“Physics in Canada” Book Review
“La Physique au Canada” Critique de livre

“Electricity and Magnetism” by Edward Purcell, Cambridge University Press, 2013, pp: 484, ISBN: 978-107-01360-5, price 70.00

This second edition was first published in 1985, and is based on the first edition first published in 1963. This textbook in its variety of editions is widely used for Electricity and Magnetism courses at the undergraduate level. It was originally written as part of a series of four courses that formed the core of the Berkeley undergraduate physics degree. It should be noted that there is a third edition by Purcell and Morin, that has been updated with additional examples and the use SI units instead of the cgs units of this second edition. The book would be good for a second year undergraduate physics course, where the students are already getting some exposure to vector calculus in concurrent math courses. I would place its level as being slightly simpler than that of Griffiths, "Introduction to Electrodynamics," but above the typical first year textbook treatment.

The first chapter largely covers electric fields from point charges and continuous charge distributions, and introduces Gauss' law. There are sections on electrical energy, force on a layer of charge and energy associated with the electric field that feel a bit out of place, but otherwise the description is excellent. The addition of the examples in the third edition are very welcome.

The second and third chapters present the electric potential, and electric fields around conductors which includes capacitance of different arrangements of conductors. The treatments of both of these is very well done. The fourth chapter on electric currents builds up to DC circuits from a fundamental level.

Chapter five describes the electric field from a moving point charge, in a way I haven't seen in other introductory textbooks. It assumes that students already have some familiarity with special relativity and derives what the electric field from a moving charge looks like. The description is again very well done, and leads to a picture of what the electric field around an accelerating charge looks like.

Chapters six and seven introduce the magnetic field and electromagnetic induction respectively. Inductance and circuits with inductive components are introduced near the end of chapter seven. The eighth chapter is on alternative current circuits, and is done using complex impedance and admittance as it should be at this level.

Chapter nine introduces the displacement current, and Maxwell's equations in differential form. Electromagnetic waves are then shown to result from these equations. Plane wave propagation and the power density in electromagnetic waves is described.

Chapters ten and eleven describe electric field in matter and magnetic fields in matter respectively. The exposition again proceeds from fundamental physics arguments, starting from the electric dipole for electric fields in matter, leading to a description of dielectrics in capacitors. Magnetization and ferromagnetic materials are also introduced.

In summary this textbook introduces electricity and magnetism in a nice logical order. Electricity and magnetism is of course the favourite first application of the vector calculus methods in a physics course, and the text does a good job of introducing the mathematics as it is being used, rather than in a separate introductory chapter with just the math. The figures are simple grey scale but are well done, and augment the description of the concepts which are presented in a practical and pedagogical way. I would recommend the third edition over this edition, due to the additional examples provided, and the use of SI units.

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