FOREWORD

The rate of scientific discoveries and important engineering applications during and following World War II has presented a peculiar challenge to electrical engineering education. Though originally rooted in the physical discoveries of Faraday and the embracing theory of Maxwell, electrical engineering had for many years been absorbed in narrow and specialized areas of this potentially most powerful field of engineering endeavor. The linkage of network theory with the mathematical field of functions of a complex variable, the successful monitoring of electron flow in solids aided by the judicious implantation of impurities, and the perception of the broad principles of controlled feedback for automatic regulation of processes have enlarged the scope of electrical engineering to the point where a fundamental reorientation of the entire undergraduate curriculum appears necessary.

In fairness to students as well as to instructors, it is important to incorporate the practically inescapable emphasis on sound and rigorous engineering science—as contrasted with the basic sciences of physics, chemistry, and mathematics—in measured steps and with careful evaluation of the learning capacity on the one hand and the ability for constructive use on the other hand. We have thus embarked at the Polytechnic Institute of Brooklyn on a comprehensive program of revision of all the courses in the electrical engineering program. Upon discussion with McGraw-Hill representatives, we conceived of a series of basic textbooks portraying the essential concepts of the evolutionary process rather than detailed design procedures still in the process of maturation. This series will carry in the title the name of the Institute and will cover the fields of electronic circuits, communication theory, electromechanical transduction, digital techniques, feedback principles, and others, jointly comprising the essence of the undergraduate course program in electrical engineering.

The present volume by Professor E. J. Angelo, Jr. is the first tangible result of this long-range planning started more than eight years ago. It contains all the elements of the basic approach we have chosen. We hope that it can serve as catalyst as well as a helpful guide for many who have accepted the challenge of the new developments in technology, and in particular the trend toward scientific engineering.

Ernst Weber

PREFACE

The study of electronics is currently considered to include studies of physical electronics, solid-state physics, linear amplifiers, nonlinear amplifiers, pulse circuits, rectifiers, and a variety of other related topics. Any attempt to cover all these topics in detail in a single volume must inevitably result in a large and unwieldy book. Partly for the purpose of avoiding such a result, this book does not undertake a thorough development of all these subjects; it does, however, attempt to establish the fundamental concepts and techniques that are basic to all of them. The subject matter of the book has served for several years as the basis for a one-year first course in electronics for juniors in electrical engineering. The important topics not treated in detail in this course are studied in a subsequent course.

The first half of the book is concerned primarily with the development of linear and piecewise-linear circuit characterizations for tubes and transistors and with examining the behavior of these devices in the basic amplifier configurations; thus it is concerned with the properties of active devices and with circuit representations for such devices. The techniques employed are quite general and are used in a subsequent course to obtain circuit representations for mechanical, electromechanical, and hydraulic devices. The second half of the book is concerned almost solely with linear tube and transistor circuits; thus it is an introduction to active-circuit theory. This study is closely correlated with the study of passive-circuit theory; in fact, it is an extension of passive-circuit theory to include active circuits. The methods employed in characterizing the active devices make it both feasible and desirable to treat tubes and transistors simultaneously. As implied above, these two devices are seen to be special cases of a large class of amplifying devices.

Physical electronics and solid-state physics are presented in just enough detail to give the student some understanding of the properties of the devices and to acquaint him with the principal factors limiting the performance that can be obtained. It is believed that the student is better motivated and better equipped for a detailed study of these subjects after he has studied the applications of the devices and has learned of the annoying limitations on their performance. Similarly,

nonlinear electronic circuits are treated only in an introductory manner in this book; thus power amplifiers, pulse circuits, modulators, and related circuits are not presented in detail.

Even with this restricted scope, the book contains more material than can be covered comfortably in a one-year course. Thus it is appropriate to mention certain sections that can be omitted without eliminating material that is prerequisite to later portions of the text. Chapters 11 and 16 can be omitted entirely; however, if Chap. 16 is omitted it may be necessary to present the Nyquist test of Chap. 17 without proof. The following sections can also be omitted: 3-7, 3-8, 13-5, 15-8, 15-9, and 15-10. In addition, various sections in Chap. 2 can be omitted in accordance with the desires of the instructor.

The author is indebted to many people among his colleagues and his students for their contributions to this work. The course for which the book was developed has been taught by more than 20 different instructors, and each of these has aided the development of the subject matter in one way or another. Special acknowledgment is due Professor Athanasios Papoulis for the resonant-peaking circle of Sec. 15-7 and for the central features in the analysis of the double-tuned amplifier.

E. J. Angelo, Jr.

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