

review of such relevant non-MHD turbulence theory as Kolmogorov theory. Here, as elsewhere in the book, Davidson presents excellent scaling arguments to justify his equations and to give the reader deeper insight into the subject.

The second and remaining part of the book gives an extensive discussion of various metallurgical applications of MHD. This part is different in tone, being more of a research monograph intended for professional researchers in industry and academia.

Problems are presented at the end of each of the book's 12 chapters. Interesting historical interpolations appear as well, particularly in the first part of the book. Like other texts in the series, the typography is easy on the eyes and the price easy on the purse. All in all, a wonderful introduction to the subject and more!

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Symmetry in Mechanics: A Gentle, Modern Introduction

Stephanie Frank Singer
 *Birkhäuser, Boston, 2001. \$29.95 paper (193 pp.). ISBN 0-8176-4145-9*

Differential geometry, important for an understanding of general relativity, is now used in almost every field of theoretical physics. A number of books, such as Theodore Frankel's *The Geometry of Physics* (Cambridge U. Press, 1999), are now available for advanced graduate students and professional physicists who need or desire to learn modern differential geometry. New graduate texts on classical mechanics, such as *Classical Dynamics: A Contemporary Approach* by Jorge V. José and Eugene J. Saletan (Cambridge U. Press, 1998), also emphasize the use and value of this subject. Stephanie Frank Singer's *Symmetry in Mechanics* is directed to students at the advanced undergraduate level and beyond, and offers a lovely presentation of the subject. The mathematics used is not too difficult but does require a level of sophistication and appreciation for subtleties that is typical of good undergraduate physics majors.

The first chapter presents a standard derivation of the equations for two-body planetary motion. Kepler's laws are then obtained and the role of conservation laws is emphasized. Although this calculation is well

known from elementary mechanics courses, Singer uses this example from classical physics throughout the book as a vehicle for explaining the concepts of differential geometry and for illustrating their use. The laws of planetary motion return in the final chapter, but are then derived as applications of the notions and methods presented in intervening chapters. In those chapters, one finds an introduction to differential forms, push-forwards and pullbacks, manifolds, the basics of symplectic geometry, Lie groups, and Lie algebras. Those readers who may not be familiar with a version of Hamilton's equations in the form $iX_H\omega = -dH$, will understand it, after a little work, when they study Hamiltonian functions. A later chapter is devoted to a very nice and straightforward exposition of group actions and momentum maps.

The final chapter presents a recapitulation of the derivation of Kepler's laws, this time as an illustration of the method of symplectic reduction, that is, the use of symmetries of the Hamiltonian system to simplify and reduce the basic symplectic form, leading, in this case, to a solution of the equations of motion. These ideas and techniques will allow the reader to understand advanced texts and research literature in which considerably more difficult problems are treated and solved by identical or related methods.

The book contains 122 student exercises, many of which are solved in an appendix. The solutions, especially, are valuable for showing how a mathematician approaches and solves specific problems. Using this presentation, the book removes some of the language barriers that divide the worlds of mathematics and physics. There are some misprints, but they are easy to spot and to correct. It would be useful if Singer were to set up a Web page for this book, not only to call attention to misprints and corrections but also to expand upon a few related topics that are mentioned but not developed in the text—such as Lie derivatives. In sum, this is a delightful book, one I thoroughly enjoyed reading and from which I expect other readers will, as I did, learn quite a lot.

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