

of functions such as divergence and curl in generalized coordinates. A final chapter points out ramifications of differential and integral theorems, as in irrotational and solenoidal fields, with fluid and electrical applications.

Many tensor concepts seem most easily taught with matrix notation instead of the summation convention used throughout this volume, but one can hardly object to use of the appropriate convention. I would like to have seen a closer tie to n -space, and regret the deletion of the author's preface. But such criticisms are minor in view of the book's excellence; it well complements Shilov's book.

* * *

The reviewer is professor of mechanical engineering at the University of Washington. His special interest is the mathematics of linear systems.

Spins and moments

MAGNETIC RESONANCE AND RELAXATION. Conf. proc. (Colloque Ampère, Ljubljana, Yugoslavia, Sept. 1966). R. Blinc, ed. 1241 pp. North-Holland, Amsterdam, 1967. \$50.00

by Thomas A. Scott

Perhaps it was the enticement of a setting in Yugoslavia, or perhaps it was that there had not been a similar conference for two years previously; more likely it was the excellent planning of the organizing committee that was responsible for making the XIVth Colloque Ampère a major international conference and the largest one ever devoted primarily to nuclear magnetic resonance. More than 200 papers were delivered in 27 sessions over a period of four and a half days. Now after a delay of a year and a half, the proceedings containing the texts of 197 of the papers have been published.

Conference proceedings in general suffer from several faults. Because of the inevitable and often lengthy time lapse before publication, many of the contributions will have been made at least partially obsolete by prior publication of the work in journals, usually in greater detail and frequently with added information not available at the time of the conference. Furthermore, some authors tend not to give the same attention to the writing of these contributions as they do to a refereed journal article.

The present book does an exceptional job of rising above these faults, although readers will still look to the journals for the final word. However, the percentage of high-quality papers presented at the conference was remarkably large and the quality has been retained in the written version. Especially valuable are the 31 invited papers, a number of which are reviews that will not be published in the same form elsewhere. As a composite the papers constitute a valuable collection, reflecting the current status of the field.

Practically every aspect of nuclear-magnetic and electric-quadrupole resonance research of interest to physicists was covered in at least one session. Dynamic polarization, double resonance, acoustic resonance, NMR in metals including superconductors, NMR and NQR in solids, relaxation theory and experiment, and new experimental techniques received especially strong emphasis. The Mössbauer effect, optical methods in rf spectroscopy, EPR and ESR, and dielectric relaxation studies were also represented in one or more sessions each. Despite the length of the book (1241 pages), some of the longer papers have been edited and condensed. Unlike previous proceedings of Colloque Ampère that were dominantly written in French, about 85 percent of the present book is in English.

The book is handsomely (and, alas, expensively) printed. There is no other single volume that better displays the immense versatility of magnetic resonance.

* * *

The reviewer is professor of physics at the University of Florida where he has been engaged in nuclear magnetic resonance and solid-state-physics research for a decade.

All the attributes of a good text

INTRODUCTION TO SPECIAL RELATIVITY. By Herman M. Schwartz. 458 pp. McGraw-Hill, New York, 1968. \$14.75

by Richard B. Zipin

An introduction to the special theory of relativity can easily become highly mathematical and perhaps boring to some physicists if the author is careless in his writing. Herman Schwartz of the University of Arkansas, the au-

thor of this new book in the well-known International Series in Pure and Applied Physics, does achieve a reasonable balance between the mathematics and the physics of his subject. The book should be well received by students of both disciplines.

Introduction to Special Relativity has all the attributes of a good textbook. The subject matter is not comprehensive, but carefully selected to reflect the author's preferences and his three purposes: to teach the special theory of relativity, to prepare the reader for a study of the general theory of relativity, and to give the student an adequate background in relativity theory to enable him to go on to subjects of current interest such as the theories of elementary particles and of plasmas. The book begins with a chapter on the basic ideas of classical mechanics, starting with Newton, followed by a chapter on the historical development of the special theory of relativity. After giving the reader an overall perspective of the subject with these preliminaries, the author is then free to discuss the various topics of interest in the order of their difficulty as this is the most logical order for a textbook from the pedagogical point of view. An exposition of Einstein's special theory of relativity follows the two preliminary chapters and this is succeeded by discussions of relativistic mechanics, tensor analysis, continuous media and the electromagnetic field. The final chapter treats relativistic quantum mechanics. The author's preferences and his ideas on what subjects are significant are obvious from the topics he concentrates on. The first four chapters require 130 pages, the next two 90 pages, and the final two chapters are each almost 100 pages in length.

The chapters are carefully divided into sections and all chapters include problems for the students. Answers to many of the problems are included, and the problems are used not only for the readers to test their own understanding of the subject, but also to extend the discussion in the text. The book includes thorough documentation in the footnoted references and in the selective bibliography. Supporting material, germane to particular chapters but not of absolute necessity, is taken up in appendices to half the chapters. Illustrations are used very sparingly but with good effect wherever they appear.

KINETICS OF REACTIONS IN IONIC SYSTEMS

VOLUME 4 OF MATERIALS SCIENCE RESEARCH*

Proceedings of the 1967 International Symposium of Special Topics in Ceramics

Edited by **T. J. Gray**, Director, Atlantic Industrial Research Institute, Nova Scotia Technical College, Halifax, Nova Scotia, and **V. D. Frechette**, SUNY College of Ceramics, Alfred University, Alfred, New York

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571 pages PP March 1969 \$27.50

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Edited by **Genrikh N. Abramovich**, Moscow Aviation Institute

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144 pages CB Special Research Report January 1969 \$22.50

TUNNELING PHENOMENA IN SOLIDS

Edited by **Elias Burstein** Department of Physics, University of Pennsylvania and **S. Lundqvist** Institute of Theoretical Physics, Goteborg, Sweden

Proceedings of the NATO Advanced Study Institute on Tunneling Phenomena in Solids, held 1967 in Riso, Denmark

Provides a complete study in concepts of tunneling phenomena, along with theoretical and experimental techniques for their investigation. It describes detailed aspects of electron tunneling in semiconductors, metals and superconductors, and atomic tunneling in solids. Will be valuable both as a graduate text in physics and as a special reference for materials scientists, electrical engineers, and metallurgists.

579 pages PP February 1969 \$35.00

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VOLUME I

PROCEEDINGS OF THE FIRST INTERNATIONAL SYMPOSIUM ON ACOUSTICAL HOLOGRAPHY, HELD 1967, AT DOUGLAS ADVANCED RESEARCH LABORATORIES, HUNTINGTON BEACH, CALIFORNIA

Edited by **A. F. Metherell**, Douglas Advanced Research Lab., McDonnell Douglas Corporation, Huntington Beach, California
H. M. S. El-Sum, El-Sum Consultants, Atherton, California
 and **Lewis Larmore**, Douglas Advanced Research Labs., McDonnell Douglas Corporation, Huntington Beach, California

The first of its kind in the field of acoustical holography, this book presents an up-to-date and complete account of the work done in holography utilizing sonic and ultrasonic frequencies. Written by the foremost investigators, the contributions consider the whole area of visualization, detection, and recording of sound fields as well as long wavelength, such as microwave, holography. This self-contained reference source for the entire field of holography will be invaluable to students, engineers, and scientists both at universities and in industry.

294 pages PP February 1969 \$15.00

LINEAR PIEZOELECTRIC PLATE VIBRATIONS:

ELEMENTS OF THE LINEAR THEORY OF PIEZOELECTRICITY AND THE VIBRATIONS OF PIEZOELECTRIC PLATES

By **H. F. Tiersten**, Bell Telephone Laboratories Inc., Murray Hill, New Jersey, and Department of Mechanics, Rensselaer Polytechnic Institute, Troy, New York

Essentially a series of lectures, this volume is concerned with the development of three-dimensional linear differential equations and boundary conditions, solutions of pertinent three-dimensional standing wave problems, approximation techniques, and applications to practical problems of the theory of piezoelectricity. This monograph will be valuable both as a nucleus for a graduate course or seminar in piezoelectric vibration theory and as a reference work for individuals familiar with the rudiments of elasticity and electromagnetism and seeking to do further research in this field.

Approx. 212 pages PP April 1969 \$15.00

MATHEMATICAL METHODS IN SOLID STATE AND SUPERFLUID THEORY

SCOTTISH UNIVERSITIES' SUMMER SCHOOL IN PHYSICS OF 1967

Edited by **R. C. Clark** and **G. H. Derrick**

Develops those mathematical methods which are proving most valuable in current research in solid state and superfluid theory. Covers variational principles, transformation theory, the microscopic description of superfluidity, transport theory, density, matrix methods, perturbation resummation methods, perturbation theory, exactly soluble models, phase transitions, particle-hole excitation, etc. This volume will be of interest to solid state, theoretical and fluid mechanical physicists, and applied mathematicians.

400 pages PP February 1969 \$29.50

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The text would be suitable for a course for advanced undergraduates if the chapters on the electromagnetic field and on quantum mechanics are not used, and the book also would be suitable for a graduate course if it is used in its entirety and is supplemented by the instructor. It can be well recommended as a textbook and would certainly be useful reading for graduate students and working physicists as a self-study introduction to special relativity.

* * *

The reviewer is responsible for the application of optics to advanced-dimensional measurement systems at the Automation and Measurement Division of The Bendix Corporation, Dayton, Ohio.

Handbook of radio-wave propagation

ENCYCLOPEDIA OF PHYSICS, Vol. 49/2, Geophysics III, Part II. S. Flügge, ed. 596 pp. Springer-Verlag, New York, 1967, \$42.00

by Jules Aarons

Predominately a monograph on radio observations of the ionosphere, this volume of the *Handbook of Physics* fulfills its title in part; it delves with great detail into the physics, the experimental equipment and the data of its subject matter. The 546 page section on "Radio Observations of the Ionosphere" is jointly written by K. Rawer of the Ionospheric Institute of Breisach, Germany and by K. Suchy, who wrote his section when he was at the University of Maryland. The second article in the volume (approximately 50 pages) by S. Matsushita of the National Center for Atmospheric Research and the University of Colorado is on "Lunar Tides in the Ionosphere."

To graduate students and beginning research workers in the field, "Radio Observations of the Ionosphere" is a second book; it must come after mastery of such volumes as Ratcliffe's *Physics of the Upper Atmosphere* or at a more elementary level, Davies's *Ionospheric Radio Propagation*. Suchy, who is listed as the principal author of the introductory theoretical section, has developed his subject matter very completely. The advanced student can utilize the text in theoretical studies. Rawer, who has ranged in his research from experi-

mental observations and instrumentation of rockets to synoptic studies of ionosoundings, describes in great detail both the theory of individual distinct experiments, the equipment used and the resulting data. At times the details wander into such items as the schematics of pulse-power generators and resulting wave forms at specified power lugs (with photos); at this stage the handbook nomenclature is carried too far. At other times, however, the detailing is important; rather than presenting an idealized freehand drawing, for example, the authors have shown particle precipitation as a function of latitude and particle energy.

From the viewpoint of those who use a handbook for often needed graphs, diagrams and tables, this volume does not satisfy. The material is not oriented for the nonspecialist.

For advanced students or those seeking details on a facet of radio-wave propagation, the volume is excellent. A listing of symbols, general references and an excellent index make up a well-edited volume. However, the English is faulty; it appears as if there were no editor to "monitor" the grammar. Many sentences are awkwardly formed ("A complete theory is not yet existing"), but this fault detracts only slightly from the erudition of the text.

The review by Matsushita is careful and succinct. The author, a leading expert in ionospheric current systems, has written an excellent review paper on lunar tides in the ionosphere.

* * *

The reviewer is a senior scientist in the Ionospheric Physics Laboratory of Air Force Cambridge Research Laboratories.

For relativists and cosmologists

RELATIVITY THEORY AND ASTROPHYSICS, PART 1: RELATIVITY AND COSMOLOGY. Conf. Proc. (Cornell, July-Aug. 1965) Jürgen Ehlers, ed. 289 pp. American Mathematical Society, Providence, R. I., 1967. \$9.40

by Wolfgang Rindler

In the summer of 1965 some 30 fortunate graduate students and recent PhD's met at Cornell for the Fourth Summer Seminar on Applied Mathematics, organized by the American Mathematical Society. Students and graduates were joined by a distin-

guished group of lecturers. The backgrounds of the participants were divided between relativity and astrophysics, and the intention was to exhibit and further stimulate the already considerable interaction between these two fields of research. The three-volume record of the formal lectures, actively and ably edited by Jürgen Ehlers (his excellent introduction makes it hard for a reviewer to be original), attests to the beautiful job that was done. We are concerned here with the first volume on relativity and cosmology; the other two deal with galactic and stellar structure respectively. These lectures will hardly serve as a substitute for a textbook, although Alfred Schild's ten-lecture introduction to modern general relativity (occupying over a third of the book) comes closest to doing so. On the whole, this volume could be regarded as a "sampler" of modern activity in relativity and cosmology, slanted toward astrophysics. It should be of great benefit to students who wish to pick up basic ideas quickly and authoritatively, often brilliantly presented and always well-referenced. Teachers, too, should be interested in these methods of presentation.

Schild discusses very clearly and with the aid of over 30 diagrams such important topics as Lie derivatives, Killing vectors, Fermi coordinates, Kruskal's extension of Schwarzschild space, the contributions of the various terms in the metric to the "crucial effects," the deduction of the field equations from a variational principle and the deduction of the law of motion from the field equations (with a particularly elegant application to spinning test particles—soon, perhaps, another "crucial" effect). Also covered are such prerequisites to the study of gravitational radiation as jump conditions and the Cauchy problem, the weak-field approximation, spinors and Petrov classification. I was baffled by only one minor item, namely the unusually strong formulation of the equivalence principle as relating whole world *tubes* (rather than just *cubes*) with similar objects in Minkowski space.

The book continues with two short lectures on new observational tests of general relativity. In the first lecture, Leonard Schiff discusses orbital gyroscopic precession (a test originally proposed by him in 1960), the second-order stellar red shift (concluding that this is not only unfeasible but uninter-