Vector Spaces And Matrices In Physics By M C Jain

H, as it is often said, mathematics is the queen of science then algebra is surely the jewel in her crown. In the course of its vast development over the last half-century, algebra has emerged as the subject in which one can observe pure mathe matical reasoning at its best. Its elegance is matched only by the ever-increasing number of its applications to an extraordinarily wide range of topics in areas other than 'pure' mathematics. Here our objective is to present, in the form of a series of five concise volumes, the fundamentals of the subject. Broadly speaking, we have covered in all the now traditional syllabus that is found in first and second year university courses, as well as some third year material. Further study would be at the level of 'honours options'. The reasoning that lies behind this modular presentation is simple, namely to allow the student (be he a mathematician or not) to read the subject in a way that is more appropriate to the length, content, and extent, of the various courses he has to take. Although we have taken great pains to include a wide selec tion of illustrative examples, we have not included any exer cises. For a suitable companion collection of worked examples, we would refer the reader to our series Algebra through practice (Cambridge University Press), the first five books of which are appropriate to the material covered here.

This book presents an elementary and concrete approach to linear algebra that is both useful and essential for the beginning student and teacher of mathematics. Here are the fundamental concepts of matrix algebra, first in an intuitive framework and then in a more formal manner. A Variety of interpretations and applications of the elements and operations considered are included. In particular, the use of matrices in the study of transformations of the plane is stressed. The purpose of this book is to familiarize the reader with the role of matrices in abstract algebraic systems, and to illustrate its effective use as a mathematical tool in geometry. The first two chapters cover the basic concepts of matrix algebra that are important in the study of physics, statistics, economics, engineering, and mathematics. Matrices are considered as elements of an algebra. The concept of a linear transformation of the plane and the use of matrices in discussing such transformations are illustrated in Chapter #. Some aspects of the algebra of transformations and its relation to the algebra of matrices are included here. The last chapter on eigenvalues and eigenvectors contains material usually not found in an introductory treatment of matrix algebra, including an application of the properties of eigenvalues and eigenvectors to the study of the conics. Considerable attention has been paid throughout to the formulation of precise definitions and statements of theorems. The proofs of most of the theorems are included in detail in this book. Matrices and Transformations assumes only that the reader has some understanding of the basic fundamentals of vector algebra. Pettofrezzo gives numerous illustrative examples, practical applications, and intuitive analogies. There are many instructive exercises with answers to the odd-numbered questions at the back. The exercises range from routine computations to proofs of theorems that extend the theory of the subject. Originally written for a series concerned with the mathematical training of teachers, and tested with hundreds of college students, this book can be used as a class or supplementary text for enrichments programs at the high school level, a one-semester college course, individual study, or for in-service programs.

The authors in this book introduce the notion of DSm Super Vector Space of Refined Labels. The notion of DSm semi super vector space is also introduced. Several interesting properties are derived. We have suggested over 100 problems, some of which are research problems.

The First Part Of This Book Begins With An Introduction To Matrices Through Linear Transformations On Vector Spaces, Followed By A Discussion On The Algebra Of Matrices, Special Matrices, Linear Equations, The Eigenvalue Problem, Bilinear And Quadratic Forms, Kronecker Sum And Product Of Matrices. Other Matrices Which Occur In Physics, Such As The Rotation Matrix, Pauli Spin Matrices And Dirac Matrices, Are Then Presented. A Brief Account Of Infinite Matrices From The Point Of View Of Matrix Formulation Of Quantum Mechanics Is Also Included. The Emphasis In This Part Is On Linear Dependence And Independence Of Vectors And Matrices, Linear Combinations, Independent Parameters Of Various Special Matrices And Such Other Concepts As Help The Student In Obtaining A Clear Understanding Of The Subject. A Simplified Proof Of The Theorem That A Common Set Of Eigenvectors Can Be Found For Two Commuting Matrices Is Given. The Second Part Deals With Cartesian And General Tensors. Many Physical Situations Are Discussed Which Require The Use Of Second And Higher Rank Tensors, Such As Effective Mass Tensor, Moment Of Inertia Tensor, Stress, Strain And Elastic Constants, Piezoelectric Strain Coefficient Tensor, Etc. Einsteins Summation Convention Is Explained In Detail And Common Errors Arising In Its Use Are Pointed Out. Rules For Checking The Correctness Of Tensor Equations Are Given. This Is Followed By Four-Vectors In Special Relativity And Covarient Formulation Of Electrodynamics. This Part Comes To An End With The Concept Of Parallel Displacement Of Vectors In Riemannian Space And Covariant Derivative Of Tensors, Leading To The Curvature Tensors And Its Properties.Appendix I Has Expanded And Two New Appendices Have Been Added In This Edition.

A Text in the Algebra of Vector Spaces and Matrices
Circuits, Matrices and Linear Vector Spaces
Matrices and Linear Algebra With GAP
Volume Two: Matrices and Vector Spaces
Further Linear Algebra

Undergraduate-level introduction to linear algebra and matrix theory. Explores matrices and linear systems, vector spaces, determinants, spectral decomposition, Jordan canonical form, much more. Over 375 problems. Selected answers. 1972 edition.

A fascinating exploration of the correlation between geometry and linear algebra, this text portrays the former as a subject better understood by the use and development of the latter rather than as an independent field. The treatment offers elementary explanations of the role of geometry in other branches of math and science — including physics, analysis, and group theory — as well as its value in understanding probability, determinant theory, and function spaces. Outstanding features of this volume include discussions of systematic geometric motivations in vector space theory and matrix theory; the use of the center of mass in geometry, with an introduction to barycentric coordinates; axiomatic development of determinants in a chapter dealing with area and volume; and a careful consideration of the particle problem. Students and other mathematically inclined readers will find that this inquiry into the interplay between geometry and other areas offers an enriched appreciation of both subjects.

Students receive the benefits of axiom-based mathematical reasoning as well as a grasp of concrete formulations. Suitable as a primary or supplementary text for college-level courses in linear algebra. 1957 edition.

Basic textbook covers theory of matrices and its applications to systems of linear equations and related topics such as determinants, eigenvalues, and differential equations. Includes numerous exercises.

Matrices and Vector Spaces
A Collection of Problems in Algebra with Solutions
Linear Algebra and Matrix Analysis for Statistics
Elementary Linear Algebra
A First Course on the Theory of Vector Spaces and Matrices

Linear algebra is one of the central disciplines in mathematics. A student of pure mathematics must know linear algebra if he is to continue with modern algebra or functional analysis. Much of the mathematics now taught to engineers and physicists requires it. This well-known and highly regarded text makes the subject accessible to undergraduates with little mathematical experience. Written mainly for students in physics, engineering, economics, and other fields outside mathematics, the book gives the theory of matrices and applications to systems of linear equations, as well as many related topics such as determinants, eigenvalues, and differential equations. Table of Contents: l. The Algebra of Matrices 2. Linear Equations 3. Vector Spaces 4. Determinants 5. Linear Transformations 6. Eigenvalues and Eigenvectors 7. Inner Product Spaces 8. Applications to Differential Equations For the second edition, the authors added several exercises in each chapter and a brand new section in Chapter 7. The exercises, which are both true-false and multiple-choice, will enable the student to test his grasp of the definitions and theorems in the chapter. The new section in Chapter 7 illustrates the geometric content of Sylvester's Theorem by means of conic sections and quadric surfaces. 6 line drawings. Index. Two prefaces. Answer section.

A textbook for a one-semester course in linear algebra for graduate or upper-level undergraduate students of mathematics and engineering. Employs a matrix perspective, and emphasizes training in definitions, theorems, and proofs. Annotation copyright Book News, Inc. Portland, Or.

Vector spaces, matrices, and tensors in physics form an essential part of the mathematical background required by physicists. This book is written primarily as textbook for undergraduate and postgraduate students and as a reference book for working physicists. Special emphasis is given to topics relevant to physics, for example linear independence and dependence of vectors, inner product, orthonormality, matrices as representations of linear transformations on vector spaces, similarity, eigenvalues, eigenvectors, diagonalization of matrices, expressing various physical quantities as tensors, tensorial formulation of vector algebra, calculus and geometry. The role of orthogonal, hermitian and unitary matrices in physics is highlighted.

Vectors and Matrices provides a progressive approach to vectors and matrices. The first half of this book is devoted to geometry, introducing matrices through its association with geometry mappings, while the rest of the chapters focus on the importance of matrices in non-geometric situations, such as the theory of linear equations and eigenvector theory. The power of eigenvector theory and its application to some problems in biology, probability, and genetics are also reviewed. Other topics include the product of scalar and vector, vector equation of a line, linear dependence, three-dimensional mappings, and orthogonal matrices. The transpose of a matrix and vector, rectangular matrices, inverse of a square matrix, and eigenvectors of a matrix are likewise emphasized in this text. This publication is beneficial to students and researchers conducting work on vectors and matrices.

Linear Algebra
Vector Spaces and Matrices
Groups, Matrices, and Vector Spaces
Matrix Methods and Vector Spaces in Physics
Algebra Through Practice: Volume 2, Matrices and Vector Spaces

The purpose of this book is to explain linear algebra clearly for beginners. In doing so, the author states and explains somewhat advanced topics such as Hermitian products and Jordan normal forms. Starting from the definition of matrices, it is made clear with examples that matrices ar operation are abstractions of tables and operations of tables. The author also maintains that systems of linear equations are the starting point of linear algebra, and linear algebra and linear equations are closely connected. The solutions to systems of linear equations are found by solvi equations in the row-reduction of matrices, equivalent to the Gauss elimination method of solving systems of linear equations. The row-reductions play important roles in calculation in this book. To calculate row-reductions of matrices, the matrices are arranged vertically, which is seldom convenient for calculation. Regular matrices and determinants of matrices are defined and explained. Furthermore, the resultants of polynomials are discussed as an application of determinants. Next, abstract vector spaces over a field K are defined. In the book, however, mainly vector considered over the real number field and the complex number field, in case readers are not familiar with abstract fields. Linear mappings and linear transformations of vector spaces and representation matrices of linear mappings are defined, and the characteristic polynomials and mini are explained. The diagonalizations of linear transformations and square matrices are discussed, and inner products are defined on vector spaces over the real number field. Real symmetric matrices are considered as well, with discussion of quadratic forms. Next, there are definitions c products. Hermitian transformations, unitary transformations, normal transformations and the spectral resolution of normal transformations and matrices are explained. The book ends with Jordan normal forms. It is shown that any transformations of vector spaces over the complex numl matrices of Jordan normal forms as representation matrices.

This book covers an undergraduate course on Matrix theory and Linear Algebra. It covers the following main topics: Matrix Algebra, Determinants, Rank of a Matrix, Linear Equations, Eigenvalues and Eigenvectors, Vector spaces, Linear transformations, Dual spaces, Annihilators, Matri representations of linear transformations, Inner product spaces, Orthogonality and Bilinear and quadratic forms. Application of GAP softwares in Matrices and Linear Algebra is also given. It is useful in several for several degree courses like BBA, BCA, BA-Maths, B.Sc/M.Sc-Maths. This helpful for several competitive exams like NET and GATE.

This book presents a concise, comprehensive introduction to the fundamentals of linear algebra. The authors develop the subject in a manner accessible to readers of varied backgrounds. The material requires only very basic algebra and a rudimentary knowledge of matrices and deter prerequisites, but the text includes an introductory chapter containing most of the foundational material required. Linear Algebra begins with the basic concepts of vector spaces, subspace, basis, and dimension. Although the authors emphasize finite dimensional vector spaces, they also of infinite dimensional vector spaces to highlight the differences between the two classes. The treatment then moves to the analysis of a single linear operator on a finite dimensional vector space, including discussions on characterizing diagonizable and triangulable operators. It uses th generalized eigenvectors to obtain an inductive procedure for constructing a Jordan basis for a triangulable linear operator and again uses an algorithmic approach to the rational canonical form. Subsequent discussions focus on finite dimensional inner product spaces and non-negative isometries, and polar and singular-value decomposition. The final chapter explores bilinear forms and extends the results of inner product spaces to bilinear spaces. Numerous examples and exercises at the end of each section make this an outstanding text for graduate and senior unde

This book is the last volume of a three-book series written for Sixth Form students and first-year undergraduates. It introduces the important concepts of finite-dimensional vector spaces through the careful study of Euclidean geometry. In turn, methods of linear algebra are then used in coordinate transformations through which a complete classification of conic sections and quadric surfaces is obtained. The book concludes with a detailed treatment of linear equations in n variables in the language of vectors and matrices. Illustrative examples are included in the main t exercises are given in each section. The other books in the series are Fundamental Concepts of Mathematics (published 1988) and Polynomials and Equations (published 1992).

Matrices and Tensors in Physics
Linear Algebra Problem Book
Introduction to Linear and Matrix Algebra
Introduction to Applied Linear Algebra
Linear Algebra and Matrix Theory

This introductory textbook grew out of several courses in linear algebra given over more than a decade and includes such helpful material as constructive discussions about the motivation of fundamental concepts, many worked-out problems in each chapter, and topics rarely covered in typical linear algebra textbooks.The authors use abstract notions and arguments to give the complete proof of the Jordan canonical form and, more generally, the rational canonical form of square matrices over fields. They also provide the notion of tensor products of vector spaces and linear transformations. Matrices are treated in depth, with coverage of the stability of matrix iterations, the eigenvalue properties of linear transformations in inner product spaces, singular value decomposition, and min-max characterizations of Hermitian matrices and nonnegative irreducible matrices. The authors show the many topics and tools encompassed by modern linear algebra to emphasize its relationship to other areas of mathematics. The text is intended for advanced undergraduate students. Beginning graduate students seeking an introduction to the subject will also find it of interest.

This unique text provides a geometric approach to group theory and linear algebra, bringing to light the interesting ways in which these subjects interact. Requiring few prerequisites beyond understanding the notion of a proof, the text aims to give students a strong foundation in both geometry and algebra. Starting with preliminaries (relations, elementary combinatorics, and induction), the book then proceeds to the core topics: the elements of the theory of groups and fields (Lagrange's Theorem, cosets, the complex numbers and the prime fields), matrix theory and matrix groups, determinants, vector spaces, linear mappings, eigentheory and diagonalization, Jordan decomposition and normal form, normal matrices, and quadratic forms. The final two chapters consist of a more intensive look at group theory, emphasizing orbit stabilizer methods, and an introduction to linear algebraic groups, which enriches the notion of a matrix group. Applications involving symm etry groups, determinants, linear coding theory and cryptography are interwoven throughout. Each section ends with ample practice problems assisting the reader to better understand the material. Some of the applications are illustrated in the chapter appendices. The author's unique melding of topics evolved from a two semester course that he taught at the University of British Columbia consisting of an undergraduate honors course on abstract linear algebra and a similar course on the theory of groups. The combined content from both makes this rare text ideal for a year-long course, covering more material than most linear algebra texts. It is also optimal for independent study and as a supplementary text for various professional applications. Advanced undergraduate or graduate students in mathematics, physics, computer science and engineering will find this book both useful and enjoyable.

Linear Algebra and Matrix Analysis for Statistics offers a gradual exposition to linear algebra without sacrificing the rigor of the subject. It presents both the vector space approach and the canonical forms in matrix theory. The book is as self-contained as possible, assuming no prior knowledge of linear algebra. The authors first address the rudimentary mechanics of linear systems using Gaussian elimination and the resulting decompositions. They introduce Euclidean vector spaces using less abstract concepts and make connections to systems of linear equations wherever possible. After illustrating the importance of the rank of a matrix, they discuss complementary subspaces, oblique projectors, orthogonality, orthogonal projections and projectors, and orthogonal reduction. The text then shows how the theoretical concepts developed are handy in analyzing solutions for linear systems. The authors also explain how determinants are useful for characterizing and deriving properties concerning matrices and linear systems. They then cover eigenvalues, eigenvectors, singular value decomposition, Jordan decomposition (including a proof), quadratic forms, and Kronecker and Hadamard products. The book concludes with accessible treatments of advanced topics, such as linear iterative systems, convergence of matrices, more general vector spaces, linear transformations, and Hilbert spaces.

One of the best available works on matrix theory in the context of modern algebra, this text bridges the gap between ordinary undergraduate studies and completely abstract mathematics. 1952 edition.

Vectors and Matrices
Vector Spaces and Matrices in Physics
Matrices and Transformations
Linear Algebra as an Introduction to Abstract Mathematics
A First Course on the Theory of Vector Spaces and Matrices, with Introductory Comments on the Theory of Groups and Other Mathematical Systems

A groundbreaking introduction to vectors, matrices, and least squares for engineering applications, offering a wealth of practical examples.

This is an introductory textbook designed for undergraduate mathematics majors with an emphasis on abstraction and in particular, the concept of proofs in the setting of linear algebra. Typically such a student would have taken calculus, though the only prerequisite is suitable mathematical grounding. The purpose of this book is to bridge the gap between the more conceptual and computational oriented undergraduate classes to the more abstract oriented classes. The book begins with systems of linear equations and complex numbers, then relates these to the abstract notion of linear maps on finite-dimensional vector spaces, and covers diagonalization, eigenspaces, determinants, and the Spectral Theorem. Each chapter concludes with both proof-writing and computational exercises.

Building upon the sequence of topics of the popular 5th Edition, Linear Algebra with Applications, Alternate Seventh Edition provides instructors with an alternative presentation of course material. In this edition earlier chapters cover systems of linear equations, matrices, and determinates. The vector space Rn is introduced in chapter 4, leading directly into general vector spaces and linear transformations. This order of topics is ideal for those preparing to use linear equations and matrices in their own fields. New exercises and modern, real-world applications allow students to test themselves on relevant key material and a MATLAB manual, included as an appendix, provides 29 sections of computational problems.

As a newly minted Ph.D., Paul Halmos came to the Institute for Advanced Study in 1938--even though he did not have a fellowship--to study among the many giants of mathematics who had recently joined the faculty. He eventually became John von Neumann's research assistant, and it was one of von Neumann's inspiring lectures that spurred Halmos to write Finite Dimensional Vector Spaces. The book brought him instant fame as an expositor of mathematics. Finite Dimensional Vector Spaces combines algebra and geometry to discuss the three-dimensional area where vectors can be plotted. The book broke ground as the first formal introduction to linear algebra, a branch of modern mathematics that studies vectors and vector spaces. The book continues to exert its influence sixty years after publication, as linear algebra is now widely used, not only in mathematics but also in the natural and social sciences, for studying such subjects as weather problems, traffic flow, electronic circuits, and population genetics. In 1983 Halmos received the coveted Steele Prize for exposition from the American Mathematical Society for "his many graduate texts in mathematics dealing with finite dimensional vector spaces, measure theory, ergodic theory, and Hilbert space."

Matrices and Linear Transformations
DSm Super Vector Space of Refined Labels
Form the Beginnings to the Jordan Normal Forms
Finite Dimensional Vector Spaces
A Group Theoretic Approach to Linear Algebra

Most of the introductory courses on linear algebra develop the basic theory of finite dimensional vector spaces, and in so doing relate the notion of a linear mapping to that of a matrix. Generally speaking, such courses culminate in the diagonalisation of certain matrices and the application of this process to various situations. Such is the case, for example, in our previous SUMS volume Basic Linear Algebra. The present text is a continuation of that volume, and has the objective of introducing the reader to more advanced properties of vector spaces and linear mappings, and consequently of matrices. For readers who are not familiar with the contents of Basic Linear Algebra we provide an introductory chapter that consists of a compact summary of the prerequisites for the present volume. In order to consolidate the student's understanding we have included a large num ber of illustrative and worked examples, as well as many exercises that are strategi cally placed throughout the text. Solutions to the exercises are also provided. Many applications of linear algebra require careful, and at times rather tedious, calculations by hand. Very often these are subject to error, so the assistance of a com puter is welcome. As far as computation in algebra is concerned, there are several packages available. Here we include, in the spirit of a tutorial, a chapter that gives 1 a brief introduction to the use of MAPLE in dealing with numerical and algebraic problems in linear algebra.

This textbook emphasizes the interplay between algebra and geometry to motivate the study of linear algebra. Matrices and linear transformations are presented as two sides of the same coin, with their connection motivating inquiry throughout the book. By focusing on this interface, the author offers a conceptual appreciation of the mathematics that is at the heart of further theory and applications. Those continuing to a second course in linear algebra will appreciate the companion volume Advanced Linear and Matrix Algebra. Starting with an introduction to vectors, matrices, and linear transformations, the book focuses on building a geometric intuition of what these tools represent. Linear systems offer a powerful application of the ideas seen so far, and lead onto the introduction of subspaces, linear independence, bases, and rank. Investigation then focuses on the algebraic properties of matrices that illuminate the geometry of the linear transformations that they represent. Determinants, eigenvalues, and eigenvectors all benefit from this geometric viewpoint. Throughout, "Extra Topic" sections augment the core content with a wide range of ideas and applications, from linear programming, to power iteration and linear recurrence relations. Exercises of all levels accompany each section, including many designed to be tackled using computer software. Introduction to Linear and Matrix Algebra is ideal for an introductory proof-based linear algebra course. The engaging color presentation and frequent marginal notes showcase the author's visual approach. Students are assumed to have completed one or two university-level mathematics courses, though calculus is not an explicit requirement. Instructors will appreciate the ample opportunities to choose *topics that align with the needs of each classroom, and the online homework sets that are available through WeBWorK.*

Linear Algebra Problem Book can be either the main course or the dessert for someone who needs linear algebraand today that means every user of mathematics. It can be used as the basis of either an official course or a program of private study. If used as a course, the book can stand by itself, or if so desired, it can be stirred in with a standard linear algebra course as the seasoning that provides the interest, the challenge, and the motivation that is needed by experienced scholars as much as by beginning students. The best way to learn is to do, and the purpose of this book is to get the reader to DO linear algebra. The approach is Socratic: first ask a question, then give a hint (if necessary), then, finally, for security and completeness, provide the detailed answer.

*Elementary Linear Algebra develops and explains in careful detail the computational techniques and fundamental theoretical results central to a first course in linear algebra. This highly acclaimed text focuses on developing the abstract thinking essential for further mathematical study The authors give early, intensive attention to the skills necessary to make students comfortable with mathematical proofs. The text builds a gradual and smooth transition from computational results to general theory of abstract vector spaces. It also provides flexbile coverage of practical applications, exploring a comprehensive range of topics. Ancillary list: * Maple Algorithmic testing- Maple TA- www.maplesoft.com Includes a wide variety of applications, technology tips and exercises, organized in chart format for easy reference More than 310 numbered examples in the text at least one for each new concept or application Exercise sets ordered by increasing difficulty, many with multiple parts for a total of more than 2135 questions Provides an early introduction to eigenvalues/eigenvectors A Student solutions manual, containing fully worked out solutions and instructors manual available*

Vectors, Matrices, and Least Squares

Vector Spaces, Matrices and Tensors in Physics

Matrices and Linear Algebra

Matrices and Vector SPates

Essential Student Algebra

Vector Spaces and Matrices in PhysicsCRC Press

This high-level text explains the mathematics behind basic circuit theory. It covers matrix algebra, the basic theory of n-dimensional spaces, and applications to linear systems. Numerous problems. 1963 edition.

Linear algebra is one of the most important subjects in the study of science and engineering because of its widespread applications in social or natural science, computer science, physics, or economics. As one of the most useful courses in undergraduate mathematics, it has provided essential tools for industrial scientists. The basic concepts of linear algebra are vector spaces, linear transformations, matrices and determinants, and they serve as an abstract language for stating ideas and solving problems. This book is based on the lectures delivered several years in a sophomore level linear algebra course designed for science and engineering students. The primary purpose of this book is to give a careful presentation of the basic concepts of linear algebra as a coherent part of mathematics, and to illustrate its power and usefulness through applications to other disciplines. We have tried to emphasize the computational skills along with the mathematical abstractions, which have also an integrity and beauty of their own. The book includes a variety of interesting applications with many examples not only to help students understand new concepts but also to practice wide applications of the subject to such areas as differential equations, statistics, geometry, and physics. Some of those applications may not be central to the mathematical development and may be omitted or selected in a syllabus at the discretion of the instructor.

Problem solving is an art that is central to understanding and ability in mathematics. With this series of books the authors have provided a selection of problems with complete solutions and test papers designed to be used with or instead of standard textbooks on algebra. For the convenience of the reader, a key explaining how the present books may be used in conjunction with some of the major textbooks is included. Each book of problems is divided into chapters that begin with some notes on notation and prerequisites. The majority of the material is aimed at the student of average ability but there are some more challenging problems. By working through the books, the student will gain a deeper understanding of the fundamental concepts involved, and practice in the formulation, and so solution, of other algebraic problems. Later books in the series cover material at a more advanced level than the earlier titles, although each is, within its own limits, self-contained.

A Vector Space Approach to Geometry

Matrices and vector spaces

Vectors, Matrices and Geometry

Linear Algebra and Matrices

This is an introduction to linear algebra. The main part of the book features row operations and everything is done in terms of the row reduced echelon form and specific algorithms. At the end, the more abstract notions of vector spaces and linear transformations on vector spaces are presented. However, this is intended to be a first course in linear algebra for students who are sophomores or juniors who have had a course in one variable calculus and a reasonable background in college algebra. I have given complete proofs of all the fundamental ideas, but some topics such as Markov matrices are not complete in this book but receive a plausible introduction. The book contains a complete treatment of determinants and a simple proof of the Cayley Hamilton theorem although these are optional topics. The Jordan form is presented as an appendix. I see this theorem as the beginning of more advanced topics in linear algebra and not really part of a beginning linear algebra course. There are extensions of many of the topics of this book in my on line book. I have also not emphasized that linear algebra can be carried out with any field although there is an optional section on this topic, most of the book being devoted to either the real numbers or the complex numbers. It seems to me this is a reasonable specialization for a first course in linear algebra.

The theory of vector spaces and matrices is an essential part of the mathematical background required by physicists. Most books on the subject, however, do not adequately meet the requirements of physics courses-they tend to be either highly mathematical or too elementary. Books that focus on mathematical theory may render the subject too dry to hold the interest of physics students, while books that are more elementary tend to neglect some topics that are vital in the development of physical theories. In particular, there is often very little discussion of vector spaces, and many books introduce matrices merely as a computational tool. Vector Spaces and Matrices in Physics fills the gap between the elementary and the heavily mathematical treatments of the subject with an approach and presentation ideal for graduate-level physics students. After building a foundation in vector spaces and matrix algebra, the author takes care to emphasize the role of matrices as representations of linear transformations on vector spaces, a concept of matrix theory that is essential for a proper understanding of quantum mechanics. He includes numerous solved and unsolved problems, and enough hints for the unsolved problems to make the book self-sufficient. Developed through many years of lecture notes, Vector Spaces and Matrices in Physics was written primarily as a graduate and post-graduate textbook and as a reference for physicists. Its clear presentation and concise but thorough coverage, however, make it useful for engineers, chemists, economists, and anyone who needs a background in matrices for application in other areas.

Linear Algebra with Applications, Alternate Edition