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The QUARTERLY prints original papers in applied mathematics which have an intimate connection with applications. It is expected that each paper will be of a high scientific standard; that the presentation will be of such character that the paper can be easily read by those to whom it would be of interest; and that the mathematical argument, judged by the standard of the field of application, will be of an advanced character.

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SUGGESTIONS CONCERNING THE PREPARATION OF MANUSCRIPTS FOR THE QUARTERLY OF APPLIED MATHEMATICS

The editors will appreciate the authors' cooperation in taking note of the following directions for the preparation of manuscripts. These directions have been drawn up with a view toward eliminating unnecessary correspondence, avoiding the return of papers for changes, and reducing the charges made for "author's corrections."

Manuscripts: Manuscripts should be typewritten double-spaced on one side only. Marginal instructions to the typesetter should be written in pencil to distinguish them clearly from the body of the text. The author should keep a complete copy.

The papers should be submitted in final form. Only typographical errors should be corrected in proof; composition charges for any major deviations from the manuscript will be passed on to the author.

Titles: The title should be brief but express adequately the subject of the paper. The name and initials of the author should be written as he/she prefers; all titles and degrees or honors will be omitted. The name of the organization with which the author is associated should be given in a separate line following his/her name.

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.

Double embellishments are not allowed. These may be replaced by superscripts following the symbols.

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

MICOS: A Microprogrammable Computer Simulator. By Lubomir Bic. Computer Science Press, 1984. 109 pp. $15.95.

This is a book and software package developed at the University of California at Irvine to teach the basic principles of assembly language and microprogramming. It provides an assembler which allows the student to write programs in a simple language and to translate these into machine language programs. An interpreter written in a microprogramming language exists which allows the machine programs to be executed. The interpreter itself may be extended by writing new sections of microcode which are translated by a microprogram assembler and appended to the existing interpreter. There is a diskette available for $15.00.

Spectral Approximation of Linear Operators. By Francoise Chatelin. Academic Press, Inc., 1983. 450 pp. $69.50.

This is a volume in Computer Science and Applied Mathematics. The topic covered is the numerical approximation of the eigenvalues of a linear operator T acting in a complex Banach space. T may represent a bounded integral operator or a closed differential operator. The methods are investigated theoretically in order to answer questions of convergence and of speed of convergence and to provide error estimates. The various methods are presented in the unifying framework provided by functional analysis. The main lines of presentation are: (i) a thorough study of the properties of various types of operator convergence; (ii) a systematic study of the spectral approximation of non-self-adjoint operators; (iii) a generalization of classical perturbation theory as presented by T. Kato for application to numerical analysis, and (iv) an emphasis on computable error bounds and iterative refinement techniques. Chapter 1 deals with the matrix eigenvalue problem, with special attention given to large problems. Chapters 2 and 3 introduce the basic concepts of functional analysis. Chapter 2 presents the classical results, while Chapter 3 contains less widely known or previously unpublished material. Chapter 4 presents the numerical methods used for approximating integral and differential operators. In the analysis of projection methods on finite-dimensional subspaces, the fundamental role projections play is stressed, following the Russian tradition of Kantorovich-Akilov and Krasnoselskii-Vainikko. Chapter 5 is concerned with characterization of strong stability and the use of radii convergence in studying series expansions for eigenvalues and eigenvectors. Chapter 6 is devoted to the establishment of error bounds, and Chapter 7 presents results on superconvergence and the iterative refinement of eigenelements.

Optimal Shape Design for Elliptic Systems. By Olivier Pironneau. Springer-Verlag, 1984. 162 pp. $36.00.

This is a volume in the Springer Series in Computational Physics. The study of optimal shape design can be arrived at by asking the following question: "What is the best shape for a physical system?" This book is an application-oriented study of such systems, in particular, those which can be described by an elliptic partial differential equation and where the shape is found by the minimum of a single criterion function. Traditionally, optimal shape design has been treated as a branch of the calculus of variations and more specifically of optimal control. This subject interfaces with four fields: optimization, optimal control, partial differential equations, and their numerical solutions. Each of these fields is reviewed briefly. Optimal control theory provides the basic techniques for computing the derivatives of the criteria functions with respect to the boundary. So in essence, optimal control and optimization may be applied when the "control" becomes associated with the shape of the domain. However, problems are encountered with numerical discretization; thus two chapters are devoted to applications with finite elements and in a finite difference, or boundary element context. Finally, two industrial applications are included for a practical illustration of the theory studied. Optimal shape design has been studied in great depth by the French school of applied mathematics and this book presents this approach. Chapter headings: 1. Elliptic Partial Differential Equations; 2. Problem Statement; 3. Existence of Solutions; 4. Optimization Methods; 5. Design Problems Solved by Standard Optimal Control Theory; 6. Optimality Conditions; 7. Discretization with Finite Elements; 8. Other Methods; 9. Two Industrial Examples.

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Structural Equation Geometry. By J. L. Kavanau. Science Software Systems, Inc., 1983. 498 pp. $16.95.

This volume is a much-simplified version of the material of chapters 1–7, 9, and 10 of the author's "Symmetry, An Analytic Treatment", 1980, intended as a sourcebook for analytical geometry of all levels and as an advanced undergraduate text. For this purpose, treatments of plane Euclidean coordinate systems and the methods and rationale of new approaches to the study of the inherent structure of curves have been greatly elaborated and 155 problems included. Detailed outlines of the solutions to most of these problems are given. Chapter headings: 1. The Discipline of Structural Equation Geometry; 2. The Rectangular Coordinate System; 3. The Polar Coordinate System; 4. The Bipolar and Hybrid Polar-rectangular Coordinate Systems; 5. The Polar-Linear Coordinate System; 6. The Polar-Circular and Linear-Circular Coordinate Systems; 7. Structure-Rule Analysis, A Survey; 8. Structure Rules of Curves About Points.

Simulation of Computer Communication Systems. By Charles H. Sauer. Prentice-Hall, Inc., 1983. 150 pp. $25.00.

The purpose of this book is to present modern simulation methodology as it applies to the simulation of computer communication systems. The focus is on representation of these systems by extended queueing networks. The authors also discuss the statistical issues and other considerations that arise in developing such simulation models. The actual models shown are constructed and simulated using a software package called Research Queuing Package (RESQ). The emphasis in these examples is on models and simulation methodology; these examples could be constructed and simulated using other software packages. Chapter 1 gives an introduction to the topics covered and an overview of the remainder of the book. Chapter 2 discusses the queueing models that are used in analytic models of computer communication systems. Chapter 3 summarizes the extensions to queueing networks that have recently made simulation a more attractive approach to system modeling. Chapter 4 introduces the characteristics of RESQ, including its capabilities for macro definition of submodels and its several components for statistical analysis of simulation runs. The remaining chapters develop specific aspects of simulating computer communication systems.

Elements of Computational Hydraulics. By Christopher G. Koutitas. Chapman & Hall, 1983. 148pp. $27.50.

This volume is primarily intended for advanced undergraduate students of civil engineering and also for practicing engineers interested in this field. It is at an introductory level throughout. Chapter headings: 1. Elements of Numerical Analysis; 2. Numerical Solution of Partial Differential Equations common in Hydraulics; 3. Flow in Closed Conduits; 4. Open Channel Flow; 5. Groundwater Flow; 6. Advective Diffusion and Dispersion; 7. The Method of Finite Elements.

Scaling and Self-Similarity in Physics. Jurg Frohlich, editor. Birkhauser, 1983. 426 pp. $27.50.

This is volume 7 of "Progress in Physics." The articles collected in this book have grown out of a series of seminar talks held at the Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette, between spring 1981 and summer 1982. The guiding idea behind this volume is to present a brief status report on the renormalization group methods for studying problems in theoretical and mathematical physics related to ideas of scaling and self-similarity. Only contributions which describe mathematically rigorous results of relevance to statistical physics and/or dynamical systems theory are included. The book is divided into two parts. The first and more voluminous part is devoted to mathematical theories of phase transitions and critical phenomena, the second part to classical, dissipative and conservative dynamical systems of finitely many degrees of freedom. There are twelve articles in all.

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Multiple Grid Methods for Equations of the Second Kind with Applications in Fluid Mechanics. By H. Schippers. Mathematisch Centrum, Amsterdam, 1983. 128 pp. Dfl. 17.60.

This monograph studies multiple grid methods for solving the algebraic system corresponding to the Fredholm equation of the second kind $f = Kf + g$ where g belongs to a Banach space X and the operator K is compact from X into X, and where it is assumed that the equation has a unique solution $f \in K$. Projection methods are used for the description of the multiple grid techniques. Applications to potential theory and to rotating flow due to an infinite disk performing torsional oscillation are described.

Computational Aspects of VLSI. By Jeffrey D. Ullman. Computer Science Press, Inc., 1984. 465 pp. $32.95.

This book is divided into three parts, of three chapters each. Each part is on the interface between integrated circuit design and algorithm design. The first part, the most theoretical, is concerned with the inherent limitations on our ability to compute using VLSI (very-large-scale-integration). Chapters 2 and 3 of that part deal with the question of what it costs to solve a problem in the VLSI environment. The second group of chapters (4–6) deals with general-purpose algorithms and how VLSI circuits can be used to implement them. Different organizations for computers composed of many independent processes are discussed. These computers may be viewed either as many on one chip, or as many chips or boards interconnected; many of the algorithms and issues are the same in either case. The third part of the book concerns design systems for VLSI circuits, their levels of abstraction, the algorithms used to compile design languages into languages of lower abstraction levels, and algorithms for implementation of the sort of tools needed for circuit design. Chapter headings: 1. VLSI Models; 2. Lower Bounds on Area and Time; 3. Layout Algorithm; 4. Algorithm Design for VLSI; 5. Systolic Algorithms; 6. Organizations with High Wire Area; 7. Overview of VLSI Design Systems; 8. Compilation and Optimization Algorithms; 9. Algorithms for VLSI Design Tools.

Microcomputer Quantum Mechanics. By J. Killingbeck. Heyden & Son, Inc., 1983. 178 pp. $22.00.

Much of this book is about the wise use of microcomputers in scientific work, but to give the work focus, the subject of the later chapters concerns the use of microcomputers in simple mechanics, particularly quantum mechanics. Chapter headings: 1. Microcomputers and BASIC; 2. Tuning the instrument; 3. The iterative approach; 4. Some finite-difference methods; 5. Numerical integration; 6. Padé approximants and all that; 7. A simple power series method; 8. Some matrix calculations; 9. Hypervirial-perturbation methods; 10. Finite-difference eigenvalue calculations; 11. One-dimensional model problems; 12. Some case studies.

Workshop on Non-Perturbative Quantum Chromodynamics. K. A. Milton, M. A. Samuel, editors. Birkhauser, 1983. 265 pp. $24.95.

This is volume 8 of "Progress in Physics." The workshop took place March 7–9, 1983 at Oklahoma State University. Subjects discussed include lattice gauge theory, infrared behavior, confinement, chromostatics and glueballs, as well as the interface with perturbative quantum chromodynamics.

Architectural Morphology: An Introduction to the Geometry of Building Plans. By J. P. Steadman. Pion Ltd., Methuen Inc., 268 pp. $27.00.

This book provides an introduction to an area of architectural research which has been emerging over the last ten years, and which has gone under the names, variously, of "architectural morphology" or "configurational studies" in architecture. It is concerned centrally with the limits which geometry places on the possible forms and shapes which buildings and their plans may take.

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Continua, Decompositions, Manifolds. R. H. Bing, W. T. Eaton, and M. P. Starbird, editors. University of Texas Press, 1983. 267 pp. $30.00.

These are the proceedings of the Texas Topology Symposium 1980. The lectures are grouped under four headings: continuous theory, decomposition spaces, manifolds, and linear isotopics and miscellaneous topics.

Statistics for technology: a course in applied mathematics. By Christopher Chatfield. Chapman and Hall, 1983. 370 pp. $12.50.

This book provides an introduction to statistics, with particular emphasis on applications in the applied sciences and engineering. It is divided into three sections. Part One includes an introduction and some material on descriptive statistics. Part Two deals with the theory of probability and statistics, while Part Three considers some applications, including the design and analysis of experiments, quality control and life-testing.

Fundamentals of Programming Languages. By Ellis Horowitz. Computer Science Press, 1984. 419 pp. $26.95.

The author of this work believes that the best possible way to study and understand today's programming languages is by focusing on a few essential concepts. These concepts form the outline for this book and include such topics as variables, expressions, statements, typing, scope, procedures, data types, exception handling and concurrency. This approach to the study of programming languages is analogous to the way natural languages are studied by linguists. The book follows the guidelines which were stated by the ACM Curriculum Committee for the design of the course CS 8, "Organization of Programming Languages." It is appropriate for undergraduate computer science majors who have had one year of programming. Knowledge of Pascal is desirable, but PL/1, ALGOL60, ALGOL68 or something similar are adequate substitutes. The book has also been used successfully in a first year graduate course whose objective was to survey the important features of current languages. Since Ada is one of the very few languages which include most of the language features the author wished to discuss, many of his examples come from Ada and Ada provides a common thread for them. A companion volume to the present work is an anthology of source material published under the title "Programming Languages: A Grand Tour." Chapter headings: 1. The Evolution of Programming Languages; 2. The Challenge of Programming Language Design; 3. Defining Syntax; 4. Variables, Expressions and Statements; 5. Types; 6. Scope and Extent; 7. Procedures; 8. Data Abstractions; 9. Exception Handling; 10. Concurrency; 11. Input-Output; 12. Functional Programming; 13. Data Flow Programming Languages; 14. Object Oriented Programming Languages.

Relative Invariants of Rings. By F. Van Oystaeyen and A. Verschoren. Marcel Dekker, Inc., 1983. 272 pp. $42.50.

This is volume 79 of the series "Pure and Applied Mathematics." The author investigates certain groups associated to associative rings, in particular, Picard groups, class groups, Brauer groups or related cohomology groups. These groups are determined by the isomorphism class of the ring considered and they may be considered to be "invariants" of the ring structure. The main aim is to infer knowledge about the structure of the ring from knowledge about certain invariants.

Applied Abstract Algebra. By Ki Hang Kim and Fred W. Roush. John Wiley & Sons, 1983. 252 pp. $24.95.

This is a volume in the Ellis Horwood Series "Mathematics and its Applications." Chapter headings: 1. Sets and Binary Relations; 2. Semigroups and Groups; 3. Vector Spaces; 4. Rings; 5. Group Representations; 6. Field Theory.

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Factor Categories with Applications to Direct Decomposition of Modules. By Manabu Harada. Marcel Dekker, Inc., 1983. 344 pp. $59.75.

This is volume 88 of the Lecture Notes in Pure and Applied Mathematics series. It is an application of category theory to ring theory, following the Krull-Remak-Schmidt-Azumaya theorem.

Learning to Program in C. By Thomas Plum. Prentice-Hall, Inc., 1983. $25.00.

This book is an introduction to computer programming using the *C* language, which is here treated as a general purpose computer language for programmers concerned with portability and efficiency. The focus is tutorial rather than reference. Chapter headings: 1. Computers and *C*; 2. Data; 3. Operators; 4. Statements and Control Flow; 5. Functions; 6. Software Development; 7. Pointers; 8. Structures.

The Finite Element Method: A Basic Introduction for Engineers. By K. C. Rockey, H. R. Evans, D. W. Griffiths, D. A. Nethercot. John Wiley & Sons, 1983. 221pp.

This is the second edition of a text first published in 1975. The authors have added a new chapter, a review of developments in the field, to bring the material up to date.

Dynamics—The Geometry of Behavior: Part 1: *Periodic Behavior.* By R. H. Abraham and C. D. Shaw. Aerial Press, Inc., 1983. 213 pp. $25.00.

Over the past century a remarkably rich theory of qualitative aspects of ordinary differential equations was developed. In recent years, largely due to the ubiquity of electronic computers, the subject has started turning back to its roots with exciting new applications to physical, biological, and even to social problems. The "Visual Mathematics Library" by Abraham and Shaw is a beautiful and remarkably unusual attempt to explain some of the important ideas in dynamical systems to nonexperts interested in applying these powerful tools to other disciplines. The book under review is Volume 1 of a four part series entitled: Volume 0, Manifolds and mappings; Volume 1, Dynamics—The geometry of behavior, Part 1, Periodic behavior; Volume 2, Dynamics—The geometry of behavior, Part 2, Stable and chaotic behavior; Volume 3, Dynamics—The geometry of behavior, Part 3, Bifurcation behavior. The authors have chosen a unique method of explaining mathematics which is almost entirely visual. "The volume is profusely illustrated, every page consisting of one or more four-color drawings with brief captions and very little text." The animation technique is used very successfully to bring out the dynamics of a variety of physical and biological systems exhibiting oscillations. Chapter headings: 1. Basic Concepts of Dynamics; 2. Classical Applications: Limit points in 2 *D* from Newton to Rayleigh; 3. Vibrations: Limit cycles in 3*D* from Rayleigh to Duffing; 4. Compound Oscillations: Invariant tori in 3*D* from Huyghens to Hayashi.

Dynamics—The Geometry of Behavior: Part 2: *Chaotic Behavior.* By R. H. Abraham and C. D. Shaw. Aerial Press, Inc., 1983. 136 pp. $15.00.

This is volume 2 of the sequence of books mentioned in the preceding notice. Chaotic limit sets have been known to theoretical dynamics since Poincaré. The first chaotic attractor in a dynamical system was discovered in 1932 by Birkhoff. Since 1950, digital simulations have become increasingly important, especially since the experimental discovery of chaotic attractors in 1962 by Lorenz. This volume is devoted to these recent developments, since 1950, on the chaotic behavior observed in experiments, expounded in the same unique method of presentation as in volume 1 (see preceding review). Chapter headings: 1. Static Limit Sets and Characteristic Exponents; 2. Periodic Limit Sets and Characteristic Multipliers; 3. Chaotic Limit Sets; 4. Attributes of Chaos.

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Multiple Integrals in the Calculus of Variations and Nonlinear Elliptic Systems. By Mariano Giaguinta. Princeton University Press, 1983. 277 pp. $35.00 cloth, $16.50 paper.

This volume is number 105 of Annals of Mathematics Studies. It is an enlarged version of lectures given by the author at the Mathematisches Institut der Universität Bonn. The aim of these lectures is to discuss the existence and differentiability of minimum points (more generally, of stationary points) of regular functionals in the calculus of variations.

Seminar on Minimal Submanifolds. Enrico Bombieri, editor. Princeton University Press, 1983. 357 pp. $45.00 cloth, $15.00 paper.

This is number 103 of Annals of Mathematics Studies. It collects the papers which were presented in the academic year 1979–1980 at the Institute for Advanced Study, in the areas of closed geodesics and minimal surfaces, as part of the activities of a special year in differential geometry and differential equations. Starting with a survey lecture, they have been arranged according to dimension and approach, from classical to that of geometric measure theory.

Orderly Tangles. By Alan Holden. Columbia University Press, 1983. 91 pp. $19.95.

This book explores topological phenomena such as rings, knots, and chains. The first chapter discusses highway interchanges and shows how mathematics can provide solutions to the problems they present. Chapter two involves tabbies and twills, the components of weaving and basketry. The third chapter details the legend of the Phrygian peasant-king Gordius and his knot. From there, the author examines the structure and symmetry of knots and their distinctions from rings. Chains of rings, which add to the complexity, are disentangled in chapter five. The last three chapters present the important concept and consequences of "regular polylinks", which manifest many of the properties of regular polyhedra, with an added dimension; they are composed of linked, rather than merely contiguous, polygonal rings. The book is lavishly illustrated and theoretically sound, and of interest not only to laymen and mathematicians, but also to sculptors who may use it as a source of designs.

Engineering Optimization: Methods and Applications. By G. V. Reklaitis, A. Ravidran, K. M. Ragsdell. John Wiley & Sons, 1983. 651 pp. $39.95.

This is a text on the practical aspects of optimization methodology, with a major focus on the techniques and stratagems relevant to engineering applications arising in design, operations, and analysis. Attention is given primarily to techniques applicable to problems in continuous variables that involve real-valued constraint functions and a single real-valued objective function. In short, the author treats the methodology often categorized as nonlinear programming. Within this framework a broad survey is given of all important families of optimization methods, ranging from those applicable to the minimization of a single-variable function to those most suitable for large-scale nonlinear constrained problems. Included are discussions not only of classical methods, important for historical reasons and for their role in motivating subsequent developments in this field, but also of promising new techniques such as those of successive quadratic programming. Chapter headings: 1. Introduction to Optimization; 2. Functions of a Single Variable; 3. Functions of Several Variables; 4. Linear Programming; 5. Constrained Optimality Criteria; 6. Transformation Methods; 7. Constrained Direct Search; 8. Linearization Methods for Constrained Problems; 9. Direction-Generation Methods Based on Linearization; 10. Quadratic Approximation Methods for Constrained Problems; 11. Structured Problems and Algorithms; 12. Comparison of Constrained Optimization Methods; 13. Strategies for Optimization Studies; 14. Engineering Case Studies.

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Classical Potential Theory and Its Probabilistic Counterpart. By J. L. Doob. Springer-Verlag, 1984. 817 pp. $58.00.

The purpose of this book is to develop the correspondence between potential theory and probability theory by examining in detail classical potential theory, that is, the potential theory of Laplace's equation, together with the corresponding probability theory, that is, martingale theory. The joining link which makes this correspondence especially perspicuous is the Brownian motion process, so this process is studied as needed. In order to carry through this program it is necessary to study parabolic potential theory, that is, the potential theory of the heat equation, and the corresponding process of space-time Brownian motion. No knowledge of potential theory is presupposed but it is assumed that the reader is familiar with basic probability concepts through conditional expectations. The necessary lattice theory, analytic set theory and capacity theory are covered in the Appendices. Thus this book on the one hand contains an introduction to classical and parabolic potential theory and on the other hand contains an introduction to the martingale theory, including a scattering of the general theory of stochastic processes and of Markov process theory. There is cross referencing between the nonprobabilistic and probabilistic aspects of the work, and the linking of classical and parabolic potential theory with martingale theory, by Brownian motion and space-time Brownian motion, is examined in depth. Table of Contents: Part I; Classical and Parabolic Potential Theory; 1. Introduction to the Mathematical Background of Classical Potential Theory; 2. Basic Properties of Harmonic, Subharmonic, and Superharmonic Functions; 3. Infima of Families of Superharmonic Functions; 4. Potentials on Special Open Sets; 5. Polar Sets and Their Applications; 6. The Fundamental Convergence Theorem and the Reduction Operation; 7. Green's Functions; 8. The Dirichlet Problem for Relative Harmonic Functions; 9. Lattices and Related Classes of Functions; 10. The Sweeping Operation; 11. The Fine Topology; 12. The Martin Boundary; 13. Classical Energy and Capacity; 14. One-dimensional Potential Theory; 15. Parabolic Potential Theory: Basic Facts; 16. Subparabolic, Superparabolic, and Parabolic Functions on a Slab; 17. Parabolic Potential Theory (continued); 18. The Parabolic Dirichlet Problem, Sweeping, and Exceptional Sets; 19. The Martin Boundary in the Parabolic Context. Part II; 1. Fundamental Concepts of Probability; 2. Optional Times and Associated Concepts; 3. Elements of Martingale Theory; 4. Basic Properties of Continuous Parameter Supermartingales; 5. Lattices and Related Classes of Stochastic Processes; 6. Markov Processes; 7. Brownian Motion; 8. The Ito Integral; 9. Brownian Motion and Martingale Theory; 10. Conditional Brownian Motion. Part III; 1. Lattices in Classical Potential Theory and Martingale Theory; 2. Brownian Motion and the PWB Method; 3. Brownian Motion on the Martin Space. Appendices: 1. Analytic Sets; 2. Capacity Theory; 3. Lattice Theory; 4. Lattice Theoretic Concepts in Measure Theory; 5. Uniform Integrability; 6. Kernels and Transition Functions; 7. Integral Limit Theorems; 8. Lower Semicontinuous Functions. Bibliography.

Generalized Functions. By Ram P. Kanwal. Academic Press, 1983. 417 pp. $58.00.

This book contains both the theory and applications of generalized functions, with a significant feature being the quantity and variety of applications of this theory. The author has attempted to furnish a wealth of applications from various physical and mathematical fields of current interest and has tried to make the presentation direct yet informal. Definitions and theorems are stated precisely, but rigor is minimized in favor of comprehension of techniques. Many examples are presented to illustrate the concepts, definitions, and theorems. Except for a few research topics, the mathematical background expected from a student is available in undergraduate courses in advanced calculus, ordinary and partial differential equations, and boundary value problems. Accordingly, most of the material is easily accessible to senior undergraduate and graduate students in mathematical, physical, and engineering sciences. The chapters that are suitable for a one-semester course are furnished with sets of exercises. Chapter headings: 1. The Dirac Delta Function and Delta Sequences; 2. The Schwartz-Sobolev Theory of Distributions; 3. Additional Properties of Distributions; 4. Distributions Defined by Divergent Integrals; 5. Distributional Derivatives of Functions with Jump Discontinuities; 6. Tempered Distributions and the Fourier Transforms; 7. Direct Products and Convolutions of Distributions; 8. The Laplace Transform; 9. Applications to Ordinary Differential Equations; 10. Applications to Partial Differential Equations; 11. Applications to Boundary Value Problems; 12. Applications to Wave Propagation; 13. Functions that have Infinite Singularities at an Interface; 14. Linear Systems; 15. Miscellaneous Topics. This book is volume 171 in the series "Mathematics in Sciences and Engineering."

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Fundamentals of Mathematical Analyis, in two volumes. By V. A. Ilyin and E. G. Poznyak. Mir Publishers, Moscow, 1982. 1075 pp. $18.95.

This 2-volume text covers the theory of real numbers, the theory of limits, differential and integral calculus of functions in one variable, the theory of number series, differential calculus of functions in several variables, the theory of implicit functions, and geometrical applications of the analysis.

Discrete Optimization Algorithms with Pascal Programs. By M. M. Syslo, N. Deo, J. S. Kowalik. Prentice-Hall, Inc., 1983. 534 pp. $37.50.

This book offers a collection of ready-to-use computer programs, together with their derivation and performance characteristics, in the field of discrete optimization, which includes linear and integer programming, covering, knapsack, graph-theoretic problems, network analysis, and scheduling.

Notes on Introductory Combinatorics. By G. Polya, R. Tarjan, and D. Woods. Birkhauser, 1983. 190 pp. $9.95 softcover, $14.95 hardcover.

In the winter of 1978, Professors George Polya and Robert Tarjan teamed up at Stanford University to teach a course titled "Introduction to Combinatorics." This book consists primarily of the class notes and related material produced by Donald Woods as teaching assistant for the course. Among the topics covered in the notes are elementary subjects such as combinations and permutations, mathematical tools such as generating functions and Polya's Theory of Counting, and specific problems such as Ramsey Theory, matchings, and Hamiltonian and Eulerian paths.

Of Hypergeometric Functions and Applications. By Harold Exton. John Wiley & Sons, 1983. 316 pp. $49.95.

This is a volume in the Ellis Horwood Series "Mathematics and its Applications." The first five chapters of this book are devoted to the theoretical background of basic hypergeometric functions and the final two chapters give a number of examples of their occurrence in number theory and various other fields. These include mechanical engineering, solid state theory in physical chemistry, linear algebra, Lie theory, elliptic functions, conduction of heat, statistics, Fourier analysis, difference equations, operational calculus, transient behavior in electrical cables, high-energy particle physics, quantum theory and cosmology. Chapter headings: 1. The Basic Hypergeometric Series; 2. Basic Differentiation and Integration: Functional Equations; 3. Transformations and Identities; 4. Basic Analogues of Certain Classical Functions; 5. A Basic Sturm-Liouville System: Basic Orthogonal Functions; 6. Applications in Number Theory and Combinatorial Analysis; 7. Applications in Physics and Other Fields.

Fundamentals of Linear Algebra and Analytical Geometry. By Ya. S. Bugrov and S. M. Nikolsky. Mir Publishers, Moscow, 1982. 189 pp. $3.45.

This is the first part of a three-part textbook "Higher Mathematics" and deals with determinants, matrices, systems of linear equations and vector algebra.

Differential and Integral Calculus. By Ya. S. Bugrov and S. M. Nikolsky. Mir Publishers, Moscow, 1982. 464 pp. $8.95.

This is the second volume in the authors' three volume series, "Higher Mathematics," and includes limits, functions, differentials, indefinite and definite integrals, applications, approximate methods, functions of several variables, and series.

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Formal Knot Theory. By Louis H. Kauffman. Princeton University Press, 1983. 167 pp. $12.00.

These notes constitute an exploration in combinatorics and knot theory. Plane projections of knots and links in three-dimensional space are emphasized for their understanding.

Optimization Methods in Structural Design. Hans Eschenauer and Niels Olhoff, editors. Birkhauser Boston, Inc., 1983. 452 pp. $24.95.

These Proceedings contain the texts of more than 60 lectures presented at the Euromech-Colloquium 164 "Optimization Methods in Structural Design" held 12–14 October 1982 at the University of Siegen, FR Germany, under the auspices of the European Mechanics Committee. The aim of the colloquium was to provide an overview of recent advances and the current state of knowledge in the field of Optimal Structural Design. The Proceedings are organized into the following four parts: 1. Theoretical Aspects—Optimization Software, 2. Multipurpose Optimal Design, 3. Shape Optimization, 4. Application of various Optimization Methods to Structures and Materials. Continuous as well as discrete structures are treated, and in each part emphasis is laid on new developments in theories and methods for optimal design.

Linear Programming. By Katta G. Murty. John Wiley & Sons, 1983. 470 pp. $37.95.

This is the first of three volumes: the second will treat networks and combinatorial programming and the third linear complementarity. It has five objectives: to provide an in-depth and clear coverage of all the important practical, technical, computational, and mathematical aspects of linear programming and the transportation problem; to discuss and illustrate very clearly the methods used to model problems as linear programs and to help develop skill in modeling; to discuss the theory and the geometry of linear programming systematically in an elementary but rigorous manner so that a reader without much mathematical background can easily understand it; to discuss clearly the algorithms for solving linear programs and transportation problems, to present their efficient implementations for the computer, and to discuss their computational complexity; to help develop skill in using algorithms intelligently to solve practical problems. The book's main distinguishing feature is its completeness and comprehensiveness. Most important topics in linear programming are discussed clearly and in depth. The practical, modeling, mathematical, geometrical, algorithmic, and computational aspects of linear programming are well covered very carefully in complete detail. Chapter headings: 1. Formulation of Linear Programs; 2. The Simplex Method; 3. Geometry of the Simplex Method; 4. Duality in Linear Programming; 5. Revised Simplex Method; 6. The Dual Simplex Method; 7. Numerically Stable Forms of the Simplex Method; 8. Parametric Linear Programs; 9. Sensitivity Analysis; 10. Degeneracy in Linear Programming; 11. Bounded-Variable Linear Programs; 12. The Decomposition Principle of Linear Programming; 13. The Transportation Problem; 14. Computational Complexity of the Simplex Algorithm; 15. The Ellipsoid Method; 16. Iterative Methods for Linear Inequalities and Linear Programs; 17. Vector Minima.

Introduction to Stochastic Integration. By K. L. Chung and R. J. Williams. Birkhauser, 1983. 184 pp. $19.95.

This is volume 4 of "Progress in Probability and Statistics." Its purpose is to present a modern version of the theory of stochastic integration, comprising but going beyond the classical theory, yet stopping short of the latest discontinuous ramifications. The primary object of study is integration with respect to a local martingale with continuous paths. Chapter headings: 1. Preliminaries; 2. Definition of the Stochastic Integral; 3. Extension of the Predictable Integrands; 4. Quadratic Variation Process; 5. The Ito Formula; 6. Applications of the Ito Formula; 7. Local Time and Tanaka's Formula; 8. Reflected Brownian Motions; 9. Generalized Ito Formula and Change of Time.

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Stochastic Systems. By George Adomian. Academic Press, 1983. 324 pp. $47.50.

This is volume 169 in the series "Mathematics in Sciences and Engineering."

The purpose of this book is to develop an understanding of the concepts of stochastic system theory and linear and nonlinear stochastic operator equations as well as the ability to solve the nonlinear stochastic equations arising in applications. The methods developed do not linearize the nonlinearities nor replace stochastic quantities by averages. They are applicable to a wide range of phenomena in the sciences. The book developed from the author's 1961 dissertation "Linear stochastic operators." There is a foreword by R. Bellman describing the method for handling stochastic equations described here as simple and yet powerful and claiming that it is the first book bringing such equations within the reach of the engineer and physicist. Chapter headings: 1. Green's Functions and Systems Theory; 2. A Basic Review of the Theory of Stochastic Processes; 3. Stochastic Operators and Stochastic Systems; 4. Linear Stochastic Differential Equations; 5. Nonlinear Stochastic Differential Equations; 6. Successive Improvements; 7. Computational Aspects and a General Method; 8. The Deterministic Limit of Stochastic Theory; 9. Comparisons and Relations; 10. Stochastic Partial Differential Equations; 11. Analytical Foundations of Stochastic Operator Equations; 12. Applications.

Complex Variables and Applications. By Ruel V. Churchill and James W. Brown. McGraw-Hill Book Company, 1984. 321 pp. $29.50.

This is the fourth edition of a text first published in 1960. There are several improvements and additions. Chapter headings: 1. Complex Numbers; 2. Analytic Functions; 3. Elementary Functions; 4. Integrals; 5. Series; 6. Residues and Poles; 7. Mapping by Elementary Functions; 8. Conformal Mapping; 9. Applications of Conformal Mapping; 10. The Schwarz-Christoffel Transformation; 11. Integral Formulas of the Poisson Type; 12. Further Theory of Functions.

Sculptured surfaces in engineering and medicine. By J. P. Duncan and S. G. Mair. Cambridge University Press, 1983. 370 pp.

This book describes the basis of a computer-aided approach to the geometrical definition of complex, designed surfaces or of measured, natural surfaces and the machining of their likenesses by numerical control. A variety of forms of data input is reduced to a computer-stored geometrical "image" of the desired surface. Each such surface is approximated by a multifaced polyhedron. An analysis of contact of a spherical end-milling cutting tool with this polyhedron by a single, fixed computer program determines cutter locations data for machining its likeness. The system of programs embracing definition and machining has been called POLYHEDRAL NC. The process of machining can be described as computer-controlled "pointing", the term used in classical sculpture to describe a traditional work. The unique feature of the POLYHEDRAL NC system is its ability, ensured by its noninterference features, to automatically machine surfaces having an extreme range of curvature. It can be used by the nonspecialist since the extensive mathematical logic behind its programs is transparent to the user.

Pascal for Fortran Programmers. By Ronald H. Perrott and Donald C. S. Allison. Computer Science Press, 1984. 330 pp. $18.95.

This book recalls how the development of new programming methods such as stepwise refinement or structured programming led to the introduction of languages and techniques which produced software of improved quality and reliability at a reasonable cost. Many of these advances are represented by PASCAL and the book is intended to make the transition to PASCAL as easy as possible to FORTRAN programmers. It also shows how these advances can, where possible, be expressed in FORTRAN. Chapter headings: 1. Historical Overview; 2. Structured Programming; 3. Basic Concepts; 4. Simple Data Types and Constants; 5. Statements; 6. Structured Data Types: Arrays and Records; 7. Subprograms; 8. Advanced Data Types: Sets, Files and Pointers; 9. Further Input and Output; 10. Pascal: Comments and Criticisms.