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Workbook for linear algebra. Problems and solutions. (Arbeitsbuch zur Linearen Algebra. Aufgaben und Lösungen.)

Heidelberg: Springer Spektrum (ISBN 978-3-662-45560-9/pbk; 978-3-662-45561-6/ebook). vii, 253 p. (2015).

Within the German four-volume book series "Textbook of mathematics" published in the early 1990s by U. Storch and H. Wiebe, the second volume provides an utmost comprehensive, rigorous, detailed and versatile introduction to classical linear algebra. The first edition of this popular standard text [*U. Storch* and *H. Wiebe*, Lehrbuch der Mathematik: für Mathematiker, Informatiker und Physiker. Band II: Lineare Algebra. Mannheim etc.: B.I.-Wissenschaftsverlag (1990; Zbl 0712.15001)] appeared twenty-five years ago, and a corrected reprint of its (revised and enlarged) second edition from 1999 was published in 2010 under the same title [Heidelberg: Spektrum Akademischer Verlag (2010; Zbl 1196.15001)]. As the reviews back then unanimously emphasized, this outstanding linear algebra text is rather unique in view of its numerous features, especially regarding its almost encyclopedic completeness, its enormously broad spectrum of topics and concrete applications, its intradisciplinary references, and its vast amount of related, often highly inspiring and further-leading exercises. The workbook under review is meant as a companion to this textbook of the two authors, in particular, and as an additional aid for the study of basic linear algebra, its allied theories, and its various applications in general. More precisely, the book contains a large number of exercises in this context, together with detailed solutions and guiding explanations. The organization of these exercises strictly follows the structure of the above-mentioned textbook, and many of the problems are taken from this source, thereby following the request of numerous readers of the latter. On the other hand, a great number of new problems is included as well. In general, the exercises substantially vary with respect to their degree of abstraction and difficulty, and those problems taken from the textbook are marked by indicating their numbering there. Also, in order to stimulate the reader's active collaboration, some of the problems are given without complete solutions, especially in those cases where the solutions are similar to others, already discussed ones. Following the twenty thematic sections of the foregoing textbook, the problems are grouped in the following twenty sections, too: (1) Fundamental algebraic concepts and vectors spaces; (2) Systems of linear equations; (3) Bases and dimension of vector spaces; (4) Affine spaces; (5) Linear maps; (6) Quotient spaces; (7) Affine maps; (8) Matrices; (9) Permutations and determinants; (10) Polynomial algebras; (11) Linear operators and eigenvalues; (12) Bilinear and sesquilinear forms; (13) Inner product spaces; (14) Isometries; (15) Selfadjoint and normal operators; (16) Minkowski spaces; (17) Normed vector spaces; (18) Applications, lattices and exponential maps; (19) Hilbert spaces and Fourier series; (20) Systems of linear differential equations. As in the textbook, the high degree of generality, abstraction and systematic presentation of the material, the strong emphasis on the crucial appearance of linear algebra in geometry, group theory, real analysis, Fourier analysis, functional analysis, numerical analysis, mathematical physics, and other areas as well as the illustrating aspect of concrete applications are strongly reflected in this accompanying workbook likewise. No doubt, it would be a great gain for the international readership if both the linear algebra text [loc. cit.] and the accompanying workbook under review would be made available in English, too, because these two books (together) are perfectly suited for self-study worldwide as well.

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Classification: H65 U45
Keywords: linear algebra; problem book; general mathematics; mathematics for non-mathematicians; applications of linear algebra; mathematical physics; textbook; vectors spaces; systems of linear equations; bases; affine spaces; linear maps; quotient spaces; affine maps; matrices; permutations; determinants; polynomial algebras; linear operators; eigenvalues; bilinear form; sesquilinear form; inner product spaces; isometries; self-adjoint operator; normal operator; Minkowski spaces; normed vector spaces; Hilbert spaces; Fourier series; systems of linear differential equations
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