

Book Reviews

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BOOK REVIEWS

A. Ya. Shklyar: COMPLETE SECOND ORDER LINEAR DIFFERENTIAL EQUATIONS IN HILBERT SPACES. Birkhäuser (Operator Theory, Advances and Applications, Vol.92), Basel 1997, xii+219 pages, ISBN 3-7643-5377-5, DM 148,-.

The book presents a unified systematic theory of linear second order equations $y''(t) + Ay'(t) + By(t) = 0$, where A, B are commuting normal operators in a separable Hilbert space. The theory naturally covers linear differential equations with constant coefficients and can be considered as a model class of abstract second order linear operator differential equations.

Questions on well-posedness of the Cauchy problem as well as the Dirichlet and Neumann problems, boundary behaviour of solutions, existence of global solutions, stability and stabilization of solutions etc. are answered in the form of necessary and sufficient conditions. The results are obtained by application of spectral theory of pairs of commuting normal operators in Hilbert space. The notion of the joint spectrum of two operators is introduced at the beginning of the book together with new results on its position in C^2 . This is then used in the investigation of problems in question. Analogues of Tauberian theorems are obtained with help of a new integral transform. Effects arising in the complete equations in contrast with incomplete second order equations (when $A = 0$ or $B = 0$) and first order equations are emphasized.

The monograph provides a self-contained presentation of the theory and offers insight into the subject in a general context. It is addressed to researchers and graduate students with interest in analysis and linear operator differential equations.

Hana Petzelová, Praha

Andreas Knauf, Yakov G. Sinai: CLASSICAL NONINTEGRABILITY, QUANTUM CHAOS. With a contribution by Viviane Baladi. DMV Seminar, Band 27, Birkhäuser, Basel 1997, vi+98 pages, ISBN 3-7643-5708-8, DM 38,-.

This booklet comprises several lectures given at the DMV Seminar "Classical nonintegrability, quantum chaos", which was intended to provide an introduction to ideas and mathematical techniques of nonlinear dynamics to students and beginning researchers. (It is a bit surprising that while one can find a list and a snap of participants of the seminar as well as a list of talks in the book, no information when and where the seminar took place is given.)

Let us sketch briefly the contents of the book: In Chapter 2, V. Baladi presents a few facts about the dynamical zeta function; the chapter is amended with an extensive commented bibliography. Chapters 3 and 4 are written by A. Knauf and are devoted to irregular scattering and quantum chaos, respectively. The last three chapters are lectures by Y. Sinai. In Chapter 5, the basic notions of ergodic theory are briefly recalled. The next chapter is devoted to the proof of existence of an absolutely continuous invariant measure for an expanding map of an interval onto itself. In the last chapter spectral properties of the Laplace-Beltrami operator on Liouville surfaces are treated.

The book preserves the vivid style of the lectures, with the emphasis laid on main ideas, not on generality or technical details.

Jan Seidler, Praha

Marc Yor: SOME ASPECTS OF BROWNIAN MOTION. Part I: Some special functionals, Part II: Some recent martingale problems. Lectures in Mathematics, Birkhäuser, Basel 1992, 1997, vii+136, xii+144 pages, ISBN 3-7643-2807-X, 3-7643-5717-7, sFr 38,-, sFr 32,-.

The two slim volumes under review have originated from lectures the author delivered at the ETH Zürich in the years 1991/92. They are devoted to various fascinating properties of Brownian motion and related processes (as Bessel processes and bridges or Brownian meanders) and of functionals thereof. Most of the included results have been discovered only recently, to a great extent due to the effort of M. Yor himself and his collaborators. To give some idea of the problems dealt with, we decided, instead of trying to list the many topics treated in the book, to state a single characteristic result (Theorem 14.2 in volume II, proved by J. Azéma, T. Jeulin, F. Knight, G. Mokobodzki and the author). Let B be a one-dimensional Brownian motion, (\mathfrak{F}_t) the Brownian filtration. With any random variable $X \in L^1(\mathfrak{F}_1)$ we may associate a continuous martingale $X_t = \mathbf{E}(X|\mathfrak{F}_t)$, $0 \leq t \leq 1$. Then the following are equivalent:

- a) $X_t(\omega) = 0$, whenever (t, ω) are such that $B_t(\omega) = 0$,
- b) $X_\gamma = 0$, where $\gamma = \sup\{s < 1; B_s = 0\}$,
- c) $\mathbf{E}(X|\mathfrak{F}_\gamma) = 0$, \mathfrak{F}_γ denoting the σ -algebra generated by all random variables z_τ , z a bounded predictable process.

Such rather nontrivial theorems are presented in a vivid, informal style, so everybody interested in probability theory may read the book with pleasure to get information about this promising and still developing field of research. On the other hand, the reader willing to follow proofs must have a profound knowledge of stochastic analysis, and yet he might find it sometimes necessary to consult the original papers. (In this connection, let us mention a paper by C. Donati-Martin and the author in *Ann. Probab.* 25(1997), 1011–1058, in which many results appearing in the book are re-proved or developed further.)

Ivo Vrkoč, Praha

Mark Alber, Bei Hu, Joachim Rosenthal (eds.): CURRENT AND FUTURE DIRECTIONS IN APPLIED MATHEMATICS. Birkhäuser, Basel 1997, viii + 261 pages, hard cover, ISBN 3-7643-3956-X, DM 78,- /öS 570,- /sFr 68,-.

This volume is a written version of eighteen invited talks delivered at a Symposium on Current and Future Directions in Applied Mathematics held in April 1996 at the University of Notre Dame (Indiana, U.S.A.). The purpose of the Symposium was to bring together experts in different areas of applied mathematics to promote exchange of ideas and discussions on the future of applied mathematics. The lectures were prepared in such a way as to provide students with a review of new results in applied mathematics and a list of open problems. Contributions include general considerations about applied mathematics as a branch of science exhibiting interdisciplinary features, and further, arguments for importance of applied mathematics for computer science, economics, computers and communications. In the second part, more specific topics are tackled as feedback stabilization for mechanical systems, function minimization, singular limits in fluid mechanics, fluid flows in porous media, problems from game theory and variational principles in relation to mechanical systems. The booklet is of particular interest for those who want to enjoy contemporary insight into the rapidly developing domain of science—applied mathematics.

Juan Straškraba, Praha

Mikhail I. Kadets, Vladimir M. Kadets: SERIES IN BANACH SPACES (CONDITIONAL AND UNCONDITIONAL CONVERGENCE). Birkhäuser, Basel 1997, viii+156 pages, DM 118,-.

Series of terms in abstract vector spaces (Banach or topological) are studied in the book. The topic goes back to Riemann who characterized in the numerical case those series that remain convergent for all possible rearrangements of their terms and those which converge only for some rearrangements, and the problem of the sum range in this case.

Conditional and unconditional convergence in the abstract case are studied, the Orlicz Theorem, general Banach space results (the Dvoretzky Theorem), Steinitz's Theorem as well as some basic results for the case of topological vector spaces are given.

An appendix on the limit set of Riemann integral sums of vector valued functions is presented.

Elementary knowledge of analysis, linear algebra and Banach spaces is required for understanding the book. For graduate students and mathematicians interested in functional analysis the book represents an interesting and very useful source with many new results presented for the first time for the English reading audience.

Štefan Schwabik, Praha

Richard H. Enns, George McGuire: NONLINEAR PHYSICS WITH MAPLE FOR SCIENTISTS AND ENGINEERS (WITH A LABORATORY MANUAL). Birkhäuser, Boston 1997, x+389+xii+136 pages, DM 148,-.

The book contains a survey of problems for nonlinear ordinary and partial differential equations occurring in many problems in contemporary physics and engineering. The book starts with a description of some very popular nonlinear systems (mechanics, population dynamics, electricity, chemistry, etc.)

Methods of topological analysis, analytic methods (exact and approximate) and numerical methods are described. Some special problems (limit cycles, forced oscillations and nonlinear iterative maps) are presented and nonlinear phenomena for partial differential equations conclude the work.

The work is connected closely with MAPLE V (Release 4) programming package, using both the symbolic as well as the graphic capabilities of the package. The main part of the book is accompanied by segments of MAPLE code for handling the respective problems.

The laboratory manual describes 28 MAPLE based experimental activities based on physical or technical problems. There is a diskette with MAPLE notebooks of the problems.

The book with all its features represents a nice introduction to nonlinear phenomena in a „multimedia“ fashion for students. It is not only a toy but helps to understand nonlinearity with a small amount of basic knowledge.

Štefan Schwabik, Praha

C. Bandle, W. N. Everitt, L. Losonczi, W. Walter (eds.): GENERAL INEQUALITIES 7. International Series of Numerical Mathematics, Vol. 123, Birkhäuser, Basel 1997, 416 pages, DM 198,-.

The *General Inequalities* meetings held at Oberwolfach have a long lasting tradition and their proceedings are regularly published by Birkhäuser. This volume contains the proceedings of the 7th meeting held in November 1995 which was attended by 51 participants. In the spirit of the volumes devoted to the previous meetings (the first took place in 1976), this one not only contains the latest results presented by the participants but is also a useful reference book for both lecturers and research workers.

The material is ordered in seven chapters entitled *Inequalities in Analysis* (4 contributions), *Inequalities for Matrices and Discrete Problems* (4), *Inequalities for Eigenvalue Problems* (4), *Inequalities for Differential Operators* (5), *Convexity* (4), *Inequalities in Functional Analysis and Functional Equations* (4), *Applications* (5), and ends with the section *Problems and Remarks* (5).

Thus, the volume reflects the importance of inequalities in mathematics, and the only comment which could be made concerns the relatively long period between the meeting and the publications of the proceedings.

Alois Kufner, Praha

Klaus Jänich: TOPOLOGIE. 5. Aufl., Springer-Verlag, Berlin 1996, x+240 pages,

LINEARE ALGEBRA. 6. Aufl., Springer-Verlag, Berlin 1996, ix+204 pages,

FUNKTIONENTHEORIE. EINE EINFÜHRUNG. 4. Aufl., Springer-Verlag, Berlin 1996, ix+123 pages

The first edition of K. Jänich's text on topology appeared in 1980. The present edition consists of the following parts: Basic concepts, Topological vector spaces, Quotient topology, Completion of metric spaces, Homotopy, Countability axioms, CW-complexes, Construction of continuous functions on topological spaces, Foliations, The Tychonoff theorem and an Appendix on set theory written by Th. Bröcker.

The lively and colloquial style of the presentation is perfectly suited for a beginner. The booklet is a user-friendly first course in topology.

The second book (Linear algebra) covers the usual topics comprising a first course in linear algebra.

The section for physicists deals with the concept of a physical vector and constructs a mathematical framework for them.

Again, it is an excellent textbook which is also well suited for self-study. Each chapter contains theoretical and numerical exercises and tests, the latter with answers at the end of the book.

The third booklet represents an introduction to complex analysis. The main topics are: Holomorphic functions, The Cauchy integral theorem with corollaries, Isolated singularities, Analytic continuation, Integration over a closed curve with the residuum theorem, Sequences of holomorphic functions, The Mittag-Leffler theorem and the Weierstrass product theorem, Riemann's mapping theorem.

The beauty of the theory of complex functions of a complex variable is formed by the combination of analytic, algebraic and geometric arguments. The author introduces the reader into the field in a very polite and readable manner. Exercises enlarge the value of the booklet and make it a good expository source for an independent study of the topic.

The present series of university texts of K. Jänich is a very popular, entertaining, inspiring and comprehensible introduction to the fundamental concepts, methods and results concerning the basic knowledge in three parts of mathematics.

Minimal background knowledge is required and all of this textbooks are in fact classical primers. A specialist in the respective fields probably can express his objections concerning the choice of the material or the completeness of the presentation. But this does not change anything on the fact, that we are facing a nicely written expository texts for a freshman and that we should learn from Klaus Jänich how to do this work.

Stefan Schwabik, Praha

H. Dym, V. Katsnelson, B. Fritzsche, B. Kirstein (eds.): TOPICS IN INTERPOLATION THEORY. Birkhäuser, Basel 1997, 516 pages, hardcover, ISBN 3-7643-5723-1, DM 188,-/sFr. 158,-.

The idea of building bridges between the mathematicians of former Soviet Union and of the Western world leads to organizing regular meetings on Schur analysis at Leipzig University. The fifth meeting was held in 1994 in honour of the 80th birthday of V. P. Potapov.

The editors of the present volume put together interesting memoirs of some Potapov's pupils and younger colleagues, translations of several fundamental papers written originally in Russian (mostly by Ukrainian mathematicians), selected papers of the conference and two expository papers written especially for this volume.

In this way, a representative book on interpolation theory arose, joining historical viewpoints, methodological richness, general and inspiring approaches and giving a rare access to papers of Ukrainian mathematicians.

The book can be very useful for all mathematicians and higher level students interested in complex analysis and operator theory.

Zdeněk Vavřín, Praha,

Rudolph A. Lorentz (ed.): MATHEMATICS FROM LENINGRAD TO AUSTIN: GEORGE G. LORENTZ' SELECTED WORKS IN REAL, FUNCTIONAL AND NUMERICAL ANALYSIS. Contemporary Mathematics, Birkhäuser, Boston, 1997, xxxvi+548 pp., ISBN 0-8176-3710-9 (volume 1), xxvii+648 pp., ISBN 0-8176-3922-5 (volume 2), ISBN 0-8176-3923-3 (set).

The book contains selected papers written during more than sixty years (1932–1994) by one of the greatest mathematical analysts of this century, George G. Lorentz. The works of G. G. Lorentz have played a fundamental role in many, quite diverse, areas of mathematics, both pure and applied. The book contains approximately two thirds of his best papers, divided into four fields, called 1) Summability and Number Theory, 2) Interpolation, 3) Real and Functional Analysis and 4) Approximation Theory. Each of the four sections is introduced by a review of its contents and significance, written by students or colleagues of G. G. Lorentz.

In addition, the book contains an extremely interesting section called "Math in a Broader Perspective", consisting of four previously unpublished essays on mathematics in general ("A Report on the University of Leningrad", "On the Work of Mathematical Mind", "Proofs in Mathematics" and "Writing Mathematical Books"). Apart from their significant contribution to the philosophy of mathematics, these essays are also unique historical documents.

The book further contains a short introduction by R. A. Lorentz (a son of G. G. Lorentz, and the editor of this Selecta), a very moving autobiography by G. G. Lorentz himself (who, according to his son, 'has lived three different lives in three different countries with mathematics in common'), the complete bibliography, an impressive list of doctoral students, and finally an essay by T. Erdélyi and P. Nevai on books by G. G. Lorentz.

G. G. Lorentz is a phenomenal mathematician who had developed fundamental new techniques in almost all areas of mathematical analysis, and, indeed, mathematics. Therefore, this book is "a must" for everyone working in the area.

Luboš Pick, Praha