the conceptual difficulties of indeterminacy and wave-particle duality but rather in the fact that the subject does not lend itself to the large volume of homework problems those students expect. Moreover, the fraction of the engineering curriculum that can be devoted to quantum mechanics is limited by the need to present other levels of abstraction of modern technology, such as circuits and systems. In the typical physics curriculum, mastery of nonrelativistic quantum mechanics requires not only two semesters of the topic itself, but also two semesters of mathematical methods. Engineering curricula, however, cannot commit that many classes to teaching quantum mechanics.

Anthony Levi's *Applied Quantum Mechanics* is a significant contribution to solving the problems mentioned above. The author addresses parts of the subject that are important to terrestrial, low-energy technologies. In contrast to a textbook aimed at physics students, Levi's book devotes minimal attention to problems such as atomic structure and scattering from spherical potentials. The text focuses on electron systems that may be described in one dimension, such as bound and extended states; on the harmonic oscillator as a model for collective modes including photons and phonons; and on perturbation theory, with discussions on Fermi's golden rule for stimulated optical transitions. The author also presents equilibrium statistical mechanics, a necessary element of any engineering application. In a very nice touch, he uses the semiconductor diode laser as the primary example of how quantum mechanics is applied. The device depends upon essentially all of the topics covered in the book. Although Levi only considers a simple model of the diode laser, presenting the device as a target application gives an instructor the opportunity to motivate students into examining the book's topics.

The first chapter is a review of classical mechanics and electromagnetism, but the author chooses examples that have relevance to quantum systems. For example, the linear chain of masses coupled by springs introduces the notion of nonlinear dispersion (frequency versus wavevector) relations. In later parts of the chapter, Levi includes discussions of classical systems, such as photonic crystals, that share a mathematical foundation with the quantum systems that are the focus of the text.

The book comes with a CD-ROM that contains MATLAB code for a number of examples and exercises; the book also introduces elementary numerical techniques for dealing with quantum problems. The inclusion of numerical techniques significantly increases the number of problems the student can solve with reasonable amounts of effort. It also offers readers a much more realistic appreciation of the way quantum systems must be analyzed in practical technological applications.

One frustrating aspect of the book is that, on some occasions, Levi develops the background for a significant result but then fails to follow through to the result itself. An example is his treatment of the dynamics of electrons in crystals, including the effects of the complicated dispersion relation, or band structure. At various points, the author mentions group velocity and describes band structures, but he never explicitly states the group-velocity and acceleration theorems that determine the electron dynamics. A novel feature of *Applied Quantum Mechanics* is the inclusion of solutions for all the exercises. I am not quite sure how this will work in the context of a course taken for credit. Because the answers are readily accessible, instructors will need to either supplement the problems given in the text or modify their grading algorithms.

In summary, Levi's book represents a very large step in the right direction for teaching quantum mechanics to engineering students. I have adopted it as the textbook for my next class on the subject. However, I believe we ultimately need an even more radical departure from the traditional physics curriculum textbook.

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**Basic Concepts for Simple and Complex Liquids**

Jean-Louis Barrat and Jean-Pierre Hansen

Liquids are strongly interacting but disordered systems whose very existence arises from a delicate balance between energy and entropy. They exist over a much smaller range of temperature and density than do solids, in which energy usually dominates, or gases, in which entropy dominates. Because liquids are relevant in everyday life and essential in biology and biophysics, physicists need to gain a better understanding of this elusive state of matter and the ideas that researchers in the field have developed in the past 50 years. However, some of those ideas are difficult and involve new concepts and approximations not usually taught in standard physics courses. *Basic Concepts for Simple and Complex Liquids*, a concise, very well-written textbook by two experts in the field, should help fill this gap in the physics curriculum.

The book by Jean-Louis Barrat and Jean-Pierre Hansen describes and connects formal work and simulations of atomic-scale properties of mostly simple fluids to the coarse-grained mesoscopic models and scaling arguments used to explain critical phenomena and to describe complex fluids such as liquid crystals and polymers. Coarse-grained models and scaling ideas are familiar to most physicists, and their integration with standard topics in condensed matter physics was well presented in the textbook *Principles of Condensed Matter Physics* (Cambridge U. Press, 1995) by Paul M. Chaikin and Tom C. Lubensky. Barrat and Hansen's book covers some of the same ground from a different perspective, with more emphasis on polymers and ionic solutions, and relates the mesoscopic-scale physics most physicists know to the less familiar molecular-scale physics of liquids. These connections should help researchers in many different fields get a succinct overview of the conceptual issues in liquid-state science. The authors' inclusive approach is quite different from that taken in most earlier books on liquids: In those books, the emphasis is mainly on simple atomic liquids and on the detailed, formal development of specialized techniques for such systems.

To get an idea of how Barrat and Hansen's approach works, consider their treatment of phase transitions. That part of the book begins with a general discussion of mean-field approaches, which includes a detailed discussion of the Landau theory of phase transitions, followed by specific applications to the van der Waals equation of state, to the Flory–Huggins theory of polymer blends,
and to the isotopic–nematic transition in liquid crystals as described by Lars Onsager’s hard-rod model. Next, the authors present a discussion on critical fluctuations and scaling ideas that includes a short, one-page description of Leo Kadanoff’s block-spin picture. However, no attempt is made to describe renormalization group ideas; instead, the authors give an application of the Ginzburg criterion to polymer blends and show why mean-field ideas are more generally applicable in the study of these blends than in simple molecular liquids. The authors then cover scaling ideas for polymer solutions and briefly describe finite-size scaling.

In subsequent parts of the book describing interfaces, nonuniform fluids, and dynamics, Barrat and Hansen follow the same approach. They first introduce general theoretical concepts like density functional theory and Langevin and Fokker–Planck methods and then illustrate those concepts by many different and sometimes surprising applications.

A wealth of material is covered in fewer than 300 pages. This textbook is the only one I know of that succinctly tackles such a diverse set of topics and attempts to find common viewpoints and theoretical approximations. The tradeoff is that the discussions can be very terse at times. The authors get to the essential ideas quickly, with little discussion of mathematical difficulties or physical subtleties that might arise. As a result, the book is not—nor is it intended to be—the place to learn about the weaknesses in the various theoretical methods presented or to gain detailed physical insight into specific applications. The level of treatment should be understandable to graduate students, provided they are aware that the authors waste few words. The book has a few well-chosen but rather difficult exercises that will help students gauge their level of understanding.

I enjoyed reading Basic Concepts for Simple and Complex Liquids and have used it in my own research group to introduce students to new research areas and ideas. The authors should be commended for an impressive pedagogical achievement.

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Nonlinear Science and Chaos

