BOOK REVIEWS

P. J. Davis, R. Hersh, A. E. Marchisotto: THE MATHEMATICAL EXPERIENCE. Birkhäuser Verlag, Basel 1995, xxi+487 pages, price sFr. 68.–

This is the second revised edition of the book, whose first edition appeared in 1981.

The main goal of the book is to show to an intelligent non-mathematician that contemporary mathematics can be presented in a meaningful and readable way.

The book presents a good piece of real feeling for the activities of a mathematician. Philosophical aspects of mathematics as well as some selected topics in mathematics are presented in a fine way. An extensive bibliography of further reading accompanies the book.

The book surely will find general readers who would like to know what mathematics is all about.

Štefan Schwabik, Praha

R. R. Akhmerov, M. I. Kamenskii, A. S. Potapov, A. E. Rodkina, B. N. Sadovskii: MEASURES OF NONCOMPACTNESS AND CONDENSING OPERATORS. Operator Theory: Advances and Applications, Vol. 55, Birkhäuser Verlag, Basel 1992, viii+249 pages, ISBN 3-7643-2716-2

Roughly speaking, a measure of noncompactness is a quantity indicating how a given set deviates from being compact. For example, the best known Kuratowski measure of noncompactness $\alpha(\Omega)$ of a set Ω in a metric space is defined as the greatest lower bound of all $d > 0$ such that Ω has a finite cover consisting of sets with diameters less than d. (Obviously, $\alpha(\Omega) = 0$ if and only if Ω is precompact.) The book under review, which is a revised translation of the Russian original issued in 1986, is devoted to an in-depth study of the use of measures of noncompactness in (both linear and nonlinear) functional analysis. Let us describe its contents in some detail. In the first chapter, measures of noncompactness in Banach spaces are introduced in a rather general way, and their properties are investigated. A particular emphasis is laid upon the classical Kuratowski and Hausdorff measures of noncompactness, formulae for their computation in some classical Banach spaces being presented. Further, the condensing (or densifying) operators are defined as those which send noncompact sets to sets with a smaller measure of noncompactness. Both contractions and compact operators are condensing with respect to e.g. the Kuratowski measure of noncompactness and in the third chapter of the book it is shown that many important theorems on fixed points and on the related index theory generalize to the condensing operators setting. Chapter 2 is about linear condensing operators, one of the crucial results being their complete characterization in terms of their spectral properties. The final, fourth chapter is devoted to applications of the developed theory to ordinary differential equations in Banach spaces, to equations of neutral type and to Itô delay equations, the existence of solutions, in particular of periodic solutions, and their asymptotic behaviour being dealt with.

Each chapter is amended with a detailed survey of related literature, which together with a systematic manner of exposition turn this monograph into a suitable reference book on condensing operators and their applications.

Milan Tvrdý, Praha

Aleksander M. Kytmanov: THE BOCHNER-MARTINELLI INTEGRAL AND ITS APPLICATIONS. Birkhäuser Verlag Basel-Boston-Berlin 1995, 305 stran, 178,- DEM

V teorii holomorfních funkcí jedné komplexní proměnné hraje, jak známo, centrální roli Cauchyův vzorec, tj. integrální reprezentace holomorfních funkcí pomocí Cauchyova jádra. Jeho nasnadě jsoucí zobecnění na případ více komplexních proměnných však funguje jen ve velmi speciálních oblastech. První zobecnění Cauchyova vzorce, jež platí pro všechny (hladké) podoblasti v C^n podali nezávisle počátkem čtyřicátých let S. Bochner a E. Martinelli. Bochner-Martinelliho singulární jádro je však pro $n > 1$ jen harmonické, nikoliv holomorfní, což se zpočátku jevilo značnou překážkou pro jeho užití v teoretických otázkách týkajících se holomorfních funkcí více komplexních proměnných. Počátkem sedmdesátých let bylo však ukázáno, že nehledě k tomu, že Bochner-Martinelliho jádro není holomorfní, platí Bochner-Martinelliho reprezentace jen pro holomorfní funkce. V osmdesátých letech byl Bochner-Martinelliho vzorec úspěšně užit při studiu vícedimenzionálních reziduí, v komplexní geometrii, při charakterizaci tzv. CR-funkcí jakožto hraničních hodnot holomorfních funkcí atd. Kytmanovova kniha je prvním monografickým zpracováním všech zásadních výsledků, dosažených v teorii holomorfních funkcí více komplexních proměnných pomocí Bochner-Martinelliho representace. Většina prezentovaných výsledků a jejich důkazů byla dosud publikována jen v časopisecké formě. Výklad je podrobný a jasný. Anglické vydání monografie (původně rusky) bylo doplněno o kapitolu věnovanou popisu funkcí definovaných na nějaké nadploše, které lze holomorfně rozšířit do pevné oblasti, jež nemusí být obálkou holomorfnosti nadplochy.

Jaroslav Fuka, Praha

I. Gohberg, M.A. Kaashoek, F. von Schagen: PARTIALLY SPECIFIED MATRICES AND OPERATORS: CLASSIFICATION, COMPLETION, APPLICATIONS. Birkhäuser Verlag 1995, 334 pages, DM 178,-

The book collects known results in a relatively new direction of linear algebra, the theory of invariants of partially specified matrices (p.s.m.) and operators and spectral analysis of their completions.

Invariants of p.s.m. are described in terms of the similarity transformation to a canonical form which represents an important generalization of the Jordan canonical form.

The study of possible spectral structure of completions of p.s.m. concentrates first on the three important cases of "full length" and "full width blocks" and principal blocks. Nonetheless, the general case is also treated.

An independent section describes results on completions of triangular matrices.

The authors explain the problems in the framework of connections with the properties of linear pencils and matrix polynomials. Presenting many applications makes the book especially important and interesting for specialists and students of more branches. The most important applications are to feedback stabilization of linear control systems, to construction of matrix polynomials with prescribed zero structure, to interpolation problems for matrix polynomials and rational matrix functions.

Although a more careful organization of some parts and correction of a few formal mistakes could bring the reader more comfort, the concluding judgement should be very positive:

The book represents a very important source of knowledge and inspiration for both mathematicians and engineers. Many of its parts can also be used for advanced students of matrix and operator theory.

Zdeněk Vavřín, Praha

Jerzy Zabczyk: MATHEMATICAL CONTROL THEORY: AN INTRODUCTION. Systems & Control: Foundations & Applications Series, Birkhäuser Verlag, Boston 1995, x+260 pages, ISBN 0-8176-3645-5, price DM 128,–

The textbook under review addresses a reader with a moderate preliminary knowledge and provides him with a careful, clear, but sufficiently in-depth exposition of some typical results of the contemporary control theory of deterministic continuous time systems. The author also includes several less traditional (however, important) topics such as impulse control problems. The emphasis is laid upon subjects that can be, rougly speaking, characterized by the keywords "controllability, stabilizability, observability, realization theory". The related results for linear, nonlinear and linear infinite-dimensional systems are developed in the first, second and fourth parts of the book, respectively. Infinite-dimensional systems are dealt with within the framework of the semigroup theory, fundamentals of which being concisely introduced in the book. Part 3 is about optimal control. First, basic results on both the Bellman dynamic programming and the Pontryagin maximum principle approaches to necessary conditions are proved, then Filippov's theorem on the existence of optimal controls is presented.

The first printing of Prof. Zabczyk's book was published in 1992; the fact that a second printing (with corrections) appears within three years witnesses that the book fills a gap in the offer of introductory yet precise and elegant textbooks on the control theory. We can recommend it to everybody who wishes to learn the control theory *ab initio* or whose teaching activities are connected with this topic.

Jan Seidler, Praha

Iain Adamson: A GENERAL TOPOLOGY WORKBOOK. Birkhäuser Verlag, Boston 1996, viii+152 pages, ISBN 0-8176-3844-X, price DM 48,–

In this textbook, the very basics of general topology are presented by means of the so-called Moore method: theorems are divided into a carefully arranged sequence of exercises (sometimes amended with hints); having solved them the reader is expected to master the material in a more active way than by merely reading the proofs. The book is divided into seven chapters, devoted to the definition of a topological space, to continuous mappings, induced topologies, convergence of filters, separation axioms, compactness and connectedness, respectively. In the second part of the book detailed complete solutions to all exercises are given. The reader meets only a rather limited number of deeper theorems or of more sophisticated examples. However, working out at least some of the exercises he or she may obtain some skills in handling the basic notions and constructions of the general topology. Therefore, Adamson's textbook may serve as a useful accompanying book to a more traditional course.

Jan Seidler, Praha

D. Laugwitz: BERNHARD RIEMANN 1826–1866. Wendepunkte in der Auffassung der Mathematik, Birkhäuser Verlag, Basel 1996, 346 pages, DM 88,–

Bernhard Riemann is well known to mathematicians today. The Riemann integral is known to beginners, many concepts of real and complex analysis are based on fundamental notions and statements of Riemann, the Riemann geometry is the basis for the theory of gravitation.

The present book goes back to the middle of the 19-th century when Riemann and others started the age of „modern mathematics". The algorithmic approach to mathematics was replaced step by step by conceptual thinking. D. Laugwitz presents Riemann's work from a unified viewpoint of the new mathematics, which was essentially created and promoted by Riemann himself. The basis of this approach to mathematics lies in the change when the mathematical proofs are not based on computational tools only but consist mainly in ideas using general concepts.

Even if the theory of integral is only a small part of Riemann's work, it shows the new approach very clearly. The general concept is the concept of an integrable (in the sense of Riemann) function. This general concept is then the tool for deriving results. For example Riemann gives a characterization of all integrable functions using the oscillation of a function.

Besides Riemann's mathematical activities the book describes his life and the mathematics in Germany and especially in Göttingen in the course of the last century. Nonetheless, the main value of the book is the description of the development of new ideas in mathematics in the last century.

The book is oriented to mathematicians and physicists and also to philosophers with some interest in mathematics.

Štefan Schwabik, Praha

A. N. Kolmogorov, A. P. Yushkevich (editors): MATHEMATICS OF THE 19TH CENTURY; GEOMETRY, ANALYTIC FUNCTION THEORY. Birkhäuser Verlag, Basel 1996, x+291 pages, DM 118,–

The book is a translation from Russian of a book which appeared in 1981 in Moscow. It is the second volume of a study of the development of mathematics in the nineteenth century.

The first chapter written by B. L. Laptev and B. A. Rozenfel'd is devoted to geometry. The main parts are: Analytic and Differential Geometry, Projective Geometry, Algebraic Geometry and Geometric Algebra, Non-Euclidean Geometry, Multi-Dimensional Geometry, Topology and Geometric Transformations. The authors express their mind by claiming that the main lines in geometry in the 19th century are the following: 1. Increased sophistication of methods and results related to the geometry of ordinary space, especially in the domain of differential geometry. 2. Enlargement of the concept of space. 3. Penetration of algebraic methods into geometry. From the viewpoint of these topics the history is explained in a detailed way.

The second chapter was written by A. I. Markushevich. This part gives a detailed description of the theory of complex functions of a complex variable and its development during the last century. A short description of the state of art from the 18th century together with the development of the concept of a complex number is the basis for presenting complex integration and all the deep results concerning various special functions (elliptic, algebraic, Abelian, automorphic, etc.). Analytic function theory arose in the nineteenth century, and most of the achievements in this field were established in the same period. The chapter presents a nice and fairly complete historical description of this essential part of mathematics.

The present volume is highly recommended to all mathematicians interested in the history of mathematics in general and in geometry and complex function theory in particular.

Štefan Schwabik, Praha