

# FUNDAMENTALS OF ENGINEERING ELECTRONICS

BY

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## PREFACE

It has for some time been a conviction of the author and his associates that, no matter how facile an engineer may be in the manipulation of electronic circuits, his effectiveness is distinctly limited unless he has a satisfactory understanding of the operating principles of the electronic circuit *elements* that he uses. The ability to grasp readily the reasons for the behavior of new devices as they appear is especially important. The relative ease with which electronic devices can be made to order to accomplish specific purposes is an added reason for placing initial emphasis in electronics instruction on internal operating principles. These considerations have been the basis for the method of instruction in electronics at the University of Michigan ever since courses in the subject were introduced about eight years ago.

In the preparation of this book, which is an outgrowth of the author's teaching experience, an attempt has been made to maintain a proper balance between two underlying objectives:

(1) To give the reader a realistic and quantitatively usable conception of the principles that govern the internal behavior of electronic devices (this is the primary objective); and

(2) To familiarize the reader with methods of circuit analysis customarily employed in connection with the most common engineering applications of electronic devices.

Accordingly, the chief emphasis in this book is placed on internal operating principles. A large part of the text is devoted to a study of the effects of the use of various geometries and materials in electronic devices, and a relatively small part to circuit studies.

The point of view is that of an engineer: Principles of importance in engineering work are selected for study; illustrations of these principles are drawn from engineering practice; and physical concepts are so treated as to permit ready determinations of *magnitudes*. Familiarity with relative magnitudes is of course essential to a satisfactory engineering understanding of any scientific subject-matter.

Reasoning from purely physical concepts has been used rather than mathematical formulation, wherever the latter could be avoided without loss of definiteness. However, a large part of the subject-matter requires mathematical analysis for the establishment of proper quantitative concepts, and wherever that is true, mathematical methods have been used freely.

It is perhaps unfortunate that one of the most difficult subjects treated falls naturally very early in the text, in Chapter II. However, in his work with undergraduates the author has tried teaching triode electrostatic field analysis later in the course, and has also tried a qualitative treatment, involving a statement of the general results with little attention to the mathematical formulation. Such methods have not proved satisfactory. The conclusions reached by means of field analyses are rather striking, and class enthusiasm is dampened if denied satisfaction of the curiosity that naturally arises as to how these conclusions are arrived at.

This book has been especially designed for use in full-year courses for undergraduate or graduate students; however, the content is so arranged that it is readily adaptable, with certain omissions, for one-semester courses. It is hoped that the book will also find a place as a reference work for engineers in industry.

The author wishes to acknowledge gratefully the encouragement and active assistance rendered during the entire period of development of the electronics work by Professors A. D. Moore, S. S. Attwood, and L. N. Holland, all of the Electrical Engineering Department of the University of Michigan; also to express appreciation of the care and thoughtfulness with which portions of the manuscript were reviewed and ably criticized by Professor Attwood, and by Professor Samuel Goudsmit of the Physics Department of the University of Michigan. The author is indebted to all other members of the staff of the Electrical Engineering Department, and to many of those in the Physics Department, especially to Professor O. S. Duffendack, for ever-ready advice and counsel; also to Messrs. Ralph Bodine and John Lopus for the thoughtful and careful draftmanship exercised during the preparation of the original drawings for the figures.

W. G. Dow

*March 20, 1937*

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