Rings Modules And Linear Algebra Mathematics Series Book

There is no one best way for an undergraduate student to learn elementary algebra. Some kinds of presentations will please some learners and will disenchant others. This text presents elementary algebra organized accord ing to some principles of universal algebra. Many students find such a presentation of algebra appealing and easier to comprehend. The approach emphasizes the similarities and common concepts of the many algebraic structures. Such an approach to learning algebra must necessarily have its formal aspects, but we have tried in this presentation not to make abstraction a goal in itself. We have made great efforts to render the algebraic concepts intuitive and understandable. We have not hesitated to deviate from the form of the text when we feel it advisable for the learner. Often the presenta tions are concrete and may be regarded by some as out of fashion. How to present a particular topic is a subjective one dictated by the author's estima tion of what the student can best handle at this level. We do strive for consistent unifying terminology and notation. This means abandoning terms peculiar to one branch of algebra when there is available a more general term applicable to all of algebra. We hope that this text is readable by the student as well as the instructor. It is a goal of ours to free the instructor for more creative endeavors than reading the text to the students.

VI of Oregon lectures in 1962, Bass gave simplified proofs of a number of "Morita Theorems", incorporating ideas of Chase and Schanuel. One of the Morita theorems characterizes when there is an equivalence of categories mod-A R::! mod-B for two rings A and B. Morita's solution organizes ideas so efficiently that the classical Wedderburn-Artin theorem is a simple consequence, and moreover, a similarity class [AJ in the Brauer group Br(k) of Azumaya algebras over a commutative ring k consists of all algebras B such that the corresponding categories mod-A and mod-B consisting of k-linear morphisms are equivalent by a k-linear functor. (For fields, Br(k) consists of similarity classes of simple central algebras, and for arbitrary commutative k, this is subsumed under the Azumaya [51]1 and Auslander-Goldman [60J Brauer group.) Numerous other instances of a wedding of ring theory and category (albeit a shot gun wedding!) are contained in the text. Furthermore, in. my attempt to further simplify proofs, notably to eliminate the need for tensor products in Bass's exposition, I uncovered a vein of ideas and new theorems lying wholely within ring theory. This constitutes much of Chapter 4 -the Morita theorem is Theorem 4. 29-and the basis for it is a corre spondence theorem for projective modules (Theorem 4. 7) suggested by the Morita context. As a by-product, this provides foundation for a rather complete theory of simple Noetherian rings-but more about this in the introduction.

This new book can be read independently from the first volume and may be used for lecturing, seminar- and self-study, or for general reference. It focuses more on specific topics in order to introduce readers to a wealth of basic and useful ideas without the hindrance of heavy machinery or undue abstractions. User-friendly with its abundance of examples illustrating the theory at virtually every step, the volume contains a large number of carefully chosen exercises to provide newcomers with practice, while offering a rich additional source of information to experts. A direct approach is used in order to present the material in an efficient and economic way, thereby introducing readers to a considerable amount of interesting ring theory without being dragged through endless preparatory material.

This book is designed as a text for a first-year graduate algebra course. The choice of topics is guided by the underlying theme of modules as a basic unifying concept in mathematics. Beginning with standard topics in groups and ring theory, the authors then develop basic module theory, culminating in the fundamental structure theorem for finitely generated modules over a principal ideal domain. They then treat canonical form theory in linear algebra as an application of this fundamental theorem. Module theory is also used in investigating bilinear, sesquilinear, and quadratic forms. The authors develop some multilinear algebra (Hom and tensor product) and the theory of semisimple rings and modules and apply these results in the final chapter to study group represetations by viewing a representation of a group G over a field F as an F(G)-module. The book emphasizes proofs with a maximum of insight and a minimum of computation in order to promote understanding.

However, extensive material on computation (for example, computation of canonical forms) is provided.
An account of how a certain fundamental algebraic concept can be introduced, developed, and applied to solve some concrete algebraic problems.
The Weyr matrix canonical form is a largely unknown cousin of the Jordan canonical form. Discovered by Eduard Weyr in 1885, the Weyr form outperforms the Jordan form in a number of mathematical situations, yet it remains somewhat of a mystery, even to many who are skilled in linear algebra. Written in an engaging style, this book presents various advanced topics in linear algebra linked through the Weyr form. Kevin O'Meara, John Clark, and Charles Vinsonhaler develop the Weyr form from scratch and include an algorithm for computing it. A fascinating duality exists between the Weyr form and the Jordan form. Developing an understanding of both forms will allow students and researchers to exploit the mathematical capabilities of each in varying situations. Weaving together ideas and applications from various mathematical disciplines, Advanced Topics in Linear Algebra is much more than a derivation of the Weyr form. It presents novel applications of linear algebra, such as matrix commutativity problems, approximate simultaneous diagonalization, and algebraic geometry, with the latter two having topical connections to phylogenetic invariants in biomathematics and multivariate interpolation. Among the related mathematical disciplines from which the book draws ideas are commutative and noncommutative ring theory, module theory, field theory, topology, and algebraic

geometry. Numerous examples and current open problems are included, increasing the book's utility as a graduate text or as a reference for mathematicians and researchers in linear algebra.

Insightful overview of many kinds of algebraic structures that are ubiquitous in mathematics. For researchers at graduate level and beyond.

The theory of algebras, rings, and modules is one of the fundamental domains of modern mathematics. General algebra, more specifically non-commutative algebra, is poised for major advances in the twenty-first century (together with and in interaction with combinatorics), just as topology, analysis, and probability experienced in the twentieth century. This volume is a continuation and an in-depth study, stressing the non-commutative nature of the first two volumes of Algebras, Rings and Modules by M. Hazewinkel, N. Gubareni, and V. V. Kirichenko. It is largely independent of the other volumes. The relevant constructions and results from earlier volumes have been presented in this volume.

Through this book, upper undergraduate mathematics majors will master a challenging yet rewarding subject, and approach advanced studies in algebra, number theory and geometry with confidence. Groups, rings and fields are covered in depth with a strong emphasis on irreducible polynomials, a fresh approach to modules and linear algebra, a fresh take on Gröbner theory, and a group theoretic treatment of Rejewski's deciphering of the Enigma machine. It includes a detailed treatment of the basics on finite groups, including Sylow theory and the structure of finite abelian groups. Galois theory and its applications to polynomial equations and geometric constructions are treated in depth. Those interested in computations will appreciate the novel treatment of division algorithms. This rigorous text 'gets to the point', focusing on concisely demonstrating the concept at hand, taking a 'definitions first, examples next' approach. Exercises reinforce the main ideas of the text and encourage students' creativity. This textbook is designed for students with at least one solid semester of abstract algebra,some linear algebra background, and no previous knowledge of module theory. Modulesand the Structure of Rings details the use of modules over a ring as a means of consideringthe structure of the ring itself--explaining the mathematics and "inductivereasoning" used in working on ring theory challenges and emphasizing modules insteadof rings.Stressing the inductive aspect of mathematical research underlying the formal deductivestyle of the literature, this volume offers vital background on current methods for solvinghard classification problems of algebraic structures. Written in an informal butcompletely rigorous style, Modules and the Structure of Rings clarifies sophisticatedproofs ... avoids the formalism of category theory ... aids independent study or seminarwork ... and supplies end-of-chapter problems.This book serves as an excellent primary.text for upper-level undergraduate and graduatestudents in one-semester courses on ring or module theory-laying a foundation formore advanced study of homological algebra or module theory.

Rings, Modules and Linear AlgebraChapman and Hall/CRC

This volume, dedicated to Bruno J. Müller, a renowned algebraist, is a collection of papers that provide a snapshot of the diversity of themes and applications that interest algebraists today. The papers highlight the latest progress in ring and module research and present work done on the frontiers of the topics discussed. In addition, selected expository articles are included to give algebraists and other mathematicians, including graduate students, an accessible introduction to areas that may be outside their own expertise.

Linear algebra is one of the most widely used mathematical

theories around, and has applications in virtually every area of mathematics, including multivariate calculus, differential equations, and probability theory. The purpose of this book is to bridge the gap between the abstract theoretical aspects and the computational applications of linear algebra. The aim of this book is two-fold: to introduce the fundamental concepts of linear algebra and to apply the theorems in computation-oriented applications. Features: - Covers theory and applications emphasizing topics useful in other disciplines - Presents a brief introduction of some aspects of abstract algebra that relate directly to linear algebra, such as groups, rings, modules, fields and polynomials over fields.
This volume consists of refereed research and expository articles by both plenary and other speakers at the International Conference on Algebra and Applications held at Ohio University in June 2008, to honor S.K. Jain on his 70th birthday. The articles are on a wide variety of areas in classical ring theory and module theory, such as rings satisfying polynomial identities, rings of quotients, group rings, homological algebra, injectivity and its generalizations, etc. Included are also applications of ring theory to problems in coding theory and in linear algebra.
About the book... In honor of Edgar Enochs and his venerable contributions to a broad range of topics in Algebra, top researchers from around the world gathered at Auburn University to report on their latest work and exchange ideas on some of today's foremost research topics. This carefully edited volume presents the refereed papers of the participants of these talks along with contributions from other veteran researchers who were unable to attend. These papers reflect many of the current topics in Abelian Groups, Commutative Algebra, Commutative Rings, Group Theory, Homological Algebra, Lie Algebras, and Module Theory. Accessible even to beginning mathematicians, many of these

articles suggest problems and programs for future study. This volume is an outstanding addition to the literature and a valuable handbook for beginning as well as seasoned researchers in Algebra. about the editors... H. PAT GOETERS completed his undergraduate studies in mathematics and computer science at Southern Connecticut State University and received his Ph.D. in 1984 from the University of Connecticut under the supervision of William J. Wickless. After spending one year in a post-doctoral position in Wesleyan University under the tutelage of James D. Reid, Goeters was invited for a tenure track position in Auburn University by Ulrich F. Albrecht. Soon afterwards, William Ullery and Overtoun Jenda were hired, and so began a lively Algebra group. OVERTOUN M. G. JENDA received his bachelor's degree in Mathematics from Chancellor College, the University of Malawi. He moved to the U.S. 1977 to pursue graduate studies at University of Kentucky, earning his Ph.D. in 1981 under the supervision of Professor Edgar Enochs. He then returned to Chancellor College, where he was a lecturer (assistant professor) for three years. He moved to the University of Botswana for another three-year stint as a lecturer before moving back to the University of Kentucky as a visiting assistant professor in 1987. In 1988, he joined the Algebra research group at Auburn University.

Relations between groups and sets, results and methods of abstract algebra in terms of number theory and geometry, and noncommutative and homological algebra. Solutions. 2006 edition.

"This book is designed as a text for the first year of graduate algebra, but it can also serve as a reference since it contains more advanced topics as well. This second edition has a different organization than the first. It begins with a discussion of the cubic and quartic equations, which leads into permutations, group theory, and Galois theory (for finite extensions; infinite Galois theory is discussed later in the book). The study of groups continues with finite abelian groups (finitely generated groups are discussed later, in the context of module theory), Sylow theorems, simplicity of projective unimodular groups, free groups and presentations, and the Nielsen-Schreier theorem (subgroups of free groups are free). The study of commutative rings continues with prime and maximal ideals, unique factorization, noetherian rings, Zorn's lemma and applications, varieties, and Gr'obner bases. Next, noncommutative rings and modules are discussed, treating tensor product, projective, injective, and flat modules, categories, functors, and natural transformations, categorical constructions (including direct and inverse limits), and adjoint functors. Then follow group representations: Wedderburn-Artin theorems, character theory, theorems of Burnside and Frobenius, division rings, Brauer groups, and abelian categories. Advanced linear algebra treats canonical forms for matrices and the structure of modules over PIDs, followed by multilinear algebra. Homology is introduced, first for simplicial complexes, then as derived functors, with applications to Ext, Tor, and cohomology of groups, crossed products, and an introduction to algebraic K-theory. Finally, the author treats localization, Dedekind rings and algebraic number theory, and homological dimensions. The book ends with the proof that regular local rings have unique factorization."--Publisher's description.

This volume provides a comprehensive introduction to module theory and the related part of ring theory, including original results as well as the most recent work. It is a useful and stimulating study for those new to the subject as well as for researchers and serves as a reference volume. Starting form a basic understanding of linear algebra, the theory is presented and accompanied by complete proofs. For a module M, the smallest Grothendieck category containing it is denoted by o[M] and module theory is developed in this category. Developing the techniques in o[M] is no more complicated than in full module categories and the higher generality yields significant advantages: for example, module theory may be developed for rings without units and also for non-associative rings. Numerous exercises are included in this volume to give further insight into the topics covered and to draw attention to related results in the literature.

Each undergraduate course of algebra begins with basic notions and results concerning groups, rings, modules and linear algebra. That is, it begins with simple notions and simple results. Our intention was to provide a collection of exercises which cover only the easy part of ring theory, what we have named the "Basics of Ring Theory". This seems to be the part each student or beginner in ring theory (or even algebra) should know - but surely trying to solve as many of these exercises as possible independently. As difficult (or impossible) as this may seem, we have made every effort to avoid modules, lattices and field extensions in this collection and to remain in the ring area as much as possible. A brief look at the bibliography obviously shows that we don't claim much originality (one could name this the folklore of ring theory) for the statements of the exercises we have chosen (but this was a difficult task: indeed, the 28 titles contain approximatively 15.000 problems and our collection contains only 346). The real value of our book is the part which contains all the solutions of these exercises. We have tried to draw up these solutions as detailed as possible, so that each beginner can progress without skilled help. The book is divided in two parts each consisting of seventeen chapters, the first part containing the exercises and the second part the solutions.

Ideal for graduate students and researchers, this book presents a unified treatment of the central notions of integral closure.

This is a comprehensive review of commutative algebra, from localization and primary decomposition through dimension theory, homological methods, free resolutions and duality, emphasizing the origins of the ideas and their connections with other parts of mathematics. The book gives a concise treatment of Grobner basis theory and the constructive methods in commutative algebra and algebraic geometry that flow from it. Many exercises included.

The "extensions" of rings and modules have yet to be explored in detail in a research monograph. This book presents state of the art research and also stimulating new and further research. Broken into three parts, Part I begins with basic notions, terminology, definitions and a description of the classes of rings and modules. Part II considers the transference of conditions between a base ring or module and its extensions. And Part III utilizes the concept of a minimal essental extension with respect to a specific class (a hull). Mathematical interdisciplinary applications appear throughout. Major applications of the ring and module theory to Functional Analysis, especially C*-algebras, appear in Part III, make this book of interest to Algebra and Functional Analysis researchers. Notes and exercises at the end of every chapter, and open problems at the end of all three parts, lend this as an ideal textbook for graduate or advanced undergradate students.

This monograph arose from lectures at the University of Oklahoma on topics related to linear algebra over commutative rings. It provides an introduction of matrix theory over commutative rings. The monograph discusses the structure theory of a projective module. This textbook provides a self-contained course on the basic properties of modules and their importance in the theory of linear algebra. The first 11 chapters introduce the central results and applications of the theory of modules. Subsequent chapters deal with advanced linear algebra, including multilinear and tensor algebra, and explore such topics as the exterior product approach to the determinants of matrices, a module-theoretic approach to the structure of finitely generated Abelian groups, canonical forms, and normal transformations. Suitable for undergraduate courses, the text now includes a proof of the celebrated Wedderburn-Artin theorem which determines the structure of simple Artinian rings.

This book is an introduction to module theory for the reader who knows something about linear algebra and ring theory. Its main aim is the derivation of the structure theory of modules over Euclidean domains. This theory is applied to obtain the structure of abelian groups and the rational canonical and Jordan normal forms of matrices. The basic facts about rings and modules are given in full generality, so that some further topics can be discussed, including projective modules and the connection between modules and representations of groups. The book is intended to serve as supplementary reading for the third or fourth year undergraduate who is taking a course in module theory. The further topics point the way to some projects that might be attempted in conjunction with a taught course. Contents:Rings and IdealsEuclidean DomainsModules and

SubmodulesHomomorphismsFree ModulesQuotient Modules and Cyclic ModulesDirect Sums of ModulesTorsion and the Primary DecompositionPresentationsDiagonalizing and Inverting MatricesFitting IdealsThe Decomposition of ModulesNormal Forms for MatricesProjective Modules Readership: Final year undergraduates and new graduate students in pure mathematics. Keywords:Module;Commutative Ring;Euclidean Domain;Fitting Ideal;Matrix Diagonalization;Invariant Factor;Elementary Divisor;Rational Canonical Form;Jordan Normal Form

A first-year graduate text or reference for advanced undergraduates on noncommutative aspects of rings and modules.

This book is an introduction to the theory of rings and modules that goes beyond what one normally obtains in a graduate course in abstract algebra. In addition to the presentation of standard topics in ring and module theory, it also covers category theory, homological algebra and even more specialized topics like injective envelopes and projective covers, reflexive modules and quasi-Frobenius rings, and graded rings and modules. The book is a self-contained volume written in a very systematic style: all proofs are clear and easy for the reader to understand and all arguments are based on materials contained in the book. A problem sets follow each section. It is suitable for graduate and PhD students who have chosen ring theory for their research subject.

This is a concise 2000 introduction at graduate level to

ring theory, module theory and number theory.
This book provides a complete abstract algebra course, enabling instructors to select the topics for use in individual classes.
This text develops linear algebra with the view that it is an important gateway connecting elementary mathematics to more advanced subjects, such as advanced calculus, systems of differential equations, differential geometry, and group representations. The purpose of this book is to provide a treatment of this subject in sufficient depth to prepare the reader to tackle such further material. The text starts with vector spaces, over the sets of real and complex numbers, and linear transformations between such vector spaces. Later on, this setting is extended to general fields. The reader will be in a position to appreciate the early material on this more general level with minimal effort. Notable features of the text include a treatment of determinants, which is cleaner than one often sees, and a high degree of contact with geometry and analysis, particularly in the chapter on linear algebra on inner product spaces. In addition to studying linear algebra over general fields, the text has a chapter on linear algebra over rings. There is also a chapter on special structures, such as quaternions, Clifford algebras, and octonions.
This book is the second part of the new edition of Advanced Modern Algebra (the first part published

as Graduate Studies in Mathematics, Volume 165). Compared to the previous edition, the material has been significantly reorganized and many sections have been rewritten. The book presents many topics mentioned in the first part in greater depth and in more detail. The five chapters of the book are devoted to group theory, representation theory, homological algebra, categories, and commutative algebra, respectively. The book can be used as a text for a second abstract algebra graduate course, as a source of additional material to a first abstract algebra graduate course, or for self-study.