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Model 5301-E

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POWER MODULE



Model 2202

To regulate an AC-line connected load by means of a small DC signal from an automatic control instrument. It supplies large amounts of power for control of resistive heaters, thermo-electric elements, light sources, etc. in temperature controlled ovens, vacuum deposition equipment, infrared heat sources, temperature baths and other applications. The instrument features a pulse-width-modulated zero crossing - fires TRIAC circuit to minimize RF Interference, electronic protection against current overloads and voltage transient, and provides linear control to a AC power line up to 25 Amp. (110 V or 220 V).

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as a possible text for a first course in technical or general physics for undergraduates majoring in materials science.

Girifalco's book fills an important need in materials science graduate curricula. The book is intended for first-year graduate students, but could also play a role as a refresher volume. It is a readable book that requires little in the way of advanced mathematics. A good introduction develops the concepts of statistical physics. This is followed by the usual applications to the solid state, such as simple crystals, free-electron theory and kinetic theory of electron transport. The author also covers order-disorder phenomena, point defects and diffusion in crystals. The volume is self-contained and would form a fine text for a course oriented to materials-science students. It is important to note that the similarity of Girifalco's book to previous treatments ends at the table of contents. Girifalco has a unique ability to make a subject interesting and indeed understandable. I am reminded of a little book that he wrote some years ago on diffusion "for the everyman" (*Atomic Migration in Crystals*, Blaisdell, New York, 1964); This little gem has received insufficient attention. It is likely that *Statistical Physics of Materials* will become an accepted graduate volume, though I think that the absence of problems will limit the book's appeal as a textbook.

These two books are an indication that the needs of education in materials science are beginning to be recognized. Both books are welcome contributions.

* * *

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Liquid State Physics—A Statistical Mechanical Introduction

C. A. Croxton

421 pp. Cambridge U.P., New York, 1974. \$28.50

Liquid-state physics is a popular and growing field. The theory of simple atomic liquids has made enormous progress during the last decade. This progress evolved from the detailed "experimental" information determined from computer simulations of atomic fluids. Armed with this information, workers have formulated a few basic concepts that provide the foundation of the modern theories of atomic liquids.

These theories are both simple and quantitatively accurate. Further, there is every reason to expect that the same concepts will lead to a successful treatment of complex molecular fluids. Thus, it seems that the time has come for a monograph or textbook that explains both the basic concepts and the theoretical techniques used in implementing the concepts. Unfortunately, Clive Croxton's book, *Liquid State Physics—A Statistical Mechanical Introduction*, does not succeed at this task.

The topics touched upon in the book are certainly the ones that should be included in a good text. These are cluster expansions, functional derivatives and functional Taylor expansions, integral equations for the equilibrium pair correlation function, perturbation theories of liquids, equilibrium theories of the liquid-vapor interface, both the Monte Carlo and the molecular dynamics techniques for computer simulations, time correlation functions, and transport phenomena. However, Croxton's treatment of each of these subjects is inadequate for several reasons.

To begin with, there are many undefined symbols and concepts in the text. For example, Croxton's first use of the structure factor, $S(k)$, occurs on page 53 in an equation. There is no statement before or near the equation that defines $S(k)$. Later on, he presents a figure showing an experimentally determined $S(k)$. Yet Croxton never states how or why $S(k)$ is measured, and he never explicitly relates it to the r -space pair correlation function. One also finds mention of the compressibility equation of state; but the compressibility theorem is never derived or stated.

These kinds of omissions make the text nearly unintelligible unless the reader is already familiar with the topics being discussed. But an even worse stumbling block to the uninitiated is the large number of typographical and conceptual errors in the book. The first conceptual error is found on page 3 where Croxton presents an example of a cluster diagram, which he says is reducible. He also explains why he thinks it is reducible. But, in fact, the diagram is irreducible.

In some portions of the book, Croxton's choice of material seems outdated. For example, in his long chapter on dynamic properties, Croxton emphasizes the kinetic-theory approach developed in the 1950's and earlier by John Kirkwood, Stuart Rice, and their co-workers. A modern treatment of linear-response theory is not to be found in the book. Indeed, the relationship between measurements and time-correlation functions is not discussed.

Many parts of *Liquid State Physics* simply paraphrase sections of older monographs in the field—especially



Planetary atmospheres have been explored during the past decade by many interplanetary probes. NASA renditions show a Mariner craft (left), one of a series to explore the inner planets. Pioneer probes (right) have sent abundant information about Jupiter's atmosphere.

Statistical Mechanics of Simple Liquids by Stuart Rice and Peter Gray (Interscience, 1965). In several cases, without using quotation marks, Croxton has extracted sentences verbatim from published articles by other authors.

Liquid State Physics can be characterized as a survey. Many literature references are given. This is the major virtue of the book. I am sure I will use it to help me track down particular references. But the frequency of errors, the lack of pedagogy, and the price will probably not allow this book to become a standard text.

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Physics of Planetary Ionospheres

S. J. Bauer
230 pp. Springer-Verlag, New York, 1973.
\$32.00

A comprehensive and complicated picture of the response of our planet's atmosphere to solar radiation has been developed during the last decade as rocket and satellite-borne instrumentation has provided detailed measurements of the atmospheric properties. Because of their importance to radio communication, considerable emphasis has been placed on the ionospheric regions of the atmosphere, and a large body of data is available on electron densities, temperatures and velocity distributions on ionic and neutral-particle distributions and on airglow emissions. These data have stimulated the construction of numerically sophisticated models of the ionosphere that incor-

porate a wide range of elementary physical and chemical collision processes modified by the effects of diffusion and transport in the magnetic and gravitational fields of the rotating Earth. The essentials of the models should apply also to the other planets and to those satellites, such as Titan and Io, that have atmospheres. Substantial information about the ionospheres of Mars and Venus, for which the primary neutral component is carbon dioxide, has been obtained by US and Russian spacecraft, and the study of the Jovian planets, for which the primary neutral particle is hydrogen, is a major part of the projected planetary exploration program of NASA. A beginning was made this year with a fly-by past Jupiter, which suggested the presence of a layered ionosphere in Jupiter's atmosphere.

Siegfried Bauer's monograph on planetary ionospheres thus appears at an appropriate time. It is a coherent account of the physical processes that lead to the production of ionization in a planetary atmosphere and of the reactions that subsequently occur. Considerable attention is given to ionospheric dynamics and the role of plasma transport processes. The book studies also the thermal structure of an ionosphere by relating the temperature distributions to the best sources and including the process of thermal conduction. Bauer includes brief accounts of experimental techniques and the characteristics of the ionospheres of the planets Earth, Mars, Venus and Jupiter are summarized and contrasted.

The intent of the book is the presentation of the fundamental theory of a planetary ionosphere, which is applicable generally to any planetary system that possesses an atmosphere. Bauer

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