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Morse theory and Floer homology. Translated from the French by Reinie Erné. (English)

Zbl 1281.57001

Universitext. London: Springer; Les Ulis: EDP Sciences (ISBN 978-1-4471-5495-2/pbk; 978-1-4471-5496-9/ebook). xiv, 596 p. (2014).

Milnor's classical lecture on Morse theory [*J. W. Milnor*, Morse theory. Based on lecture notes by M. Spivak and R. Wells. Princeton, N.J.: Princeton University Press (1963; Zbl 0108.10401)] is readable, and there are at least two books on Morse homology [*M. Schwarz*, Morse homology. Basel: Birkhäuser Verlag (1993; Zbl 0806.57020)] and [*A. Banyaga* and *D. Hurtubise*, Lectures on Morse homology. Berlin: Springer (2004; Zbl 1080.57001)]. Floer homology introduced by *A. Floer* [Commun. Pure Appl. Math. 41, No. 4, 393–407 (1988; Zbl 0633.58009); J. Differ. Geom. 28, No. 3, 513–547 (1988; Zbl 0674.57027); Commun. Math. Phys. 120, No. 4, 575–611 (1989; Zbl 0755.58022); J. Differ. Geom. 30, No. 1, 207–221 (1989; Zbl 0678.58012)] in his proof of the Arnol'd conjecture [*V. I. Arnol'd*, C. R. Acad. Sci., Paris 261, 3719–3722 (1965; Zbl 0134.42305)] within symplectic geometry is an infinite-dimensional analogue of Morse homology à la Witten, the objects and techniques of which have been imported into the former. Floer homology uses not only geometry and topology but also much analysis, namely, Fredholm operators and Sobolev spaces.

This is its charm and difficulty at the same time. This well-written book, based upon two courses in 2004–2005 for first and second year graduates, aims to explain the solution of Arnold's conjecture. The book, which is an English translation of the French book [Zbl 1217.57001] consists of two parts, the first part (Chapter 1–4) being concerned with Morse homology while the second part (Chapter 5–14) is dealing with Floer homology. The book is accompanied by three appendices devoted to preliminaries on differential geometry (from manifolds to Riemann metric), algebraic topology (including Chern classes) and analysis (the Arzelà-Ascoli theorem, Fredholm theory, distributions, Sobolev spaces, the Cauchy-Riemann equation).

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MSC:

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53D40 Floer homology and cohomology, symplectic aspects

Keywords:

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