Fortney, Jon Pierre
A visual introduction to differential forms and calculus on manifolds. (English) Zbl 1419.58001
Cham: Birkhäuser (ISBN 978-3-319-96991-6/hbk; 978-3-319-96992-3/ebook). xii, 468 p. (2018).

Differential forms play a major role in a wide range of mathemtical fields and applications. It is not difficult to give a formal definition of differential forms, but a genuinely abstract treatment of differential forms would surely leave many aspiring undergraduate mathematics majors perplexed and appear indigestible to physics majors. They would woner what they are and where they come from not historically but conceptually. The reviewer believes firmly that the royal way to understand differential forms, in particular the exterior differentiation, is to take differential forms as a natural higher-dimensional generalization of vector calculus [*H. Nishimura*, Far East J. Math. Sci. (FJMS) 32, No. 3, 335–346 (2009; Zbl 1166.51008)].

One of the two principal objectives in this book is to address and remedy exactly this gap in the typical undergraduate mathematics and physics curriculums, and the other is to help undergraduate mathematics majors during the second year and third year make the transition from the concrete computation-based subjects such as seen in high school and lower-level undergraduate courses to the abstract topics generally found in upper-level undergraduate and graduate courses. The book consists of twelve chapters and two appendices, among which Chapter 5 (visualizing one-, two-, and three-forms) and Chapter 9 (vector calculus and differential forms) are most attractive. The reviewer recommends young mathematics and physics majors to open the book and to keep it on their bookshelves. Indeed, the reviewer even envies young students who can study differential forms with such a fascinating book.

Reviewer: Hirokazu Nishimura (Tsukuba)

MSC:

58-01	Textbooks (global analysis)
58A10	Differential forms (global analysis)
53A45	Vector and tensor analysis

Keywords:

differential forms; exterior differentiation

Full Text: DOI