Advanced Undergraduate or Graduate Textbook

Classical Electromagnetic Radiation. Jerry B. Marion. Academic Press, New York, 1965. xvi + 479 pp. Illus. $10.75.

The stated objectives of this book are to provide a text for a one-semester, three- or four-hour course for physics students at the advanced undergraduate or beginning graduate level and to provide a modern and reasonably sophisticated mathematical treatment of classical electrodynamics at the undergraduate level with emphasis on radiation problems and the wave aspects of the electromagnetic field. The author assumes "that the reader has a recent acquaintanceship with the basic principles of electromagnetism." An unrationalized Gaussian cgs system of equations and units is employed throughout.

The book is well written. It is not absolutely clear whether the author considers a course in general physics (with the usual chapters on electricity and magnetism) as the only prerequisite or assumes that the students have had some prior course in field theory. In the first eventuality, he is probably an optimist (but no more so than most authors) if he thinks students will really master a book of this size in the time suggested. In the second eventuality, they probably will—or they should.

The contents of the text are best described by chapter headings: "Fundamentals of electromagnetics" (27 pp.); "Multipole fields" (19 pp.); "The equations of Laplace and Poisson" (31 pp.); "The electromagnetic field equations" (22 pp.); "Electromagnetic waves" (25 pp.); "Reflection and refraction" (34 pp.); "The Liénard-Wichert potentials and radiation" (24 pp.); "Radiating systems" (48 pp.); "Classical electron theory" (30 pp.); "Spherical scalar waves" (21 pp.); "Interference phenomena" (34 pp.); "Scalar diffraction theory" (36 pp.); "Relativistic electrodynamics" (42 pp.); and some appendices on vector and tensor analysis, Fourier series and integrals, and units, for example.

The treatment of multipoles (chapter 2) could be strengthened by starting with, and expanding, the definitions illustrated by diagrams in Section 2.6, expressing the multipole potentials as appropriate directional derivatives, dispensing with Taylor series, and applying instead the series of spherical harmonics (which are introduced in chapter 3). This approach would be more in keeping with the author's expressed desire to link static multipoles with radiating multipoles and would provide another application of spherical harmonics in addition to that given in chapter 10.

Radiating systems (chapter 8), interference phenomena (chapter 11), and diffraction theory have much in common. For pedagogic reasons this should have been stressed. If this were done, the "remarkable fact . . . that scalar diffraction theory yields a quite satisfactory description of diffraction [of electromagnetic waves] . . ." would have ceased to be remarkable. In fact, it is very easy to include polarization effects without impairing the theory.

In chapter 6, on reflection and refraction, it is assumed that, even when one medium is metallic, the permeabilities are equal. Of course, this is the most important case. Unfortunately, the final formulas, although correct, are misleading. They imply that reflection is caused by the difference in propagation constants (or velocities, if the media are nondissipative)—and this is wrong. However, this faulty treatment is not confined to this book; it may be found in many other books. I have known a number of physicists who hold this erroneous belief.

The author's apologia for the use of Gaussian units is not very convincing. Of course, there is a matter of personal preference. To the author "it is very comforting to see a factor of 4π explicitly appear when an integration over the entire solid angle is performed." On the other hand, this factor appears in Maxwell's equations where the integrations are performed over portions of the solid angle, and, furthermore, only in one term and not the other two. There is also a pesky factor of 2 in the expression for the magnetic intensity around an infinite current filament.

There is a curious inconsistency which should be explained or, at least, commented on. An accelerating charge radiates. Hence, its field must exert a force on it, which must be balanced by an external force (which does work). For an electric charge in bulk it is easy to calculate this force. It turns out to be proportional to the time rate of change of the acceleration. The author obtains the same force for a particle from the principle of conservation of energy (p. 300). But the field of an accelerated particle, although apparently exact (p. 209, equation 7.60a), does not indicate such a force.

An errata sheet lists about a dozen and a half of errors. I noted two others: the quadrupole potentials, equations 4 and 5 (pp. 44 and 45), should be multiplied by 3/2. These are minor errors unless the book is used for reference to specific results. Students should be able to find such errors—it is good for them. On the whole, the book is probably as free from errors as one could hope.

One error, however, is serious. On page 242, figure 8-8 shows a linear antenna driven by a coaxial cable. On page 243 it is stated that "since the system is symmetric," the current distribution is symmetric. The system is *not* symmetric electrically, and the current distribution is not symmetric. The voltage is applied not only between the two arms of the antenna but also between *one* of these arms and the outer surface of the coaxial cable. I have seen the same error in some other intermediate and advanced books.

In the matter of adoption of this book, instructors should be guided primarily by the first three paragraphs of this review. The few weak spots that I have mentioned can be easily strengthened by the instructors themselves.

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Population Genetics

The Effects of Inbreeding on Japanese Children. William J. Schull and James V. Neel. Harper and Row, New York, 1965. xii + 419 pp. Illus. $15.

Within a year of the time when the atomic bombs were dropped on Hiroshima and Nagasaki, plans were being made to evaluate the short- and the long-range biological effects of what is now elliptically and dispassionately known as "the Japanese experience." The work of the Atomic Bomb Casualty Commission, a joint effort of the bombers and the bombed, has included an intensive effort to get at the genetic effects of what we hope will remain a unique pair of mass radiation exposures. In 1956, J. V. Neel and W. J. Schull published an extreme-