A FIRST COURSE IN ATMOSPHERIC THERMODYNAMICS

Grant W. Petty, 2008, 337 pp., $48.00 ($36.00 when ordered directly from publisher), paperbound, Sundog Publishing, ISBN 978-0-9729033-2-5

Before being asked to review Grant Petty's *A First Course in Atmospheric Thermodynamics*, I had already assigned it as a required text to students in my sophomore-level calculus-based course in atmospheric thermodynamics. It is the fourth text I have tried in eight years of teaching such a course. As I write this review, the fall semester is half over, and I can say without reservation that I highly recommend the text for use in an undergraduate meteorology curriculum.

A First Course in Atmospheric Thermodynamics squarely hits its target audience of undergraduate meteorology majors beginning their sequence of calculus-based meteorology courses. In the preface of the text, Petty acknowledges that the text is written to complement a course that is the first in which calculus and quantitative problem solving is being applied toward the atmosphere. An entire 23-page appendix is dedicated to problem solving, including detailed sections on dimensional consistency, basic differentiation and integration, symbolic notation, and numerical precision, as well a sample problem that contrasts good and bad problem-solving techniques.

The book is organized in a logical fashion. The first third of the text covers the composition and structure of the atmosphere, thermodynamic systems and variables, physical properties of air, and atmospheric pressure. The First Law of Thermodynamics is next, followed by a short chapter on the Second Law. The topics of moisture and stability comprise the remainder of the textbook, followed by appendices covering problem solving, a math review, physical dimensions, units, and some useful tables and charts. A skew T–log$p$ diagram is included in the endpapers, and Petty provides downloads of both black-and-white and color skew T–log$p$ diagrams in PDF format scaled for 8.5-by-11-inch paper.

Petty has found a good balance between description, examples, and mathematical derivations throughout the text. He carefully leads students through derivations, explaining his reasoning and assumptions along the way, and he does not leave large gaps while deriving new mathematical relationships. The material is presented in a friendly, conversational manner, in contrast to the dry technical approach found in many science texts. Each chapter contains a section titled "In Practice" that presents an overview of practical tools, concepts, and applications that are related to the topic of the chapter. Enough material in these sections is dedicated to meteorological instrumentation such that the text could serve as a nice supplement to an undergraduate meteorological instrumentation course.

The author uses the rather unconventional approach of embedding all exercises within the text rather than at the end of the chapter—as is common in most science textbooks.

Students are therefore encouraged to pick up a pencil every couple of pages and solve problems that make use of the immediately preceding material. This approach blends problem solving with descriptive material and mathematical derivations, and may help students digest the material in manageable pieces. Indeed, I have seen many of my own students voluntarily tackle exercises that were not assigned for a grade as they made their way through the chapters, a phenomenon I had only rarely encountered with other texts.

Another unconventional and perhaps controversial aspect of the book is that only a few pages are dedicated to the Second Law of Thermodynamics and entropy. Petty justifies this in the preface to the instructor by stating that relatively few undergraduate meteorology majors are ready to ponder these topics. While some may disagree with this philosophy, my own experience is aligned with that of the author. I feel I have yet to satisfactorily cover these topics at the undergraduate level, and have found it more productive to instead to go slower though specific sections of the class that consistently give students the most trouble. This text, as its title implies, is not meant to serve as a textbook for a graduate course in atmospheric thermodynamics.

A straw poll of my students taken halfway through the semester indicated unanimous satisfaction with the text. Their enthusiasm mirrors my own, and I can say with certainty that I will be using it again in the future. Is the best thermodynamics textbook I have found specifically for undergraduates in the beginning of their calculus-based meteorology coursework. As a bonus, the book is available in softcover and can be purchased directly from the publisher for a very student-friendly $36.

—LEIGH ORF

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