Applications of Mathematics

Book Reviews

BOOK REVIEWS

EVOLUTION EQUATIONS, CONTROL THEORY, AND BIOMATHEMATICS. Lecture Notes in Pure and Applied Mathematics Vol. 155, Philippe Clément, Günter Lumer—Editors, Marcel Dekker, Inc., New York-Basel-Hong Kong, 1993, 616 pages, bound illustrated, Price: $ 165,–.

This volume is Proceedings of the Third International Workshop—Conference on Evolution Equations, Control Theory and Biomathematics, which was held at the Han-sur-Lesse Conference Center of the Belgium Ministry of Education. Among the topics discussed were recent developments in evolution equations related to physical, engineering, and biological applications, population models, epidemic models, diffusion models with shocks, control theory, optimal control, the Riccati equation, the Hamilton-Jacobi equation, the Korteweg-de Vries equation, asymptotics of spectral functions, viscosity solutions, the Laplace transform method, perturbation methods, stochastic analysis, and diffusion problems. It is desirable that this publication be present in any mathematically-specialized library.

Ivan Straškraba

Emmanuele DiBenedetto: PARTIAL DIFFERENTIAL EQUATIONS. Birkhäuser Boston, Basel, Berlin, 1995, xiii+416 pages, price SFr 78,–.

This is a classical textbook on partial differential equations. Besides the standard issues as quasilinear equations via the Cauchy-Kowalewski theorem, Laplace equation, double layer potential in connection with boundary-value problems, heat and wave equation, the chapters on integral equations and eigenvalue problems, and equations of first order and conservation laws are included. Each chapter contains Problems and Complements. Preliminaries and index are also included. The reader is assumed to be familiar with advanced differential calculus and some basic L^p-theory. Despite of the classical contents of the book, some important results of last decades are presented at the university level. This book certainly can be recommended as an introduction to partial differential equations in mathematical faculties and technical universities.

Ivan Straškraba

Alessandra Lunardi: ANALYTIC SEMIGROUPS AND OPTIMAL REGULARITY IN PARABOLIC PROBLEMS. Birkhäuser 1995, pp. xvii+424, price SFr 128,–.

In the book, the theory of analytic semigroups in Banach spaces is presented as an abstract tool for investigation of partial differential problems of parabolic type. It takes into account recent developments of the theory and, even if results of generation of analytic semigroups by elliptic operators in L^p spaces are given and mild solutions are also treated, it is focused to classical solutions with continuous and Hölder continuous derivatives. The maximal regularity results are emphasized. These results allow to solve more complicated problems by perturbation arguments and also to investigate fully nonlinear problems, where the nonlinear perturbation is of the same order as the linear part of the equation. Interpolation spaces are of crucial importance in proving the optimal regularity results. The beginning of the book is devoted to the interpolation theory and an investigation of analytic

semigroups in intermediate spaces. Together with reularity, also the asymptotic behaviour of solutions is treated in connection with spectral properties of a generator of the semigroup.

The heart of the book is Chapter 4, which deals with the initial value problem

$$u'(t) = Au(t) + f(t), \quad t > 0, \quad u(0) = u_0$$

where A is a sectorial operator in a general Banach space. A variation of parameters formula is derived and used to study optimal regularity, asymptotic behaviour of solutions, existence of bounded and periodic solutions, backward solutions. Applications to linear parabolic problems follow and semilinear equations are investigated, both abstract and concrete. Last parts of the book are devoted to fully nonlinear equations with the particular attention to geometric properties of their solutions. The theory is explained by many examples and applications.

The book provides a self-contained presentation of the theory of analytic semigroups and its applications to parabolic problems in the new, unified approach. It contains a lot of material, which is useful for graduated students and researchers in abstract evolution equations and partial differential equations of parabolic type.

Hana Petzeltová

FINITE ELEMENT METHODS: FIFTY YEARS OF THE COURANT ELEMENT. Edited by M. Křížek, P. Neitaanmäki, R. Stenberg. Lecture Notes in Pure and Applied Mathematics, vol. 164, Marcel Dekker, Inc., New York-Basel-Hong Kong, 1994, 528 pages, $ 165,–.

The book presents the proceedings of a recently held conference at the University of Jyväskylä, Finland, commemorating the 50th anniversary of the publication of the Richard Courant's paper „Variational Methods for Problems of Equilibrium and Vibration"—a crucial contribution to the development of the finite element method. It contains the Courant's original groundbreaking paper and papers by over 80 experts in finite element methods which deal with both fundamental questions in numerical analysis and special problems that occur in applying the finite element method to various fields of science and engineering. The proceedings describe the early history of the finite element method, survey finite element methods for parabolic problems, examine variational formulations in Sobolev spaces, give details on the finite element method in elliptic problems with interfaces and singularities, consider least-squares mixed finite elements, discuss compressible flow computations, analyze Maxwell's equations, investigate how to recover the gradient of the discrete solution on irregular triangulations and more.

Jana Daňková