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Complete Normed Algebras *Introduction to Normed *-Algebras and Their Representations* **Non-Associative Normed Algebras : Volume 2, Representation Theory and the Zel'manov Approach** ***Normed Algebras*** **Non-Associative Normed Algebras Banach Algebras and the General Theory of *-algebras Numerical Ranges of Operators on Normed Spaces and of Elements of Normed Algebras Normed Algebras** ***Non-Associative Normed Algebras Characterizations of C* Algebras*** Stability of Functional Equations in Banach Algebras **Non-associative Normed Algebras Ultrametric Banach Algebras Complete Normed Algebras** Locally Convex Quasi *-Algebras and their Representations **Topological Algebras** ***Topological Algebras with Involution*** **Associative and Non-Associative Algebras and Applications** General Theory of Banach Algebras **C*-Algebras and Operator Theory Metric Generalizations of Banach Algebras Seminar on Banach Algebras Normed Lie Algebras and Analytic Groups** Topological Algebras and Applications **Calculus on Normed Vector Spaces** ***Operator Algebras and Their Modules*** **Non-Associative Normed Algebras: Volume 1, The Vidav–Palmer and Gelfand–Naimark Theorems Topological Algebras Non-Associative Normed Algebras : Volume 2, Representation Theory and the Zel'manov Approach** Functional Analysis Banach Algebras and Compact Operators Nonstandard Methods in Functional Analysis Banach Algebras and Applications ***Algebraic K-Theory Introduction to Banach Spaces and Algebras*** **Geometry of State Spaces of Operator Algebras Functional Analysis and Valuation Theory Metric Generalizations of Banach Algebras** Fuzzy Operator Theory in Mathematical Analysis **Numbers**

The first systematic account of the basic theory of normed algebras, without assuming associativity. Sure to become a central resource. The axioms of a complex Banach algebra were very happily chosen. They are simple enough to allow wide ranging fields of application, notably in harmonic analysis, operator theory and function algebras. At the same time they are tight enough to allow the development of a rich collection of results, mainly through the interplay of the elementary parts of the theories of analytic functions, rings, and Banach spaces. Many of the theorems are things of great beauty, simple in statement, surprising in content, and elegant in proof. We believe that some of them deserve to be known by every mathematician. The aim of this book is to give an account of the principal methods and results in the theory of Banach algebras, both commutative and non commutative. It has been necessary to apply certain exclusion principles in order to keep our task within bounds. Certain classes of concrete Banach algebras have a very rich literature, namely C*-algebras, function algebras, and group algebras. We have regarded these highly developed theories as falling outside our scope. We have not entirely avoided them, but have been concerned with their place in the general theory, and have stopped short of developing their special properties. For reasons of space and time we have omitted certain other topics which would quite naturally have been included, in particular the theories of multipliers and of extensions of Banach algebras, and the implications for Banach algebras of some of the standard algebraic conditions on rings. The first unified, in-depth discussion of the now classical Gelfand-Naimark theorems, thiscomprehensive text assesses the current status of modern analysis regarding both Banachand C*-algebras.Characterizations of C*-Algebras: The Gelfand-Naimark Theorems focuses on general theoryand basic properties in accordance with readers' needs ... provides complete proofs of theGelfand-Naimark theorems as well as refinements and extensions of the original axioms. . . gives applications of the theorems to topology, harmonic analysis. operator theory.group representations, and other topics ... treats Hermitian and symmetric *-algebras.algebras with and without identity, and algebras with arbitrary (possibly discontinuous)involutions . . . includes some 300 end-of-chapter exercises . . . offers appendices on functionalanalysis and Banach algebras ... and contains numerous examples and over 400 referencesthat illustrate important concepts and encourage further research.Characterizations of C*-Algebras: The Gelfand-Naimark Theorems is an ideal text for graduatestudents taking such courses as The Theory of Banach Algebras and C*-Algebras: inaddition , it makes an outstanding reference for physicists, research mathematicians in

analysis,and applied scientists using C*-algebras in such areas as statistical mechanics, quantumtheory. and physical chemistry. The axioms of a complex Banach algebra were very happily chosen. They are simple enough to allow wide ranging fields of application, notably in harmonic analysis, operator theory and function algebras. At the same time they are tight enough to allow the development of a rich collection of results, mainly through the interplay of the elementary parts of the theories of analytic functions, rings, and Banach spaces. Many of the theorems are things of great beauty, simple in statement, surprising in content, and elegant in proof. We believe that some of them deserve to be known by every mathematician. The aim of this book is to give an account of the principal methods and results in the theory of Banach algebras, both commutative and non commutative. It has been necessary to apply certain exclusion principles in order to keep our task within bounds. 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This first systematic account of the basic theory of normed algebras, without assuming associativity, includes many new and unpublished results and is sure to become a central resource for researchers and graduate students in the field. This second volume revisits JB*-triples, covers Zel'manov's celebrated work in Jordan theory, proves the unit-free variant of the Vidav–Palmer theorem, and develops the representation theory of alternative C*-algebras and non-commutative JB*-algebras. This completes the work begun in the first volume, which introduced these algebras and discussed the so-called non-associative Gelfand–Naimark and Vidav–Palmer theorems. This book interweaves pure algebra, geometry of normed spaces, and infinite-dimensional complex analysis. Novel proofs are presented in complete detail at a level accessible to graduate students. The book contains a wealth of historical comments, background material, examples, and an extensive bibliography. This first systematic account of the basic theory of normed algebras, without assuming associativity, includes many new and unpublished results and is sure to become a central resource for researchers and graduate students in the field. This first volume focuses on the non-associative generalizations of (associative) C*-algebras provided by the so-called non-associative Gelfand–Naimark and Vidav–Palmer theorems, which give rise to alternative C*-algebras and non-commutative JB*-algebras, respectively. The relationship between non-commutative JB*-algebras and JB*-triples is also fully discussed. The second volume covers Zel'manov's celebrated work in Jordan theory to derive classification theorems for non-commutative JB*-algebras and JB*-triples, as well as other topics. The book interweaves pure algebra, geometry of normed spaces, and complex analysis, and includes a wealth of historical comments, background material, examples and exercises. The authors also provide an extensive bibliography. This book is about all kinds of numbers, from rationals to octonians, reals to infinitesimals. It is a story about a major thread of mathematics over thousands of years, and it answers everything from why Hamilton was obsessed with quaternions to what the prospect was for quaternionic analysis in the 19th century. It glimpses the mystery surrounding imaginary numbers in the 17th century and views some major developments of the 20th century. This book consists of nine chapters. Chapter 1 is devoted to algebraic preliminaries. Chapter 2 deals with some of the basic definition and results concerning topological groups, topological linear spaces and topological algebras. Chapter 3 considered some generalizations of the norm. Chapter 4 is concerned with a generalization of the notion of convexity called p-convexity. In Chapter 5 some differential and integral analysis involving vector valued functions is developed. Chapter 6 is concerned with spectral analysis and applications. The Gelfand representation theory is the subject-matter of Chapter 7. Chapter 8 deals with commutative topological algebras. Finally in Chapter 9 an exposition of the norm uniqueness theorems of Gelfand and Johnson (extended to p-Banach algebras) is given. The Fifth International Conference on Topological Algebras and Applications was held in Athens, Greece, from June 27th

to July 1st of 2005. The main topic of the Conference was general theory of topological algebras and its various applications, with emphasis on the ''non-normed'' case. in addition to the study of the internal structure of non-normed, and even non-locally convex topological algebras, there are applications to other branches of mathematics, such as differential geometry of smooth manifolds, and mathematical physics, such as quantum relativity and quantum cosmology. Operator theory of unbounded operators and related non-normed topological algebras are intensively studied here. Other topics presented in this volume are topological homological algebra, topological algebraic geometry, sheaf theory and K-theory. The text begins by giving the basic theory of Banach spaces, in particular discussing dual spaces and bounded linear operators. It establishes forms of the theorems that are the pillars of functional analysis, including the Banach-Alaoglu, Hahn-Banach, uniform boundedness, open mapping, and closed graph theorems. There are applications to Fourier series and to operators on Hilbert spaces. -- In this book, ultrametric Banach algebras are studied with the help of topological considerations, properties from affinoid algebras, and circular filters which characterize absolute values on polynomials and make a nice tree structure. The Shilov boundary does exist for normed ultrametric algebras. In uniform Banach algebras, the spectral norm is equal to the supremum of all continuous multiplicative seminorms whose kernel is a maximal ideal. Two different such seminorms can have the same kernel. KrasnerOCoTate algebras are characterized among Krasner algebras, affinoid algebras, and ultrametric Banach algebras. Given a KrasnerOCoTate algbebra A = K { t }[x], the absolute values extending the Gauss norm from K { t } to A are defined by the elements of the Shilov boundary of A . Contents: Tree Structure; Ultrametric Absolute Values; Hensel Lemma; Circular Filters; Analytic Elements; Holomorphic Properties on Infraconnected Sets; Analytic Elements on Classic Partitions; Holomorphic Functional Calculus; Definition of Affinoid Algebras; Jacobson Radical of Affinoid Algebras; Separable Fields; KrasnerOCoTate Algebras; Universal Generators in Tate Algebras; Associated Idempotents; and other topics. Readership: Graduate students and researchers in ultrametric functional analysis, number theory and dynamical systems." In this book we give a complete geometric description of state spaces of operator algebras, Jordan as well as associative. That is, we give axiomatic characterizations of those convex sets that are state spaces of C*-algebras and von Neumann algebras, together with such characterizations for the normed Jordan algebras called JB-algebras and JBW-algebras. These non associative algebras generalize C*-algebras and von Neumann algebras re spectively, and the characterization of their state spaces is not only of interest in itself, but is also an important intermediate step towards the characterization of the state spaces of the associative algebras. This book gives a complete and updated presentation of the character ization theorems of [10]' [11] and [71]. Our previous book State spaces of operator algebras: basic theory, orientations and C*-products, referenced as [AS] in the sequel, gives an account of the necessary prerequisites on C*-algebras and von Neumann algebras, as well as a discussion of the key notion of orientations of state spaces. For the convenience of the reader, we have summarized these prerequisites in an appendix which contains all relevant definitions and results (listed as (AI), (A2), ...), with reference back to [AS] for proofs, so that this book is self-contained. This first systematic account of the basic theory of normed algebras, without assuming associativity, includes many new and unpublished results and is sure to become a central resource for researchers and graduate students in the field. This first volume focuses on the non-associative generalizations of (associative) C*-algebras provided by the so-called non-associative Gelfand-Naimark and Vidav-Palmer theorems, which give rise to alternative C*-algebras and non-commutative JB*-algebras, respectively. The relationship between non-commutative JB*-algebras and JB*-triples is also fully discussed. The second volume covers Zel'manov's celebrated work in Jordan theory to derive classification theorems for non-commutative JB*-algebras and JB*-triples, as well as other topics. The book interweaves pure algebra, geometry of normed spaces, and complex analysis, and includes a wealth of historical comments, background material, examples and exercises. The authors also provide an extensive bibliography. This is the first volume of a two volume set that provides a modern account of basic Banach algebra theory including all known results on general Banach *-algebras. This account emphasises the role of *-algebra structure and explores the algebraic results which underlie the theory of Banach algebras and *-algebras. This first volume is an independent, self-contained reference on Banach algebra theory. Each topic is treated in the

maximum interesting generality within the framework of some class complex algebras rather than topological algebras. In both volumes proofs are presented in complete detail at a level accessible to graduate students. In addition, the books contain a wealth of historical comments, background material, examples, particularly in noncommutative harmonic analysis, and an extensive bibliography. Together these books will become the standard reference for the general theory of *-algebras. In an elegant and concise fashion, this book presents the concepts of functional analysis required by students of mathematics and physics. It begins with the basics of normed linear spaces and quickly proceeds to concentrate on Hilbert spaces, specifically the spectral theorem for bounded as well as unbounded operators in separable Hilbert spaces. While the first two chapters are devoted to basic propositions concerning normed vector spaces and Hilbert spaces, the third chapter treats advanced topics which are perhaps not standard in a first course on functional analysis. It begins with the Gelfand theory of commutative Banach algebras, and proceeds to the Gelfand-Naimark theorem on commutative C*-algebras. A discussion of representations of C*-algebras follows, and the final section of this chapter is devoted to the Hahn-Hellinger classification of separable representations of commutative C*-algebras. After this detour into operator algebras, the fourth chapter reverts to more standard operator theory in Hilbert space, dwelling on topics such as the spectral theorem for normal operators, the polar decomposition theorem, and the Fredholm theory for compact operators. A brief introduction to the theory of unbounded operators on Hilbert space is given in the fifth and final chapter. There is a voluminous appendix whose purpose is to fill in possible gaps in the reader's background in various areas such as linear algebra, topology, set theory and measure theory. The book is interspersed with many exercises, and hints are provided for the solutions to the more challenging of these. This book presents functional analysis over arbitrary valued fields and investigates normed spaces and algebras over fields with valuation, with attention given to the case when the norm and the valuation are nonarchimedean. It considers vector spaces over fields with nonarchimedean valuation. book and to the publisher NOORDHOFF who made possible the appearance of the second edition and enabled the author to introduce the above-mentioned modifi cations and additions. Moscow M. A. NAIMARK August 1963 FOREWORD TO THE SECOND SOVIET EDITION In this second edition the initial text has been worked over again and improved, certain portions have been completely rewritten; in particular, Chapter VIII has been rewritten in a more accessible form. The changes and extensions made by the author in the Japanese, German, first and second (= first revised) American, and also in the Romanian (lithographed) editions, were hereby taken into account. Appendices II and III, which are necessary for understanding Chapter VIII, have been included for the convenience of the reader. The book discusses many new theoretical results which have been developing in tensively during the decade after the publication of the first edition. Of course, lim itations on the volume of the book obliged the author to make a tough selection and in many cases to limit himself to simply a formulation of the new results or to pointing out the literature. The author was also compelled to make a choice of the exceptionally extensive collection of new works in extending the literature list. Monographs and survey articles on special topics of the theory which have been published during the past decade have been included in this list and in the litera ture pointed out in the individual chapters. This volume is addressed to those who wish to apply the methods and results of the theory of topological algebras to a variety of disciplines, even though confronted by particular or less general forms. It may also be of interest to those who wish, from an entirely theoretical point of view, to see how far one can go beyond the classical framework of Banach algebras while still retaining substantial results. The need for such an extension of the standard theory of normed algebras has been apparent since the early days of the theory of topological algebras, most notably the locally convex ones. It is worth noticing that the previous demand was due not only to theoretical reasons, but also to potential concrete applications of the new discipline. Algebraic K-theory is a modern branch of algebra which has many important applications in fundamental areas of mathematics connected with algebra, topology, algebraic geometry, functional analysis and algebraic number theory. Methods of algebraic K-theory are actively used in algebra and related fields, achieving interesting results. This book presents the elements of algebraic K-theory, based essentially on the fundamental works of Milnor, Swan, Bass, Quillen, Karoubi, Gersten, Loday and Waldhausen. It includes all principal algebraic K-theories, connections with topological K-theory

and cyclic homology, applications to the theory of monoid and polynomial algebras and in the theory of normed algebras. This volume will be of interest to graduate students and research mathematicians who want to learn more about K-theory. The first systematic account of the basic theory of normed algebras, without assuming associativity. Sure to become a central resource. This book serves as an introduction to calculus on normed vector spaces at a higher undergraduate or beginning graduate level. The prerequisites include basic calculus and linear algebra, as well as a certain mathematical maturity. All the important topology and functional analysis topics are introduced where necessary. In its attempt to show how calculus on normed vector spaces extends the basic calculus of functions of several variables, this book is one of the few textbooks to bridge the gap between the available elementary texts and high level texts. The inclusion of many non-trivial applications of the theory and interesting exercises provides motivation for the reader. This book familiarizes both popular and fundamental notions and techniques from the theory of non-normed topological algebras with involution, demonstrating with examples and basic results the necessity of this perspective. The main body of the book is focussed on the Hilbert-space (bounded) representation theory of topological *-algebras and their topological tensor products, since in our physical world, apart from the majority of the existing unbounded operators, we often meet operators that are forced to be bounded, like in the case of symmetric *-algebras. So, one gets an account of how things behave, when the mathematical structures are far from being algebras endowed with a complete or non-complete algebra norm. In problems related with mathematical physics, such instances are, indeed, quite common. Key features: - Lucid presentation - Smooth in reading - Informative - Illustrated by examples - Familiarizes the reader with the non-normed *-world - Encourages the hesitant - Welcomes new comers. - Well written and lucid presentation. - Informative and illustrated by examples. - Familiarizes the reader with the non-normed *-world. The present book is not intended as a first approach to the matter. This book treats: - spectral theory of Banach *-algebras, - basic representation theory of normed *-algebras, - spectral theory of representations of commutative *-algebras. A feature of the book is the construction of the enveloping C*-algebra of a general normed *-algebra. Stripped of the usual assumptions of presence of an approximate identity, completeness, and continuity of the involution. The 8th edition sports a new part on - representations on separable Hilbert spaces and slightly beyond. This self-contained monograph presents an overview of fuzzy operator theory in mathematical analysis. Concepts, principles, methods, techniques, and applications of fuzzy operator theory are unified in this book to provide an introduction to graduate students and researchers in mathematics, applied sciences, physics, engineering, optimization, and operations research. New approaches to fuzzy operator theory and fixed point theory with applications to fuzzy metric spaces, fuzzy normed spaces, partially ordered fuzzy metric spaces, fuzzy normed algebras, and non-Archimedean fuzzy metric spaces are presented. Surveys are provided on: Basic theory of fuzzy metric and normed spaces and its topology, fuzzy normed and Banach spaces, linear operators, fundamental theorems (open mapping and closed graph), applications of contractions and fixed point theory, approximation theory and best proximity theory, fuzzy metric type space, topology and applications. This book constitutes a first- or second-year graduate course in operator theory. It is a field that has great importance for other areas of mathematics and physics, such as algebraic topology, differential geometry, and quantum mechanics. It assumes a basic knowledge in functional analysis but no prior acquaintance with operator theory is required. In the early 1960s, by using techniques from the model theory of first-order logic, Robinson gave a rigorous formulation and extension of Leibniz' infinitesimal calculus. Since then, the methodology has found applications in a wide spectrum of areas in mathematics, with particular success in the probability theory and functional analysis. In the latter, fruitful results were produced with Luxemburg's invention of the nonstandard hull construction. However, there is still no publication of a coherent and self-contained treatment of functional analysis using methods from nonstandard analysis. This publication aims to fill this gap. Banach algebras is a multilayered area in mathematics with many ramifications. With a diverse coverage of different schools working on the subject, this proceedings volume reflects recent achievements in areas such as Banach algebras over groups, abstract harmonic analysis, group actions, amenability, topological homology, Arens irregularity, C*-algebras and dynamical systems, operator theory, operator spaces, and locally compact

quantum groups. This book gathers together selected contributions presented at the 3rd Moroccan Andalusian Meeting on Algebras and their Applications, held in Chefchaouen, Morocco, April 12-14, 2018, and which reflects the mathematical collaboration between south European and north African countries, mainly France, Spain, Morocco, Tunisia and Senegal. The book is divided in three parts and features contributions from the following fields: algebraic and analytic methods in associative and non-associative structures; homological and categorical methods in algebra; and history of mathematics. Covering topics such as rings and algebras, representation theory, number theory, operator algebras, category theory, group theory and information theory, it opens up new avenues of study for graduate students and young researchers. The findings presented also appeal to anyone interested in the fields of algebra and mathematical analysis. This invaluable reference is the first to present the general theory of algebras of operators on a Hilbert space, and the modules over such algebras. The new theory of operator spaces is presented early on and the text assembles the basic concepts, theory and methodologies needed to equip a beginning researcher in this area. A major trend in modern mathematics, inspired largely by physics, is toward `noncommutative' or `quantized' phenomena. In functional analysis, this has appeared notably under the name of `operator spaces', which is a variant of Banach spaces which is particularly appropriate for solving problems concerning spaces or algebras of operators on Hilbert space arising in 'noncommutative mathematics'. The category of operator spaces includes operator algebras, selfadjoint (that is, C*-algebras) or otherwise. Also, most of the important modules over operator algebras are operator spaces. A common treatment of the subjects of C*-algebras, Non-selfadjoint operator algebras, and modules over such algebras (such as Hilbert C*-modules), together under the umbrella of operator space theory, is the main topic of the book. A general theory of operator algebras, and their modules, naturally develops out of the operator space methodology. Indeed, operator space theory is a sensitive enough medium to reflect accurately many important non-commutative phenomena. Using recent advances in the field, the book shows how the underlying operator space structure captures, very precisely, the profound relations between the algebraic and the functional analytic structures involved. The rich interplay between spectral theory, operator theory, C*-algebra and von Neumann algebra techniques, and the influx of important ideas from related disciplines, such as pure algebra, Banach space theory, Banach algebras, and abstract function theory is highlighted. Each chapter ends with a lengthy section of notes containing a wealth of additional information. This first systematic account of the basic theory of normed algebras, without assuming associativity, includes many new and unpublished results and is sure to become a central resource for researchers and graduate students in the field. This second volume revisits JB*-triples, covers Zel'manov's celebrated work in Jordan theory, proves the unit-free variant of the Vidav–Palmer theorem, and develops the representation theory of alternative C*-algebras and non-commutative JB*-algebras. This completes the work begun in the first volume, which introduced these algebras and discussed the so-called non-associative Gelfand–Naimark and Vidav–Palmer theorems. This book interweaves pure algebra, geometry of normed spaces, and infinite-dimensional complex analysis. Novel proofs are presented in complete detail at a level accessible to graduate students. The book contains a wealth of historical comments, background material, examples, and an extensive bibliography. This book offers a review of the theory of locally convex quasi *-algebras, authored by two of its contributors over the last 25 years. Quasi *-algebras are partial algebraic structures that are motivated by certain applications in Mathematical Physics. They arise in a natural way by completing a *-algebra under a locally convex *-algebra topology, with respect to which the multiplication is separately continuous. Among other things, the book presents an unbounded representation theory of quasi *-algebras, together with an analysis of normed quasi *-algebras, their spectral theory and a study of the structure of locally convex quasi *-algebras. Special attention is given to the case where the locally convex quasi *-algebra is obtained by completing a C*-algebra under a locally convex *-algebra topology, coarser than the C*-topology. Introducing the subject to graduate students and researchers wishing to build on their knowledge of the usual theory of Banach and/or locally convex algebras, this approach is supported by basic results and a wide variety of examples. book and to the publisher NOORDHOFF who made possible the appearance of the second edition and enabled the author to introduce the above-mentioned modifi cations and additions. Moscow M. A. NAIMARK August 1963 FOREWORD TO THE SECOND

SOVIET EDITION In this second edition the initial text has been worked over again and improved, certain portions have been completely rewritten; in particular, Chapter VIII has been rewritten in a more accessible form. The changes and extensions made by the author in the Japanese, German, first and second (= first revised) American, and also in the Romanian (lithographed) editions, were hereby taken into account. Appendices II and III, which are necessary for understanding Chapter VIII, have been included for the convenience of the reader. The book discusses many new theoretical results which have been developing in tensively during the decade after the publication of the first edition. Of course, lim itations on the volume of the book obliged the author to make a tough selection and in many cases to limit himself to simply a formulation of the new results or to pointing out the literature. The author was also compelled to make a choice of the exceptionally extensive collection of new works in extending the literature list. Monographs and survey articles on special topics of the theory which have been published during the past decade have been included in this list and in the litera ture pointed out in the individual chapters. Some of the most recent and significant results on homomorphisms and derivations in Banach algebras, quasi-Banach algebras, C*-algebras, C*-ternary algebras, non-Archimedean Banach algebras and multi-normed algebras are presented in this book. A brief introduction for functional equations and their stability is provided with historical remarks. Since the homomorphisms and derivations in Banach algebras are additive and R-linear or C-linear, the stability problems for additive functional equations and additive mappings are studied in detail. The latest results are discussed and examined in stability theory for new functional equations and functional inequalities in Banach algebras and C*-algebras, non-Archimedean Banach algebras, non-Archimedean C*-algebras, multi-Banach algebras and multi-C*-algebras. Graduate students with an understanding of operator theory, functional analysis, functional equations and analytic inequalities will find this book useful for furthering their understanding and discovering the latest results in mathematical analysis. Moreover, research mathematicians, physicists and engineers will benefit from the variety of old and new results, as well as theories and methods presented in this book.