmosphere	Absorption, Emission, and Scattering in the Atmosphere
Extinction, Absorption, Scattering and Radiative Transfer in the Atmosphere HW#2 assigned	Radiative Transfer in the Atmosphere
Review of Homework #1	Property of Molecules and Particles in the Atmosphere Radiation
Mid-term Review	Review of Homework #2
Paper-Project Meeting	Property of Molecules and Particles in the Atmosphere Radiation (Continuing)
Absorption and Emission of Atoms and Molecules	Absorption and Emission of Atoms and Molecules (Continuing)
Spectral line of Gaseous Absorption and Emission HW#3 assigned	Spectral line of Gaseous Absorption and Emission (Continuing)
Terrestrial Infrared Radiative Transfer	Terrestrial Infrared Radiative Transfer (Continuation 1)
Review of HW#3	Terrestrial Infrared Radiative Transfer (Continuation 2)
Pre-Exam Review	**Exam**
Review of Exam	**Thanksgiving - No Class**
Radiative Transfer Model	Radiative Transfer Model (Continuing)
Presentations	Presentations **Last Class**