

*Electronics*  
*for*  
*Modern Communications*

George J. Angerbauer

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# *Electronics for Modern Communications*

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## *Preface*

This text provides, in one volume, the basic electronic and radio theory necessary for a person to pass successfully the several Federal Communications Commission (FCC) license examinations. This includes both commercial and radio amateur licenses. Important laws, rules, and regulations governing the operation of radio stations have also been included.

This book has been written to meet the needs of junior colleges, technical institutes, and correspondence schools whose students desire to learn the essentials of electronic communication. High school students studying electronics should also be able to profit from it. Anyone should be able to study the text on his own and still be able to pass the desired FCC license examinations.

- All the essential material has been arranged in appropriate chapters, from the simple to the more complex, thus making the volume suitable as a text for nearly all beginning electronics students as well as those wishing to acquire any of the FCC licences. The author has chosen this approach, rather than the question-and-answer method, because of the continuity provided from subject to subject.

Numerous FCC-type questions have been included at the end of each chapter, compiled from the latest publications provided by the FCC. These are intended to indicate the *nature* and *scope* of the questions asked in the various FCC examinations. The actual FCC examination questions are of the *multiple-choice* type from which the applicant selects the best answer. These sample questions have served as a basis for writing this comprehensive text on electronic communication for applicants for the several FCC commercial and radio amateur licenses.

Solid-state devices and circuits have been included, where possible, to reflect the changing state of the art. Appropriate questions are included in the

respective chapters to acquaint the reader with likely changes in future FCC questions.

The author has also included a number of problems at the end of most chapters to be used at the discretion of the instructor or for self-study. These are intended to supplement the FCC-type questions. A solution manual for these problems is available to instructors upon request.

Chapters 25 and 26 cover the essential information needed to answer the FCC questions for Elements 1 and 2, which are required for all classes of FCC licenses.

The author is indebted to the following individuals who have made various contributions and suggestions in the preparation of this volume. Mr. Leon Savage, instructor in commercial and radio amateur license classes; Mr. John Hecomovich, telecommunications and electronics instructor at College of San Mateo; Mr. Sam Cooper, General Electric Company; and Mr. Jack Gittings, telecommunications.

For the final credit I wish to thank my wife, Gerry, for her excellent work in typing the manuscript.

GEORGE J. ANGERBAUER

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## Circuits Review

### 1-1 THE ATOM

Matter may be defined as any substance that has weight (mass) and occupies space. It is found in any one of three states: solid, liquid, or gaseous. All matter consists of one or more basic materials called elements, of which there are over 100.

All elements are made up of atoms, which in turn are made up of electrons, protons, and other minute particles. The center, or *nucleus*, of an atom contains positively charged particles called *protons*. Orbiting the nucleus are negatively charged particles called *electrons*. Normally, there are as many electrons as protons in the atom.

In some elements the outermost electrons are not tightly bound to their nucleus and can move from one atom to another. These are called *free electrons* and constitute the flow of electricity in a wire when an electrical pressure, or voltage, is applied.

When an atom loses one or more of its electrons, it becomes a *positive ion*. If it acquires an extra electron, it becomes a *negative ion*. Under certain conditions electricity can flow between two points as a result of these charges.

An *electrostatic* (or *dielectric*) field surrounds any charged body. Its magnitude is a function of the strength of the electric charge. This charge may be represented by electric lines of force, as shown in Fig. 1-1.

The fundamental law of electrostatic charges states: *like charges repel and unlike charges attract*.

When one of the charged bodies has a polarity opposite to the other, there is said to be a *difference of potential* between them. If a wire were connected between these two charged bodies, the excess of electrons on the negatively charged body would flow through the wire to the positively charged body. This flow would continue until the charges were equalized.