

Preface

This work has been developed by the authors after 30 years of teaching several courses of electricity and magnetism. The book contains more than three hundred solved problems, the majority of which have been proposed by the Department of Applied Physics to Natural Resources in official exams of Advance Physics, Physics II and Electromagnetism and Waves in the Mining and Energy School (ETSIME) of the Polytechnic University of Madrid (UPM).

The book has been written for both beginners and advanced students in this subject. However, it may be useful for physicists and engineers, and also for people that work with related topics and need the electromagnetic theory for understanding other disciplines.

The objective of this book is to expose the fundamental concepts of electromagnetism through problems. Starting with this idea each chapter is divided into two parts. The first one contains a brief theoretical introduction where the most important concepts and formulae employed in the chapter are usually presented without demonstrating them. The second one is devoted to the exercises labeled as problems A, B and C, respectively, depending on its difficulty and sometimes thematically. Problems of type A are thought for beginners in electricity and magnetism or for lectures on General Physics, where definitions and concepts about this subject appear for first time. Problems of type B are a bit tougher and can be worked by students who have some basic knowledge in calculus and electromagnetics. For closing each chapter, problems of type C are introduced. These kinds of exercises, even though they are not very difficult, have some conceptual or/and mathematical complications which make them more adequate for advanced lectures. According with the academic level of the student, this chapter distribution gives to the reader the possibility of using the book in a flexible way.

Our experience showed us that the most simplest things may be very difficult for the student at the beginning of learning a subject, if the explanations of the ideas involved are not clear. Sometimes, the supposition by part of the writer that one idea or concept is obvious may lead to waste reader's time. For this reason we have tried to explain the problems in-depth with an emphasis on physical concepts rather than on the mathematical developments.

The book is structured in 14 chapters. It begins with an introductory chapter devoted to the basic mathematical theorems and formulae that are needed for further developments. The next two chapters deal with the electric field in different situations, namely in vacuum and when matter is present. An important topic when studying fields and circuits are the currents; this is the subject of Chap. 4. In the same way as commented for the electric field, Chaps. 5 and 6 study the origin of the magnetic field and the phenomenon of the magnetization. Until this part of the book the techniques for solving the electric and magnetic fields generated under specific circumstances are based on direct calculations. In Chap. 7 other more complicated methods for obtaining these fields are studied. Chapter 8 works out the important topic of the electromagnetic induction. The different causes of producing electromotive force are explained in detail. The understanding of this phenomenon encompasses the knowledge of former chapters. For this reason it is not recommended to be studied without studying previously the fundamentals of the electric and magnetic fields. Chapter 9 refers to energetic aspects of the electromagnetic field and a didactic investigation of the Maxwell equations is left to Chap. 10. The solution of partial differential equations may be very difficult. However, the viewpoint adopted in this chapter is more conceptual than mathematical. In fact, for systems of high symmetry it is possible to find a solution in a simpler way without solving the system of differential equations. In our opinion, numerous questions can be answered using a simple mathematical apparatus, without losing rigor and clarity. Due to the importance of the plasmas, cosmic rays, and machines as cyclotron and betatron, among others, we have included the study of the movement of charged particles in electromagnetic field. This is the subject of Chap. 11. One of the most important consequences of the Maxwell equations is the unification of the electricity and the magnetism and also the light. In this regard in Chap. 12 a general view of the electromagnetic waves is given and in Chap. 13, the phenomena of reflexion and refraction are treated. In this context, an interesting approach to the propagation of electromagnetic waves throughout anisotropic media is dealt with in the last part, Chap. 14.

We would like to express our sincere gratitude, wholeheartedly, to our colleague and friend Faustino Fernández López, for many years of his teaching, experience and for help wherever we needed.

We are also in indebted to Prof. Aristide Dogariu and his scientific team at CREOL of the University of Central Florida. Their valuable discussions in the group meetings provided us very important information which allowed to introduce some ideas and explanations in some parts of this book.

A very special place in this book is for our colleague Dr. James Germann, who reviewed all this work, word by word, and also corrected all equations carefully. We would like to thank him for his invaluable work, dedication, and professionalism. Without his help this book would not have seen the light. We wish him all the best for his future and expect the best in his work with two-photon microscopy and corneal imaging. We hope his work in this book can be appreciated in his scientific career.

Thanks are also due to the Editorial Springer, especially Dr. Claus Ascheron for providing help in the preparation of this book. His generosity and patience with us during the writing is largely appreciated.

Finally, we would like to give special thanks to all our students, without whom we would have never written this book.

Madrid, Spain
Madrid, Spain
Madrid, Spain
Seville, Spain

Félix Salazar Bloise
Rafael Medina Ferro
Ana Bayón Rojo
Francisco Gascón Latasa

<http://www.springer.com/978-3-662-48366-4>

Solved Problems in Electromagnetics

Salazar Bloise, F.; Medina Ferro, R.; Bayón, A.; Gascón, F.

2017, XVIII, 806 p. 580 illus., 138 illus. in color.,

Softcover

ISBN: 978-3-662-48366-4