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QUARTERLY OF APPLIED MATHEMATICS

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Mathematical Work: As far as possible, formulas should be typewritten; Greek letters and other symbols not available on the average typewriter should be inserted using either instant lettering or by careful insertion in ink. Manuscripts containing pencilled material other than marginal instructions to the typesetter will not be accepted.

The difference between capital and lower-case letters should be clearly shown; care should be taken to avoid confusion between zero (0) and the letter O, between the numeral one (1), the letter l and the prime ($'$), between alpha and a, kappa and k, mu and u, nu and v, eta and n.

The level of subscripts, exponents, subscripts to subscripts, and exponents to exponents should be clearly indicated.

Single embellishments over individual letters are allowed; the only embellishment allowed above groups of letters is the overbar.

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Complicated exponents and subscripts should be avoided. Any complicated expression that recurs frequently should be represented by a special symbol.

For exponentials with lengthy or complicated exponents the symbol exp should be used, particularly if such exponentials appear in the body of the text. Thus,

$$\exp[(a^2 + b^2)^{1/2}] \text{ is preferable to } e^{[a^2+b^2]^{1/2}}.$$

Fractions in the body of the text and fractions occurring in the numerators or denominators of fractions should be written with the solidus. Thus,

$$\frac{\cos(x/2b)}{\cos(a/2b)} \text{ is preferable to } \frac{\cos \frac{x}{2b}}{\cos \frac{a}{2b}}.$$

In many instances the use of negative exponents permits saving of space. Thus,

$$\int u^{-1} \sin u \, du \text{ is preferable to } \int \frac{\sin u}{u} \, du.$$

Whereas the intended grouping of symbols in handwritten formulas can be made clear by slight variations in spacing, this procedure is not acceptable in typeset formulas. To avoid misunderstanding, the order of symbols should therefore be carefully considered. Thus,

$$(a + bx)\cos t \text{ is preferable to } \cos t(a + bx).$$

Figures: Figures should be drawn in black ink with clean, unbroken lines; do not use ball point pen. The paper should be of a nonabsorbant quality so that the ink does not spread and produce fuzzy lines. If the figures are intended for reduction, they should be drawn with heavy enough lines so that they do not become flimsy at the desired reduction. The notation should be of professional quality and in proportion for the expected reduction size. Figures which are unsuitable for reproduction will be returned to the author for redrawing. Legends accompanying figures should be written on a separate sheet.

Bibliography: References should be grouped together in a Bibliography at the end of the manuscript. References in text to the Bibliography should be made by numerals between square brackets.

The following examples show the desired arrangements: (*for books*—S. Timoshenko, *Strength of materials*, vol. 2, Macmillan and Co., London, 1931, p. 237; *for periodicals*—Lord Rayleigh, *On the flow of viscous liquids, especially in three dimensions*, Phil. Mag. (5) 36, 354–372 (1893)). Note that the number of the series is not separated by commas from the name of the periodical or the number of the volume.

Authors' initials should precede their names rather than follow them.

In quoted titles of books or papers, capital letters should be used only where the language requires this. Thus, *On the flow of viscous fluids* is preferable to *On the Flow of Viscous Fluids*, but the corresponding German title would have to be rendered as *Über die Stromung zaher Flüssigkeiten*.

Titles of books or papers should be quoted in the original language (with an English translation added in parentheses, if this seems desirable), but only English abbreviations should be used for bibliographical details such as ed., vol., no., chap., p.

Footnotes: As far as possible, footnotes should be avoided. Footnotes containing mathematical formulas are not acceptable.

Abbreviations: Much space can be saved by the use of standard abbreviations such as Eq., Eqs., Fig., Sec., Art., etc. These should be used, however, only if they are followed by a reference number. Thus, "Eq. (25)" is acceptable but not "the preceding Eq." Moreover, if any one of these terms occurs as the first word of a sentence, it should be spelled out.

Special abbreviations should be avoided. Thus "boundary conditions" should always be spelled out and not be abbreviated as "b.c." even if this special abbreviation is defined somewhere in the text.

CONTENTS

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Shell Theory: General Methods of Construction. By I. N. Vekua. Pitman Advanced Publishing Program, Boston, 1985. pp. xv + 287.

This is volume 25 in the series Monographs, Advanced Texts and Surveys in Pure and Applied Mathematics. It is a translation from the Russian, by Ts. Gabeskina, of a monograph first published in Moscow in 1982. It has a foreword by Professor G. Fichera of the University of Rome. The present book is mainly a summary of the author's studies in the theory of shells, carried out over twenty-five years. The book does, however, contain some new results. The theory of generalized analytic functions is widely used in the present study. This part of the theory of partial differential equations proved to be linked organically with problems of differential geometry and continuum mechanics. Without knowledge of the fundamentals of this theory, it will be almost impossible to read Chapters 3–5 of the present book, where the reader is often referred to the author's monograph on generalized analytic functions. This monograph consists of two parts. The first part comprises Chapters 1 and 2 in which the general methods of reducing three-dimensional problems of the equilibrium of elastic shells to two-dimensional ones are presented. In these chapters the author confines himself to considering isotropic homogeneous shells, subject to generalized (physical and geometrical) linear Hooke's law. The results obtained are, however, easily generalized to the case of anisotropic shells. Chapters 3–5, constituting the second part of the book, deal with special problems of shell equilibrium, using a new method which differs materially from those of Chapters 1 and 2. The new method, based on the representation of the unknown stress fields, allows the author to reduce the problems under study, on every coordinate surface $x^3 = \text{const}$, to a system of first-order partial differential equation (Weingarten's non-homogeneous equation). It is important to note that from the mathematical viewpoint these equations coincide with those of the membrane theory of shells and infinitesimal bending of a surface. The type of equation is therefore determined by the sign of the principal curvature of the middle if it is used as a parameterization base of a shell; in the case of convex shells the author thus gets first-order elliptic systems or second-order elliptic equations. Hence, for convex shells the problems under consideration may be reduced to generalized Cauchy-Riemann equations. This enables the author to make wide use of the theory of generalized analytic functions in order to study the problems in question. In the special case when the middle surface of a shell is a second-order algebraic surface, the problem is reduced to (non-homogeneous) Cauchy-Riemann equations. Thus for a fairly wide class of shells which have obvious practical applications the problems are reduced to boundary value problems of analytic functions. Chapter headings: 1. Expansions into Legendre polynomials. 2. Method of successive differentiation for equilibrium equations of elastic shells. 3. Statically definable problems of shell theory. 4. Determination of the deformation of a shell, compatible with the kinematic conditions of bush constraints. 5. Neutral surfaces of an elastic shell.

Nonlinear Ordinary Differential Equations. By D. W. Jordan and P. Smith. Oxford University Press, New York, 1987. pp. ix + 381. $42.50 hardcover, $24.95 paperback.

This is the second edition of a volume in the Oxford Applied Mathematics and Computing Science Series, first published in 1977. Several chapters have been completely rewritten, and it includes a completely new chapter on bifurcations, structural stability, and the chaotic behavior of oscillators treated from an elementary point of view. It is an introduction to dynamical systems in the context of systems of differential equations. The authors have given the subject a qualitative slant throughout, emphasizing how the presence of a nonlinear element may introduce totally novel phenomena. Chapter headings: 1. Second-order differential equations in the phase plane. 2. First-order systems in two variables and linearization. 3. Geometrical and computational aspects of the phase diagram. 4. Averaging methods. 5. Perturbation methods. 6. Singular perturbation methods. 7. Forced oscillations: harmonic and subharmonic response, stability, entrainment. 8. Stability. 9. Determination of stability by solution perturbation. 10. Liapunov methods for determining stability. 11. The existence of periodic solutions. 12. Bifurcations, structural stability, and chaos.

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An Introduction to Linear Programming and Game Theory. By Paul R. Thie. John Wiley & Sons, New York, 1988. pp. xv + 396. $50.22.

This textbook provides, at an introductory level, a development of some of the theoretical concepts and computational techniques of linear programming and game theory; it also offers some discussion on the applications of these topics in the social, life, and managerial sciences. It presents an introduction to the process of mathematical model building, which is discussed in the two distinct settings of linear programming and game theory. The text is written for students of mathematics, science, economics, and operations research. The presentation is mathematically complete in terms of definitions, theorems, and proofs. However, examples are used frequently, not only to motivate new ideas, but also to assist in the understanding of the theory and the associated proofs. Chapter headings: 1. Mathematical models. 2. The linear programming model. 3. The Simplex method. 4. Duality. 5. Sensitivity analysis. 6. Integer programming. 7. The transportation problem. 8. Other topics in linear programming. 9. Two-person, zero-sum games. 10. Other topics in game theory.

Applied Problems in Probability Theory. By E. Wentzel and L. Ovcharov. Mir Publishers, Moscow, 1986. pp. 1 + 431. $13.95.

This is a translation, with revisions and additions, by Irene Aleksanova of the Russian text published in 1983. It is divided into eleven chapters, each of which begins with a short theoretical introduction which is followed by relevant formulas. The problems differ both in the fields of application and in difficulty. At the beginning of each chapter the reader will find comparatively simple problems whose purpose is to help the reader grasp the fundamental concepts and acquire and consolidate the experience of applying probabilistic methods. Then follow more complicated applied problems, which can be solved only after the requisite theoretical knowledge has been acquired and the necessary techniques mastered. There are about 700 problems in all, with defined solutions. It is thus very suitable as a companion text to basic probability courses, or for self study. Chapters: 1. Fundamental concepts of probability theory. 2. Algebra of events. 3. The total probability formula and Bayes' theorem. 4. Discrete random variables. 5. Continuous and mixed random variables. 6. Systems of random variables. 7. Numerical characteristics of functions of random variables. 8. Distributions of functions of random variables. The limit theorems of probability theory. 9. Random functions. 10. Flows of events. Markov stochastic processes.

Point Processes and Their Statistical Inference. By Alan F. Karr. Marcel Dekker, 1986. pp. xi + 490.

This is a volume in Probability: Pure and Applied, A Series of Textbooks and Reference Books, edited by Marcel Neuts. It has as its goal to present a unified description of inference for point processes. By depicting the probabilistic and statistical heart of the subject, as well as several of its boundaries, the author has endeavoured to convey simultaneously the subject's unity and its diversity. The style of presentation is meant to be accessible to probabilists and statisticians alike, but more background is assumed in probability than in statistics. The important themes that pervade the whole book are: maximum likelihood, empirical averages as estimators, martingale representations, and exploitation of special structure. Chapters 1–5 concern broad subjects whereas chapters 6–11 investigate in more detail correspondingly narrower topics. The chapter headings are: 1. Point Processes: Distribution Theory. 2. Point Processes: Intensity Theory. 3. Inference for Point Processes: Introduction. 4. Empirical Processes Associated with a Sequence of Point Processes. 5. Intensity-based Inference: General Theory. 6. Inference for Poisson Processes on General Spaces. 7. Inference for Cox Processes on General Spaces. 8. Nonparametric Inference for Renewal Processes. 9. Inference for Stationary Point Processes. 10. Inference for Stochastic Processes Based on Point Process Samples. There are two appendices, on Spaces of Measures, and Continuous-time Martingales, respectively, and an extensive bibliography of about 700 items.

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Microcomputer Modeling by Finite Differences. By Gordon Reece. John Wiley & Sons, New York, 1986. pp. x + 126. $18.95.

This little book shows how BASIC and mathematics barely above the high-school level can be used to solve real problems in physics and engineering by finite-difference methods.

One-Dimensional Stefan Problems: An Introduction. By James M. Hill. John Wiley & Sons, New York, 1987. pp. xviii + 204. $106.00.

This is volume 31 in the series Pitman Monographs and Surveys in Pure and Applied Mathematics. It deals exclusively with the classical single phase one-dimensional Stefan problems. These problems constitute the simplest non-trivial problems which convey all the mathematical difficulties inherent in more complicated heat-diffusion moving-boundary problems. This book assumes some knowledge of either heat conduction or diffusion and some familiarity with either Carslaw and Jaeger's *Conduction of Heat in Solids* or with Crank's *The Mathematics of Diffusion.* The author attempted to pitch the book at a fairly elementary level so that it may be suitable either for third- or fourth-year students in science, engineering or mathematics or for practical scientists and engineers who are not primarily mathematicians. Chapter headings: 1. Heat-diffusion moving-boundary problems. 2. Large Stefan number expansion. 3. Integral formulation and bounds. 4. Integral equations. 5. Polynomial approximations. 6. Boundary-fixing transformations and series solutions. 7. Two simultaneous chemical reactions.

Statistics for Economics, Business Administration, and the Social Sciences. By E. B. Anderson, N. E. Jensen, and N. Kousgaard. Springer-Verlag, New York, 1987. pp. xi + 437. $28.00.

This is volume 2 in the Australian Mathematical Society Lecture Series. It is a revised version in English of a text originally written in Danish for a first course in applied statistics for students of economics, public administration and business administration. A limited knowledge of mathematics is required for understanding the text, except for a single chapter where some knowledge of elementary matrix algebra is necessary. Complicated mathematical proofs are avoided and the explanations are based on intuition and numerical examples. The aim of the book is to enable the student to appreciate the reasoning underlying a statistical analysis and to apply statistical methods to problems likely to be met within the fields of economy, public administration and business administration. The content of the book can be divided into four parts: methods for exploratory data analysis are presented in Chapter 2; probability theory and standard statistical distributions are discussed in Chapters 3–9; statistical inference theory is presented in Chapters 10–12; and the application of statistical methods is discussed in Chapters 13–19.

Homogeneous Denumerable Markov Processes. By Hou Zhenting and Guo Qingfeng. Springer-Verlag and Science Press, Beijing, 1988. pp. x + 282. $79.50.

This is a revised edition of the original Chinese edition published by Science Press, Beijing, in 1978 as the second volume in the series in Pure and Applied Mathematics. It is essentially a monograph expounding the authors' and their collaborators' contributions to the subject, employing two methods which they entitle "the method of minimal nonnegative solution" and "the limit transition method." The fourteen chapters of the book are divided into 5 parts: 1. Construction Theory of Sample Functions of Homogeneous Denumerable Markov Processes. 2. Theory of Minimal Nonnegative Solutions for Systems of Nonnegative Linear Equations. 3. Homogeneous Denumerable Markov Chains. 4. Homogeneous Denumerable Markov Processes. 5. Construction Theory of Homogeneous Denumerable Markov Processes.

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Optimization Theory: Applications in OR and Economics. By M. J. Fryer and J. V. Greenman. Edward Arnold Publishers, Baltimore, 1987. pp. vii + 293. $24.95.

This text has evolved from an integrated set of lecture courses given for a number of years at the Mathematics Department at Essex University to students studying Economics and Operational Research. The basic Lagrangean theory is developed in the first three chapters of the text. The theory is developed further in Chapter 4 to derive the primaldual structure that is of importance, for example, in linear and geometric programming. In the remaining chapters, the authors apply the Lagrangean method to solve particular types of optimization problems. In Chapter 5, they derive the simplex method for solving linear programs, while in Chapters 6 and 7 they derive the Hamiltonian method for solving problems in discrete and continuous optimal control theory. Chapter headings: 1. The basics: unconstrained optimization. 2. Optimization with equality constraints. 3. Inequality constraints. 4. Duality. 5. Linear programming. 6. Optimal control theory: the basics. 7. Optimal control: generalizations. 8. Postscript.

Mecanique. By Paul Germain. Vol. I: 444 pp.; Vol II: 446 pp. Ecole Polytechnique, Paris, 1986.

This two-volume work is a comprehensive and modern introduction to continuum mechanics. Its scope is indicated by the table of contents. Volume I: 1. Le mouvement et ses représentations. 2. Déformations. 3. La représentation des efforts et les éconcés fondamentaux de la mécanique. 4. Dynamique des systémes de corps rigides. 5. Milieux continus dont le comportement est déterminé par des liaisons internes parfaites. 6. Statique et dynamique d'un milieu continu. Constraintes. 7. Les lois de conservation et l'inégalité fondamentale de la physique des milieux continus. Volume II: 8. Élasticité. 9. Dissapation et compressibilité dans le écoulements de fluides classiques. 10. Stabilité. Vibrations et mouvements voisins. Bifurcations. 11. Thermodynamique des milieux continus et lois comportement.

Executing Temporal Logic Programs. By Ben Moszkowski. Cambridge University Press, New York, 1986. pp. 1 + 125. $14.95.

Temporal logic has been recently put forward as a useful tool for reasoning about concurrent programs and hardware. Within temporal logic, one can express logical operators corresponding to time-dependent concepts such as "*always*" and "*sometimes.*" The author developed Tempura, an imperative programming language based on subsets of temporal logic. This monograph expands his ideas.

Mathematical Physics. By Robert Geroch. University of Chicago Press, Chicago, 1986. pp. vi + 351.

This is a volume in the series Chicago Lectures in Physics. The book has 56 chapters. Chapters 2–24 deal with things algebraic and chapters 25–42 with things topological. In chapters 43–50, the author discusses some special topics: structures which combine algebra and topology, Lebesgue integrals, Hilbert spaces. Chapters 51–56 deal with the spectral theorem and its usefulness in physics. The only prerequisites are elementary set theory, algebra and elementary calculus.

Integral Equations. By F. G. Tricomi. Dover Publications, New York, 1985. pp. viii + 238. $6.00.

This is an unabridged and unaltered republication of the work first published by Interscience Publishers, Inc., in 1957.

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Introduction to Theoretical Neurobiology. By Henry C. Tuckwell, Volume 1 (chapters 1–6): Linear cable theory and dendritic structure, pp. xiii + 291. Volume 2: Nonlinear and stochastic theories, pp. xii + 265. $49.50 each volume. Cambridge University Press, New York, 1988.

This work in two volumes deals with theories of the dynamical behavior of neurons. It is intended to be useful to graduate students and research workers in both applied mathematics and neurology. It essentially contains descriptions and analyses of the principal mathematical models that have been developed for neurons in the last 30 years. Chapter 1, however, contains a brief review of the basic neuroanatomical and neurophysiological facts that will form the focus of the mathematical developments. The remainder of the book is a mathematical treatment of nerve-cell properties and responses, the theme being the systematic development of mathematical theories of the dynamical behavior of neurons. There is a steady increase in mathematical level, but an attempt has been made to explain some of the essential mathematics as it is needed. Chapter headings: 1. Introductory neuroanatomy and neurophysiology: the properties of motorneurons. 2. The classical theory of membrane potentials. 3. The Lapicque model of the nerve cell. 4. Linear cable theory for nerve cylinders and dendritic trees: steady-state solutions. 5. Time-dependent cable theory for nerve cylinders and dendritic trees. 6. Rall's model neuron. 7. Sub-threshold response to synaptic input. 8. Theory of the action potential. 9. The stochastic theory of neurons. 10. The analysis of stochastic neuronal activity.

The Finite Element Method and Its Applications. By Masatake Mori. Macmillan Publishing Company, New York, 1986. pp. xi + 188. $34.95.

This is a translation by the author, of the Japanese edition published in 1983. It is its purpose to introduce the finite element method from the standpoint of applied mathematics. There are two conventional ways to approach the finite element method–from structural mechanics and from the solution of partial differential equations. The book is written from the standpoint of solving partial differential equations, principally in two dimensions. There are some more advanced chapters on detailed error analyses.

Automated Theorem-Proving in Non-Classical Logics. By P. B. Thistlewaite, M. A. McRobbie, and R. K. Meter. Pitman Publishing, New York, 1988. pp. 1 + 154.

This is a volume in the series Research Notes in Theoretical Computer Science. Its topic lies in the intersection of logic and computer science. The authors' principal concern is with the design and implementation of theorem-proving programs for a range of non-classical logics, and especially for the *relevant* or *relevance* family of non-classical logics.

Summing and Nuclear Norms in Banach Space Theory. By G. J. O. Jameson. Cambridge University Press, New York, 1987. pp. xi + 172. $13.95 paperback, $39.50 hardcover.

This is volume 8 in the series London Mathematical Society Student Texts. The author's aim in this monograph is to show that the summing and nuclear norms of linear operators merit recognition as very basic concepts in Banach space theory, even at quite an elementary level, that they have powerful applications to a variety of Banach space equations, and that they generate a theory that is interesting and elegant in its own right. The only prerequisite is a beginner's course on normed linear spaces. The author claims that as well as to the confirmed Banach space specialist, the topic has something to offer to analysts whose main interest is, for example, approximation theory or operator theory.

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Algorithms: The Construction, Proof, and Analysis of Programs. By Pierre Berlioux and Philippe Blizard. John Wiley & Sons, New York, 1986. pp. ix + 144. $24.95.

The authors' main aim is to show how the construction, proof, and analysis of programs are all closely linked. Chapter 1 introduces the basic elements which allow the authors to carry out the formal proof and analysis of iterative programs. With the help of examples, Chapter 2 shows how one is led from these notions of proof towards the construction of current programs, in particular through the definition of invariant properties. Chapters 4 and 5, which deal with recursive programs, follow the same plan. In Chapter 5, the authors discuss the choice, for a given problem, of a recursive decomposition from which a correct recursive procedure can be constructed immediately. Chapter 6 presents a method of transformation which allows them to convert a recursive program into an iterative program: the correctness of the more efficient version is assured by that of the original recursive program. Chapter 3 gives a fuller account of the concepts introduced in Chapter 1. Chapter headings: 1. Proofs of programs. 2. Application to the construction of programs. 3. Proof and analysis of iterative programs-further material. 4. Proof and analysis of recursive programs. 5. Construction of recursive programs. 6. Elimination of recursion.

Computability Theory, Semantics, and Logic Programming. By Melvin Fitting. Oxford University Press, New York, 1987. pp. xi + 198. $35.00.

This is volume 13 in the series Oxford Logic Guides. In Chapter 1, a simple and natural language called EFT is defined for manipulating strings over an alphabet L. The language is PROLOG-like. In Chapter 2, for each algebraic data structure S a programming language EFS (S) is defined and general properties are considered. In Chapter 3, the definition of EFS procedure is extended so that procedures for operators can be written. In Chapter 4, the implementation of one data structure in another is discussed. In Chapter 5, the Church-Turing thesis, a mathematical model of a computer, is presented, based on the register machines of Shepherdson and Sturgis. In Chapter 6, an interpretation for EPS in itself is written. Some 200 exercises are scattered throughout the text.

Tales of Physicists and Mathematicians. By Semyon Grigorevich Gindikin. Birkhäuser, Boston, 1988. pp. x + 157.

This is a translation, by Alan Shuchat, of a Russian book which is based on articles published in Quant Magazine over the course of several years. The articles are entitled: 1. Ars Magne (The Great Art), taking its title from that of a book by Gerolamo Cartano, published in 1545, which was concerned with the solution of third- and fourth-order equations. In this article, the author discusses Scipione dal Ferro, Niccoló Tartaglia, Cardano himself, and Luigi Ferrari, and their contributions. 2. Two Tales of Galileo: the discovery of the laws of motion, and the Medicean stars. 3. Christiaan Huygens, Pendulum Clocks, and a Curve. 4. Blaise Pascal. 5. Prince of Mathematicians (Carl Friedrich Gauss).

Some Topics in Nonlinear Functional Analysis. By Mohan C. Joshi and Ramendra K. Bose. John Wiley & Sons, New York, 1985. pp. viii + 311.

This text presents the theory of nonlinear functional analysis in a systematic way, culminating with applications to concrete differential and integral equations. The main topics discussed are monotone operators, fixed point theorems, degree theory and random operator equations. In eight chapters the book first builds the theory of monotone operators and fixed points as essential ingredients and then goes on to give applications of the main theory to differential and integral equations. Included is a chapter on random operators, to give an interdisciplinary approach to the subject.

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Advances in Nuclear Science and Technology: Volume 19*—Festschrift in Honor of Eugene P. Wigner.* Edited by Jeffery Lewins and Martin Becker. Plenum Press, New York, 1987. pp. xix + 489. $85.00.

This volume in the annual review series represents a departure from the usual practice in that it serves as a Festschrift for Eugene P. Wigner. It contains the following articles: Eugene Wigner and Nuclear Energy, by A. M. Weinberg; The PIUS Principle and the SECURE Reactor Concepts, by Kåre Hannerz; PRISM: An Innovative Inherently Safe Modular Sodium Cooled Breeder Reactor, by P. R. Pluta et al.; Generalised Perturbation Theory–A Heuristic Approach, by A. Gandini; Some Recent Developments in Finite Element Methods for Neutron Transport Theory, by R. T. Ackroyd et al.

Reaction-Diffusion Equations and Their Applications to Biology. By N. F. Britton. Academic Press, New York, 1986. pp. ix + 277.

Reaction-diffusion systems have applications in developmental biology, ecology, physiology, and many other fields. The emphasis throughout this book is on practical methods, and on obtaining answers to the questions of biological importance, rather than on abstract mathematical questions. In Chapter 1, the equations are derived. In Chapter 2, an introduction to the techniques of ordinary differential equations is given. In Chapter 3, a particular class of reaction-diffusion equations is considered: those whose kinetic equations are conservative. Such systems have limitations as models in ecology, but are widely and successfully used in epidemiology. In Chapter 4, scalar reaction-diffusion equations are considered; applications include the wave of advance of an advantageous gene in a population and the control of the spruce budworm of North America. In Chapter 5, general reaction-diffusion systems are discussed from a mathematical point of view; comparison theorems, which may be used to prove the existence and uniqueness of solutions and to find bounds for the solutions of interactible systems and which form the basis of numerical techniques for the computations of solutions, are stressed. In Chapter 6, steady and periodic solutions of such systems are discussed by using bifurcation theory, with applications to pattern formulation, including the regeneration of hydranths in the marine hydroid *tubularia*, and to a prey-predator system. In many applications small parameters appear in the equations, and much information may be obtained by the use of asymptotic methods; in the last three chapters such methods are discussed. In Chapter 7, oscillatory systems are considered. Applications include a model for target patterns in the Belousov-Zhabotinskii chemical reaction. In Chapter 8, matching techniques for systems with fast and slow variables are considered, with applications in enzyme kinetics, nerve physiology and the control system in a slime mould. In Chapter 9, techniques for systems with small diffusion coefficients are considered, leading to boundary problems, and models for facilitated diffusion of oxygen into muscle and for carbon monoxide poisoning are analyzed.

An Introduction to Fast Fourier Transform Methods for Partial Differential Equations, with Applications. By Morgan Pickering. John Wiley & Sons, New York, 1986. pp. xi + 178. $49.95.

This is volume 4 in the Applied and Engineering Mathematics Series of Electronic and Electrical Engineering Research Studies. Introductory FFT material is covered in Chapter 1, and Chapter 2 concentrates on the mathematics of the transforms used in solving suitable partial differential equations. Chapter 3 examines various problems which can be solved directly by the FFT method, and Chapter 4 discusses the basic ideas of the cyclic reduction method and the FACR algorithm which is a combination of the methods of Fourier analysis and cyclic reduction. Chapter 5 considers the application of fast solvers to problems on irregular regions using the so-called capacity matrix approach. The iterative use of fast solvers for solving more complicated equations and the use of a numerical Laplace transform technique for the solution of certain time-dependent problems are discussed in Chapter 6.

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Notes in Logic and Set Theory. By P. T. Johnstone. Cambridge University Press, New York, 1987. pp. x + 110. $12.95 paperback, $34.50 hardcover.

This book has its origins in a course of lectures given to third-year undergraduates in Cambridge. Its raison d'être is to try to collect within a single pair of covers everything that the well-educated mathematician in the late twentieth century needs to know about the foundations of his subject. Chapters 1–3 develop the language and machinery of first-order logic, up to the proof of the completeness theorem and some of its consequences. Chapter 4 develops recursion theory from its beginnings up to the recursion theorem. Chapters 5–8 develop Zermelo-Fraenkel set theory, beginning with the axioms and working up to the 'traditional' discussion of ordinal and cardinal arithmetic. Finally, Chapter 9 contains a proof of Gödel's incompleteness theorems, followed by a fairly informal discussion of the technology of set-theoretic independence proofs.

An Introduction to Communication Theory and Systems. By B. J. Thomas. Springer-Verlag, New York, 1988. pp. xi + 349.

This is a volume in the series Springer Texts in Electrical Engineering. It is written as a first treatment of statistical communication theory and communication systems at a senior graduate level. The only formal prerequisite is a knowledge of elementary calculus. Chapter 1 is introductory material. Chapter 2 is an elementary introduction to probability theory at a nonrigorous and nonabstract level. Chapter 3 is a brief treatment of random processes and spectral analysis. Chapter 4 considers linear systems with random inputs. Chapter 5 treats the matched filter and the linear test mean-square-error filter at an elementary level but in some detail.

Fully Abstract Models of Programming Languages. By Allen Stoughton. John Wiley & Sons, New York, 1988. pp. 1 + 123. $19.95.

This is a volume in the series Research Notes in Theoretical Computer Science. It presents a language-independent theory of abstract denontational semantics of programming languages—models that identify program fragments exactly when they are operationally interchangeable—and uses this theory to show that existence or nonexistence of such models for several example programming languages. It is intended for researchers in programming language semantics, and is mathematically self-contained: only naive set theory and some very basic notions of category theory are assumed. Some familiarity with universal algebra and domain theory would be helpful, however.

Numerical Recipes in C: The Art of Scientific Computing. By William H. Press, Brian P. Flannery, Saul A. Teukolsky, and William T. Vetterling. Cambridge University Press, New York, 1988. pp. xxii + 735. $44.50.

This is the *C* version of the well known recipes book previously available in a FORTRAN/Pascal edition. Diskettes for it and for the accompanying example book are now available in *C* but (unlike the FORTRAN/Pascal versions) not for the Apple Macintosh but only for IBM-PC and compatibles. Chapter headings: 1. Preliminaries. 2. Solutions of linear algebraic equations. 3. Interpolation and extrapolation. 4. Integration of functions. 5. Evaluation of functions. 6. Special functions. 7. Random numbers. 8. Sorting. 9. Root finding and nonlinear sets of equations. 10. Minimization or maximization of functions. 11. Eigensystems. 12. Fourier transform spectral methods. 13. Statistical description of data. 14. Modeling of data. 15. Integration of ordinary differential equations. 16. Two point boundary value problems. 17. Partial differential equations.

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Ill-Posed Problems in the Natural Sciences. Edited by A.N. Tikhonov and A. V. Goncharsky. Mir Publishers, Moscow, 1987. pp. 1 + 344. $9.95.

This book, translated from the Russian by M. Bloch, contains a collection of papers on regularizability of functions; inverse problems in geophysical prospecting, electrodynamical prospecting and in seismology; gravity and magnetometry; plasma diagnostics; astrophysics; scattering; computer diagnostics in medicine; inverse problems in image processing; electrodynamics; synthesis of optical elements and synthesis of thin-layered optical systems.

Infinite Dimensional Lie Algebras: Second Edition. By Victor G. Kac. Cambridge University Press, New York, 1987. pp. xvii + 280. $24.95.

This book contains a detailed exposition of the foundations of the theory of Kac–Moody algebras, a particular class of infinite-dimensional Lie Algebras, and their representations. The theory has applications in many areas of mathematics and mathematical physics, for instance, combinatorics, topology, singularity theory, group theory, Hamiltonian mechanics, solution equations and quantum field theory. These applications are discussed in relation to the basic theory where appropriate.

Comparison of Singular Solutions in Elliptic Problems and Elasticity. By D. Leguillon and E. Sanchez-Palencia. John Wiley & Sons, New York, 1987. pp. 1 + 200. $42.95.

The Masson edition of this book appears in the series <<Recherches en Mathématique Appliquées>>, edited by P. G. Ciarlet and J. L. Lions. The stress field in composite elastic media often contains singularities, in particular at intersections of interfaces with boundaries. These singularities yield "infinite" values of the stress, leading in practice to damage. The actual computation of singular solutions involves many equations and boundary or interface conditions. In this book, the authors develop a numerical procedure by which the eigenvalue problem derives directly from the variational formulation of the elasticity problem in two space variables. An economical computing method follows from this procedure.

Lectures in Geometry—Semester V: Lie Groups and Lie Algebras. By M. Postnikov. Mir Publishers, Moscow, 1986. pp. 1 + 437. $10.95.

This is a translation by Vladimir Shokurov, revised from the 1982 Russian edition. It consists of the texts of twenty-one lectures delivered by the author at Moscow University, designed for seniors and graduate students. Lectures 1 to 3 introduce the basic notions: Lie groups, Lie algebras and the Lie algebras of a given Lie group. Lectures 4 to 7 are devoted to the local, lectures 8 to 10 to the global theory. Lectures 11 and 12 expound subgroups and quotient groups of Lie group, 13 Clifford algebras and spinor groups, 14 to 16 consider groups G_2 and F_2 in detail, and 17 to 21 comprise a large fragment of the theory of Lie algebras.

Applications of Control Theory in Ecology. Edited by Y. Cohen. Springer-Verlag, New York, 1987. pp. vi + 101.

This is volume 73 of Lecture Notes in Biomathematics. It is the proceedings of a symposium held at SUNY, Syracuse, in August 1986. There are five papers on behavioral decisions of insects, optimal reproductive strategies in annual plants, foraging problems, the bioeconomics of the extinction of seals and whales, and predator-prey coevolution.

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The Solution of Ordinary Differential Equations. By E. L. Ince and I. N. Sneddon. John Wiley & Sons, New York, 1987. pp. x + 234. $24.95.

This is a volume in Longman Mathematical Texts. Ince's Integration of Ordinary Differential Equations was published in 1939. (His larger treatise, Ordinary Differential Equations, dates from 1927.) Ince died in 1941. The present book is based on the second reprint (1963) of the seventh edition of 1956 (which had been revised by A. Erdèlyi). Professor Sneddon has brought it up to date with modern practice and added a further seventy-five problems; his aim has been to "preserve in a compact form an introduction to the methods of solution of ordinary differential equations for students of mathematics taking a first course in the study of differential equations and their solution, and for students in science and technology who, for their work in these subjects, have to acquire a feel for the nature of the solutions to differential equations before going on to study their numerical solution in the computing laboratory."

Biograph: A Graphical Simulation Package with Exercises to Accompany Lee A. Segel's "Modeling Dynamic Phenomena in Modular and Cellular Biology." By Garrett M. Odell and Lee A. Segal. Cambridge University Press, New York, 1987. pp. xiii + 242. $39.50.

The programs in this book are available on diskettes for IBM-PC computers equipped with a mathematical compressor; the cost of the diskettes is included in the price of the book.

Groups: A Path to Geometry. By R. P. Burn. Cambridge University Press, New York, 1987. pp. ix + 242. $16.95.

This is a corrected, paperback edition of the book, first published in 1985. It is a first course in the theory of groups of transformations, and consists of a sequence of over 800 problems. Most of the groups of the book are constructed in the context of the geometry of two or three dimensions.

Introduction to Higher Order Categorical Logic. By. J. Lambek and P. J. Scott. Cambridge University Press, New York, 1988. pp. ix + 293. $24.95.

This is volume 7 of Cambridge Studies in Advanced Mathematics. It makes an effort to reconcile two different attempts to come to grips with the foundations of mathematics. One is mathematical logic, which traditionally consists of proof theory, model theory and the theory of recursive functions; the other is category theory. It is divided into four parts: 1. Introduction to category theory. 2. Cartesian closed categories and λ-calculus. 3. Type theory and toposes. 4. Representing numerical functions in various categories.

Mathematics of Kalman-Bucy Filtering. By P. A. Ruymgaart and T. T. Soong. Springer-Verlag, New York, 1988. pp. xii + 170. $35.00.

This is the second, corrected edition of volume 14 in the Springer Series in Information Sciences, first published in 1984. Chapter headings: 1. Elements of probability theory. 2. Calculus in mean square. 3. The stochastic dynamic system. 4. The Kalman-Bucy filter. 5. A theorem by Lipster and Shiryayev.

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Statistical Inference for Spatial Processes. By B. D. Ripley. Cambridge University Press, 1988. viii+148 pp., $34.50.

This monograph arose from the essay which won the 1985/6 Adams Prize competition of the University of Cambridge. The introductory chapter answers the question "What is so special about spatial statistics?" The next three chapters elaborate this by providing examples of new difficulties with likelihood inference in spatial Gaussian processes, the dominance of edge effects for the estimation of interaction in point processes. The author shows, for example, how Monte Carlo methods can make likelihood methods feasible in problems traditionally thought intractable. The last two chapters deal with digital images. Here the problems are principally ones of scale dealing with up to a quarter of a million data points. Chapter 5 takes a very general Baysian viewpoint and shows the importance of spatial models to encapsulate prior information about images. Chapter 6 is concerned with summarizing and understanding images, the beginnings of an "exploratory data analysis" of images. Chapter headings: 1. Introduction; 2. Likelihood analysis for spatial Gaussian processes; 3. Edge corrections for spatial images; 4. Parameter estimation for Gibbsian point processes; 5. Modelling spatial images; 6. Summarizing binary images.

Alternate Realities—Mathematical Models of Nature and Man. By John L. Casti. John Wiley and Sons, 1989. xvii+493 pp. $34.95.

In this book, the author brings together many of the strands of modern dynamical systems theory for a treatment of the theory and practice of mathematical modeling. His focus is on the transition from the observed behaviour of natural and human systems to the development of formal mathematical models of such behaviour. The chapters discuss model-making in biology, cognitive processes, ecological and natural resource systems, fluid flow, evolution, artistic forms, games of chance, and other real-world topics. For this task, he uses system-theoretic concepts such as complexity, self-organization, adaptation, bifurcation, resilience, surprise, and uncertainty, as well as other mathematical structures. Chapter headings: 1. The ways of modelmaking: natural systems and formal mathematical representation; 2. Pattern and the emergence of living form: cellular automata and discrete dynamics; 3. The analytical engine: a Newtonian view of brains, minds, and mechanisms; 4. Catastrophes and life: the singularities of ecological and natural resource systems; 5. Order in chaos: turbulence and pattern in the flow of fluids, populations and money; 6. Strategies for survival: competition, games and the theory of evolution; 7. Taming nature and man: control, anticipation, and adaptation in social and biological processes; 8. The geometry of human affairs: connective structure in art, literature, and games of chance; 9. How do we know?: myths, models and paradigms in the creation of belief.

Elements of Differentiable Dynamics and Bifurcation Theory. By David Ruelle. Academic Press, 1989. vi+187 pp., $27.50.

This monograph is intended as an introduction to differentiable dynamics, with emphasis on bifurcation theory and hyperbolicity, as needed for the understanding of complicated time evolutions occurring in nature (turbulence and "chaos"). The author's aim is to present the basic facts of differentiable dynamics in an accessible manner for use by mathematicians or mathematically inclined students of the natural sciences. Ideas rather than proofs are emphasized, as are the problems of infinite dimensional systems, noninvertible maps, attractors, and bifurcation theory. The monograph contains three parts. The first part is centered on differentiable dynamics and begins with the definitions of manifolds and differentiable dynamical systems. Then the author discusses fixed points, periodic orbits and their invariant manifolds, as well as attractors, bifurcations and generic properties. The second part is centered on bifurcations: for a fixed point, for a periodic orbit, and for semiflows. The third part is a collection of appendices, containing material for easy reference in the main text and material of a more specialized nature.

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Mathematical Frontiers in Computational Chemical Physics. Edited by Donald G. Truhlar. Springer Verlag, 1988. xii+349 pp. $36.80.

This is volume 15 of The IMA Volumes in Mathematics and Its Applications. It is the proceedings of a Workshop on Atomic and Molecular Structure and Dynamics which was an integral part of the 1986-87 Institute of Mathematics and Its Applications (at the University of Minnesota) program on Scientific Computation. There are eleven chapters arranged in five groups: 1. Introductory chapters; 2. Spectral theory; 3. Classical many-body systems; 4. Quantum dynamics; 5. Dynamical groups.

Viscosity Solutions and Optimal Control. By Robert J. Elliot. Longman Scientific & Technical, and John Wiley & Sons, New York, 1987. pp. 1 + 95. $39.95.

This is volume 165 in the Pitman Research Notes in Mathematics Series. The basic theme is the study of cost/value function of an optimal control problem or a differential game, in particular the function's analytic properties. The author shows that the cost function is a generalized solution of the so-called Hamilton–Jacobi–Bellman equation. The first part of the notes discusses generalized solutions of HJB equations, the viscosity solutions.

Nonlinear Partial Differential Equations and their Applications, Collège de France Seminar–Volume VIII. Edited by H. Brezis and J. L. Lions. Longman Scientific & Technical, and John Wiley & Sons, New York, 1988. pp. 1 + 220. $51.95.

This is volume 166 in the Pitman Research Notes in Mathematics Series. It consists of written versions of lectures held during the year 1984–1985 at the weekly Seminar on Applied Mathematics at the Collège de France. There are ten papers.

Theory and Applications of Inverse Problems. Edited by H. Haario. Longman Scientific & Technical, and John Wiley & Sons, New York, 1988. pp. 1 + 159. $46.95.

This is volume 167 in the Pitman Research Notes in Mathematics Series. It contains the papers presented at a symposium organized jointly by mathematicians and physicists at the University of Helsinki in September, 1985. They cover, for example, the inverse scattering problem of quantum physics; exact methods stemming from quantum physics used to solve inverse problems in geophysics or other, more classical, fields; statistical (especially Bayesian) methods of parameter identification and numerical methods for handling ill-posed problems.

The Theory of Electromagnetic Flow-Measurement. By J. A. Shercliff. Cambridge University Press, New York, 1987. pp. xiii + 146. $14.95.

This is a volume in the series Cambridge Science Classics. It was first published in the Cambridge Engineering Series in 1962. Chapter headings: 1. Electromagnetic flow-measurement since Faraday. 2. Induction flow meter theory. 3. Effects peculiar to liquid metals. 4. Other techniques of electromagnetic flow-measurement. 5. An appraisal of electromagnetic flow-measurement.

Parallel Computers and Computations. Edited by J. van Leeuwen and J. K. Lenstra. Mathematisch Centrum, Amsterdam, 1985. pp. 1 + 184. Dfl. 28.80.

This is volume 9 of the series CWI Syllabus. There are eight lectures surveying the field as it looked in 1983.