ELECTROMAGNETISM

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FOUNDATIONS OF ENGINEERING

Series Editor: G. E. Drabble

Electromagnetism

R. G. Powell

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MACMILLAN

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To Janice, Charis and Jason

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SERIES EDITOR'S FOREWORD

This series of programmed texts has been written specifically for first year students on degree courses in engineering. Each book covers one of the core subjects required by electrical, mechanical, civil or general engineering students, and the contents have been designed to match the first year requirements of most universities and polytechnics.

The layout of the texts is based on that of the well-known text, *Engineering Mathematics* by K. Stroud (first published by Macmillan in 1970, and now in its third edition). The remarkable success of this book owes much to the skill of its author, but it also shows that students greatly appreciate a book which aims primarily to help them to learn their chosen subjects at their own pace. The authors of this present series acknowledge their debt to Mr Stroud, and hope that by adapting his style and methods to their own subjects they have produced equally helpful and popular texts.

Before publication of each text the comments of a class of first year students, of some recent engineering graduates and of some lecturers in the field have been obtained. These helped to identify any points which were particularly difficult or obscure to the average reader or which were technically inaccurate or misleading. Subsequent revisions have eliminated the difficulties which were highlighted at this stage, but it is likely that, despite these efforts, a few may have passed unnoticed. For this the authors and publishers apologise, and would welcome criticisms and suggestions from readers.

Readers should bear in mind that mastering any engineering subject requires considerable effort. The aim of these texts is to present the material as simply as possible and in a way which enables students to learn at their own pace, to gain confidence and to check their understanding. The responsibility for learning is, however, still very much their own.

G. E. Drabble

HOW TO USE THIS BOOK

Electromagnetism is an essential part of a curriculum in electrical and electronic engineering, and a highly desirable part of any broadly based programme in engineering or applied science. It is fundamental to the understanding of the design and application of the whole range of electrical and electronic devices and equipment from the tiny integrated circuits encountered in electronics to the very large machines associated with the power supply system. Without such understanding, the reasons for the differences between ‘real’ components and the ideals of circuit theory will remain forever a mystery.

In the manner of K. Stroud’s *Engineering Mathematics* mentioned in the Series Editor’s Foreword, this book consists of a number of programmes (nine in all) each of which contains a number of frames. The frames are usually less than one page in length. Most of them end with a question of some sort, the answer to which is given in a box at the beginning of the following frame. For best results, always try to work out the answer *before* referring to the next frame.

At regular intervals throughout each programme there are revision exercises in the form of a set of ‘true or false’ questions to test your understanding of the fundamentals, and a number of numerical problems to test whether you can apply the theory. As these are designed to consolidate the work covered up to that point, it is *NOT* a good idea to skip them. The answers to the numerical problems are given in the last frame of each programme.

There are three occasions when I have resorted to the irritating phrase ‘it can be shown that...’, which often leads readers to suspect that the author can’t do it himself! However, I believe that in these instances, there would be nothing to be gained in presenting the proofs (which are somewhat long-winded) nor any virtue in asking you to look them up for yourself.

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My thanks are also due to Dr Peter Holmes for encouraging me to write this book and to the many students with whom I have had the pleasure of working at Nottingham (formerly Trent) Polytechnic and who, by their questioning, have helped me to see things more clearly.

Nottingham, October 1989

R. G. POWELL