Algebra for Everyone

A Beautiful Book at an Affordable Price

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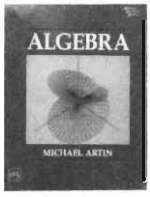

Algebra
M Artin
Prentice-Hall of India Private Limited,
New Delhi. 1994
pp. 618. Rs.150.

In primary school we learn how to perform the operations of addition and multiplication with natural (or counting) numbers. We then learn how to include the negative numbers to perform subtractions and fractions to perform divisions. Later in high school we learn to use variables *as if* these were numbers and perform operations on them. Soon after, we learn elementary operations on matrices and discover the possibility that multiplication may not be commutative (i.e., *AB need not be equal to BA*). The study of these basic entities and operations lies at the foundation of modern algebra.

The natural question that arises is: When can we extend the operations and work *as if* we are dealing with the familiar number system? A well-known warning in school is "do not divide by zero" — can one always divide by a non-zero entity or equivalently what can one divide by? Another pitfall is the one indicated above: that matrices do not commute. Modern algebra formalises the rules necessary to deal with operations that are *like* addition, subtraction, division and multiplication in such a manner as to avoid similar traps. A number of beautiful (and sometimes unexpected) applications to other areas result — since we can now recognise the familiar operations in a number of different disguises.

We have here not so much an algebraist's algebra book but one for a more general mathematical training.

A pure algebraist would thus be quite content to study the general *formal* theory with examples introduced only to show why some results cannot be stated in greater generality (—most algebraists are not so pure however!). The book under review has taken an approach almost opposite to this. All topics and definitions are introduced with examples to show how these work. In that sense we have here not so much an algebraist's algebra book but one for a more general mathematical training (which is not to say a budding algebraist will not benefit from reading it!). In fact one could go so far as to say that the material in this book is essential for any person wishing to use any kind of mathematics. A more detailed account of the material in this book follows.

The first four chapters deal with the elements of matrices, groups, vector spaces and linear transformations. Chapter 4 has some nice applications to systems of linear differential equations. Chapter 5 has beautiful discussions on symmetries of plane figures, groups of motions of the plane, discrete groups of motions,

abstract symmetry etc. It is unusual to find this kind of material presented so well in a book at this level. Chapter 6 continues with more group theory and ends with a section on the Todd-Coxeter Algorithm, again a topic not usually found in a book at this level. Chapter 7 deals with bilinear forms, hermitian forms, spectral theorem etc. An introduction to linear groups and group representations is attractively presented in Chapters 8 and 9. The notion of the Lie algebra of a linear group is discussed in Chapter 8. These two chapters can be used at the M.Sc. first year level to give an introductory course on Lie groups and group representations. Chapter 10, which is mainly a chapter on rings and ideals has a concluding section providing a nice motivation for the study of algebraic geometry. The chapter on factorization, Chapter 11, has a detailed discussion on the arithmetic of quadratic number fields, again a topic not normally found in an introductory text book. Chapter 12 is on modules leading to applications to the structure theorem for abelian groups and various canonical forms for linear operators. Chapters 13 and 14 provide an excellent introduction to field theory including Galois theory.

This book can be used as a text at the undergraduate as well as the M.Sc. levels. *A Note for the Teacher* included in the beginning of the book gives several useful suggestions for developing various courses based on it. There are plenty of excellent exercises, the more challenging ones being marked with an asterisk. It is fortunate that this book is now available to Indian students and teachers at an eminently affordable price. No personal collection of a research mathematician, student or teacher will be complete without it!

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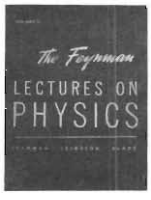
A Joyous Romp Through Basic Physics

The Work of a Magician of the Highest Calibre

V Balakrishnan



The Feynman Lectures on Physics, Vol. 1 & 2
R P Feynman, R B Leighton, M Sands
Addison-Wesley, Reading, Mass., 1963 and Narosa, New Delhi, 1987
pp.550 + 580 Rs.300

Some years ago, this reviewer began an additional preface to the Indian edition of the *Feynman Lectures on Physics (FLP)* with the words, "The Feynman Lectures on Physics rank among the classics of our times, and it borders on impertinence to attempt to write a preface to them". If a preface is impertinence, a review may be lèse-majesté!"But one must try", as Dirac is reported to have told Feynman in connection with the "search for a meson equation" analogous to that discovered by Dirac for the electron. And so: