

Syllabus & Course Outline

Instructor: Dr. Richard O. Gray email: grayro@appstate.edu

Office: CAP 311/313, Telephone: 262-2430; Lab: CAP 324

Office Hours: Tuesday & Thursday 2:15 - 3:15 pm.
These are my official office hours for this class, but I maintain an "open-door" policy which means that you are welcome to drop in at times other than listed above.

Textbook: There is no specified textbook for this course; however, I have prepared lecture notes which will be handed out in class on a weekly basis. The following books will be useful reference texts and are either available in the library or will be placed on reserve: Environmental Physics, by Boeker & van Grondelle 1995 (Wiley); A Climate Modeling Primer, by McGuffie & Henderson-Sellers 1997 (Wiley). Another excellent resource is the Intergovernmental Panel on Climate Change's Report "Climate Change 2007: The Physical Science Basis". This may be obtained at <http://www.ipcc.ch/ipccreports/assessments-reports.htm>

Class meeting: Tuesday & Thursday 1:00 - 2:15 p.m., CAP 108

Web Site: This course has its own web site! Point your browser to <http://www.phys.appstate.edu/ep.html>

Evaluation: Three in-class exams will be given over the lecture material. These exams will count for 12.5% of the total grade each. The exams will involve short answer or short essay questions, with possible simple mathematical problems. A final exam will be given at the end of the semester (20% of the grade) and one project on an environmental physics topic (see below) will be required. This project will constitute 25% of the grade. Homework will also be assigned weekly. This homework will count for 17.5% of the grade. I encourage class participation and discussion, which is what really makes this class interesting and the amount that you contribute to the class in this way will count, somewhat subjectively, in your grade evaluation.

Extra Credit: A number of the best projects will be chosen to be presented to the class. These presentations will earn extra credit for the presenters.

Attendance: Attendance in class is very important, as most class material will come from the lecture or class assignments and discussion. However, attendance will not be monitored in a formal way unless it turns out to be necessary.

This class is being offered to respond to the growing need for knowledge about the physics behind contemporary environmental problems. The lectures will concentrate on the physics of one of the most pressing global environmental problems of the day - the threat of global climate change due to increased greenhouse gases in the earth's atmosphere. We will also examine the ozone depletion problem, alternative energy sources, such as solar and wind power, and environmental issues associated with nuclear power. Environmental Physics is by its nature cross-disciplinary, as it draws on data and insights from diverse fields such as astronomy, chemistry, geology and biology, and its results are of fundamental importance to the future of society.

We will have 28 class meetings during this semester. The proposed schedule (below) will be supplemented by presentations of some of the best term papers.

Lecture	Topic
1	Introduction

Part I Electromagnetic Radiation and Planetary Atmospheres

2	The nature of light: Wavelength and energy, the electromagnetic spectrum, blackbody radiation
3	Atomic spectroscopy; Kirchoff's laws
4	Molecular spectroscopy
5	Albedo and Planetary Temperatures
6	The effect of an atmosphere: greenhouse gases, IR radiation and the greenhouse effect; energy balance models & feedback effects.
7	UV radiation, the ozone layer and ozone depletion.

Part II The Origin of Planetary Atmospheres

8	[EXAM 1]
9	The origin of the solar system and the origin of the atmospheres of the terrestrial planets
10	Modification of the atmospheres of the terrestrial planets; comparative study of Venus, Earth, Mars

- 11 Paleoclimate of the Earth: The causes of the Ice Ages
- Part III Greenhouse Gases and Global climate change on Earth
- 12 Anthropogenic CO₂ and other greenhouse gases, evidence for increase in the atmosphere
- 13 The Carbon cycle
- 14 Aerosols. Intro to Global Climate modeling
- 15 Physical principles involved in climate modeling
- 16 1) Radiative Forcing and Atmospheric Structure
- 17 2) Atmospheric structure and global circulation
- 18 3) The Ocean, and the Thermohaline circulation
- 18 **[EXAM 2]**
- 19 The temperature history of the Earth. Global climate model predictions in general.
- 20 Global Climate (Circulation) models & predictions
- 21 IPCC reports: Greenhouse gas emission scenarios and resulting climate predictions. Reliability of climate predictions. Other possible drivers of climate change.

Part V Mitigation of Global Climate Change

- 22 Fossil fuels and energy supply options; the Kyoto protocol; Copenhagen; future international agreements?
- 23 Is Nuclear energy a viable energy source??
- 24 - 25 Alternative energy sources: Hydropower, Biomass, Wind, Solar and Geothermal
- 26 **[EXAM 3]**

Lectures 27 - 29 will be devoted to other environmental physics issues or a more in-depth treatment of some of the topics already covered. These class sessions will be partly or wholly based on term-paper or project presentations.

Important dates (some of these are tentative)
 Turn in abstract for your project: September 17
 Exam #1: Tuesday, September 22
 Exam #2: October 27
 Projects Due: November 19
 Exam #3: November 24
 Final Exam: Friday, Dec 11, 2009: Noon - 2:30pm

Projects: Each student will be expected to complete a project on some topic relevant to environmental physics during the semester. This project may either be a term paper on an approved topic (see the list below) or some other project. Term papers will involve research from primary and secondary sources and should be at least 15 pages long, with 1.5 spacing and 12pt font. Illustrations and figures can be included in the 15 pages.

The projects, on the other hand, can encompass any number of activities. For instance, there are simple solar projects that one can carry out easily and cheaply to supplement heating in your home or apartment. Students who are good computer programmers may wish to tackle writing a simple computer climate model. Alternately, there is an excellent, research grade global climate model now available for free on the web, EdGCM. A project computing a model climate for a hypothetical situation would be an excellent project. A survey of energy usage in a selected building on campus, along with suggestions for better energy efficiency is another possible project. If you have an idea for a project, come to me and discuss it. All projects should be accompanied by a short (3 - 5) page report. Projects are preferable to term papers.

Some possible term paper subjects (others are possible - check with me first)

- Solar variability and the earth's climate
- The Montreal Protocol and the phase-out of Ozone-depleting chemicals
- Ocean circulation and global climate change
- Plant growth in an enhanced CO₂ atmosphere
- The case for electric vehicles
- Hybrid vehicles
- Progress and problems in the storage of nuclear waste
- Advances in solar energy
- What promise nuclear fusion?
- Geothermal Energy
- Practical ways ASU can conserve energy
- CO₂ concentrations and the Ice Ages
- Fuel Cells & the Hydrogen economy
- Snowball Earth

OTHER Matters:

Academic Integrity Code: *As a community of learners at Appalachian State University, we must create an atmosphere of honesty, fairness, and responsibility, without which we cannot earn the trust and respect of each other. Furthermore, we recognize that academic dishonesty detracts from the value of an Appalachian degree. Therefore, we shall not tolerate lying, cheating, or stealing in any form and will oppose any instance of academic dishonesty. This course will follow the provisions of the Academic Integrity Code, which can be found on the Office of Student Conduct Web Site:*
<http://www.studentconduct.appstate.edu>

Accommodations for Students with Disabilities: *Appalachian State University is committed to making reasonable accommodations for individuals with documented qualifying disabilities in accordance with the Americans with Disabilities Act of 1990, and Section 504 of the Rehabilitation Act of 1973. Those seeking accommodations based on a substantially limiting disability must contact and register with The Office of Disability Services (ODS) at <http://www.ods.appstate.edu> or 828-262-3056. Once registration is complete, individuals will meet with ODS staff to discuss eligibility and appropriate accommodations.*