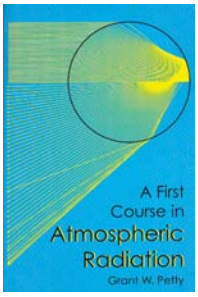
A FIRST COURSE IN ATMOSPHERIC RADIATION

Grant W. Petty, 2004, 445 pp., $46.00 ($34.00 direct from publisher), paperbound, Sundog Publishing, ISBN 0-9729033-0-5

I have searched in vain to find a textbook covering atmospheric radiation that is appropriate for advanced undergraduates. My search is near completion. Grant Petty's *A First Course in Atmospheric Radiation* is a nearly ideal introduction for advanced undergraduates. My organic chemistry professor told me that there are two types of textbooks: those written for students, and those written for professors. This book is written for students. Petty has tried to keep from overwhelming undergraduates, while at the same time giving the necessary rigor. When students complete this book, most will have a good understanding of atmospheric radiation processes, but will not be ready for independent research in atmospheric radiation. They will be ready for a graduate level atmospheric radiation course that leads to independent research.



Advanced undergraduates are often the hardest group of students to teach. They have been introduced to elementary calculus and physics, but have had little experience in using their new knowledge, especially in new situations. This transition from elementary science is even more difficult in atmospheric radiation, where the physics background needed for radiation is usually covered in the second-year modern physics course that most atmospheric science students do not take. Petty has taken these circumstances into account, and provides the needed solid-angle mathematics and an intermediate introduction to radiation physics necessary to understand atmospheric radiation.

The subjects covered are standard for an undergraduate course, and include the properties of radiation, the electromagnetic spectrum, reflection and refraction, radiative properties of natural surfaces, thermal emission, atmospheric transmission, atmospheric emission, scattering and absorption by particles, and radiative transfer with multiple scattering. More advanced material covers absorption by atmospheric gases and broadband fluxes and heating rates. The appendix includes sections on Legendre polynomial expansion and δ-scaling of the phase function. There is enough material for a 10–15-week semester course, depending on the speed and depth of coverage. This will leave time to cover other material that is often included with a course in atmospheric radiation, such as an introduction to cloud physics.

While professors tend to favor a theoretical approach, most undergraduates prefer an approach based on applications. Most students in atmospheric science programs are not interested in atmospheric radiation processes. If they were not required to take such a course, most would take another synoptic or mesoscale course. While the subject material may not be the favorite of most students, did this book pass the student test? I was already using another book when this book was published. Thus, I assigned some sections from Petty's book and asked my students to compare it with their current textbook. They all agreed that Petty's book was much more approachable. They especially liked the emphasis on applications. Several students on their end-of-course evaluations recommended changing to Petty's book. The students also preferred the price of Petty's book ($34 including postage and handling when ordered directly from the publisher), which is not a trivial concern with the high cost of textbooks.

It is easy to overwhelm undergraduates in an atmospheric radiation course. Much of the material is new, and the mathematical sophistication required is higher than most other undergraduate courses. The homework problems in this book are, for the most part, appropriate for students making the transition to advanced undergraduate studies. While most of the homework problems are little more than working through the formulas and concepts, they help to build students' confidence just when they are feeling overwhelmed. The homework problems help the professor to determine why students are having problems; is the problem weak calculus skills or poor understanding of the material? (Unfortunately, I have found the major problem is weak calculus skills.) The book's homework problems do a good job in reinforcing the main points of each chapter. Additional problems that would challenge the very best students would be a nice addition.

Petty has done several things to make the instructor's job easier by providing an updated errata and other updates at the book's Web site, a complete set of solutions for adopting instructors, and a complete set of book figures in printable form for overhead transparencies and electronic presentations.

The writing style is relaxed, almost conversational,

in approach. While this might irritate the purist, it strikes an appropriate level for most undergraduates—the target audience. The author also points out common errors that might lead one astray in understanding. Petty also reminds students of concepts learned earlier when applying them to new situations.

While the book is self-published and has some typos, these do not cause major distractions from its usefulness. The misprints that I found were already listed on the errata. The layout is pleasing and does not present the material as foreboding or overbearing. Numerous illustrations and graphs assist in the book's presentation.

In the next edition of this book, I would like to see more on the history of atmospheric radiation research and the individuals that have made breakthroughs in our understanding. I think that it is important for students to have an understanding of how a field develops, and to know that our understanding changes with new discoveries. Students need to have a sense that discovery is a process that develops over time, and that we have only a minimal understanding of the system.

Additionally, while the author has done such a good job of writing for the advanced undergraduate audience, I believe it would be a real service to students if the book was expanded to include cloud physics and precipitation processes which are often included in courses covering atmospheric radiation. Adding these topics would be consistent with the AMS recommendations that all atmospheric science students take a three-semester-hour course in atmospheric physics covering atmospheric radiation, cloud physics, and precipitation processes. Adding these would give the students a more integrated understanding of the atmospheric system.

—David Emory Stooksbury

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