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PREFACE

Because of the tremendous rate at which scientific developments are expanding and the extremely short time lag before they are applied in engineering practice, the engineering curriculum has become increasingly science oriented. In addition, the student is introduced, at an early stage, to advanced and sophisticated analytical methods so that an increasing amount of subject matter is covered in the short space of four or five years of the undergraduate program. As a result, he often acquires a facility for manipulating mathematical expressions at the expense of understanding the underlying physical principles. This sometimes engenders a distaste for "hardware."

This text places major emphasis on the physical concepts, and uses relatively simple analytical approaches to the study of capacitors, magnetic circuits, and transformers. Principles of energy storage and conversion are applied in derivations where this approach seems most effective. The first chapter, for example, deals with energy relationships in rather simple systems.

Practical aspects of electric fields and the significance of electric field intensity as related to dielectric strength, corona, and the construction of capacitors and single-conductor cables are discussed in Chapter 2. The treatment of magnetic fields in Chapter 3 uses the concept of the unit magnetic pole to emphasize the aspect of forces in the magnetic field in a manner similar to that which makes use of the test charge in treating the electric field. The concept of inductance is reinforced by relating it to simple magnetic circuits; the inconsistencies among the various definitions of inductance are discussed for cases of circuits containing magnetic materials. Although the student has probably studied electric and magnetic fields in earlier courses from a more mathematical viewpoint, the treatment in this text is intended to strengthen his physical concepts. While permanent magnets, electromagnets, and transformers play a most vital part in many engineering applications, a chapter on saturable reactors and frequency multipliers is considered necessary and has been included. Much of the material in this text has been used successfully in mimeograph form for a three-hour course during the second semester of the Junior year in Electrical Engineering at the University of Arizona for the past six years.

The author acknowledges his indebtedness to Thomas L. Martin, Jr., formerly Dean of Engineering at the University of Arizona, at whose suggestion this work was initiated and whose encouragement has lightened the burden of this task. Acknowledgement is also due to A. J. Hoehn, Michael Wozny, and others for many useful suggestions, as well as to my wife for her patient assistance in the preparation of this manuscript.

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