Magnetism and Magnetic Materials

Covering basic physical concepts, experimental methods, and applications, this book is an indispensable text on the fascinating science of magnetism, and an invaluable source of practical reference data.

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List of tables of numerical data

Preface

This book offers a broad introduction to magnetism and its applications, designed for graduate students and advanced undergraduates as well as practising scientists and engineers. The approach is descriptive and quantitative, treating concepts, phenomena, materials and devices in a way that emphasises numerical magnitudes, and provides a wealth of useful data.

Magnetism is a venerable subject, which underwent four revolutionary changes in the course of the twentieth century – understanding of the physics, extension to high frequencies, the avalanche of consumer applications and, most recently, the emergence of spin electronics. The reader probably owns one or two hundred magnets, or some billions if you have a computer where each bit on the hard disc counts as an individually addressable magnet. Sixty years ago, the number would have been at best two or three. Magnetics, in partnership with semiconductors, has created the information revolution, which in turn has given birth to new ways to research the subject – numerical simulation of physical theory, automatic data acquisition and web-based literature searches.

The text is structured in five parts. First, there is a short overview of the field. Then come eight chapters devoted to concepts and principles. Two parts follow which treat experimental methods and materials, respectively. Finally there are four chapters on applications. An elementary knowledge of electromagnetism and quantum mechanics is needed for the second part. Each chapter ends with a short bibliography of secondary literature, and some exercises. SI units are used throughout, to avoid confusion and promote magnetic numeracy. A detailed conversion table for cgs units, which are still in widespread use, is provided inside the back cover. There is some attempt to place the study of magnetism in a global context; our activity is not only intellectual and practical, it is also social and economic.

The text has grown out of courses given to undergraduates, postgraduates and engineers over the past 15 years in Dublin, San Diego, Tallahassee, Strasbourg and Seagate, as well as from the activities of our own research group at Trinity College, Dublin. I am very grateful to many students, past and present, who contributed to the venture, as well as to numerous colleagues who took the trouble to read a chapter and let me have their criticism and advice, and correct at least some of the mistakes. I should mention particularly Sara McMurry, Plamen Stamenov and Munuswamy Venkatesan, as well as Grainne Costigan, Graham Green, Ma Qinli and Chen Junyang, who all

worked on the figures, and Emer Brady who helped me get the whole text into shape.

Outlines of the solutions to the odd-numbered exercises are available at the Cambridge website www.cambridge.org/9780521816144. Comments, corrections and suggestions for improvements of the text are very welcome; please post them at www.tcd.ie/physics/magnetism/coeybook.php.

Finally, I am grateful to Wong May, thinking of everything we missed doing together when I was too busy with this.

J. M. D. Coey
Dublin, November 2009

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