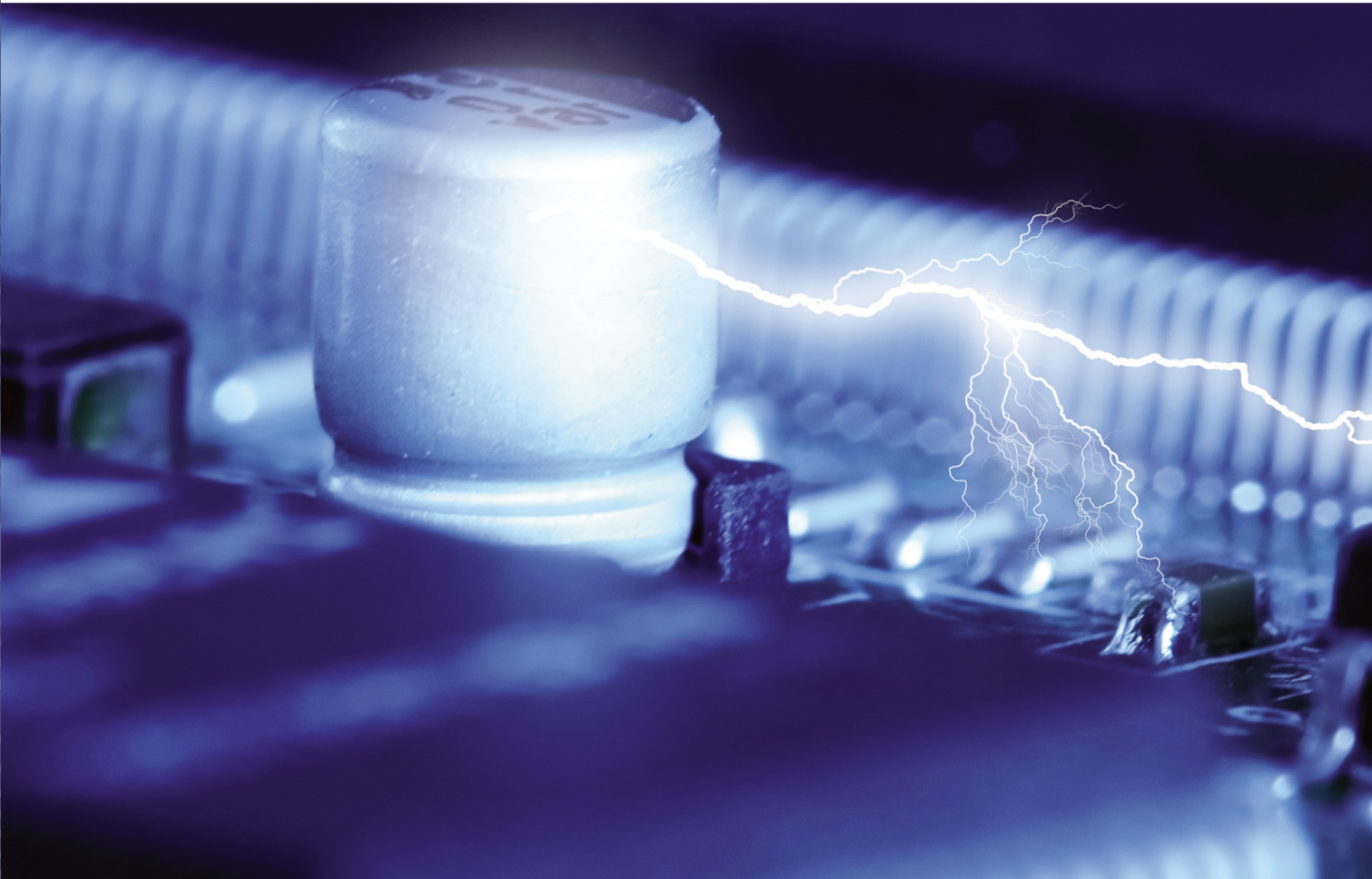


**INTRODUCTION TO
BASIC ELECTRICITY AND
ELECTRONICS TECHNOLOGY**

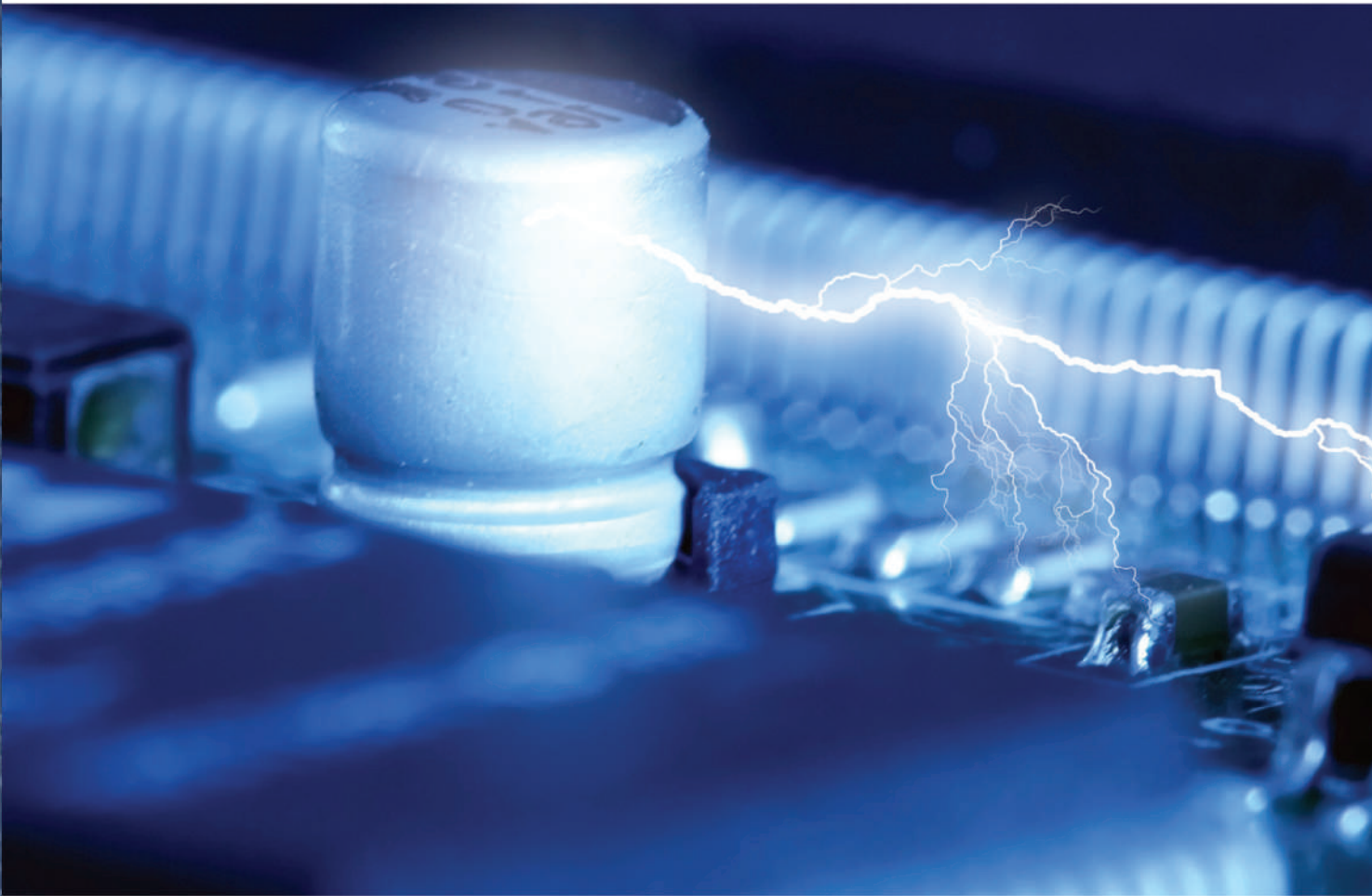


EARL GATES

**INTRODUCTION TO
BASIC ELECTRICITY AND
ELECTRONICS TECHNOLOGY**



INTRODUCTION TO BASIC ELECTRICITY AND ELECTRONICS TECHNOLOGY



EARL GATES



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**Introduction to Basic Electricity and
Electronics Technology**

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Library of Congress Control Number: 2012949451

ISBN-13: 978-1-133-94851-3

ISBN-10: 1-133-94851-0

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PREFACE

INTENDED AUDIENCE

Introduction to Basic Electricity and Electronics Technology is written to meet the needs of a one-year program for electronics in high schools, vocational schools, and technical colleges, and as an introduction to electricity and electronics in four-year colleges. This textbook may also be used in a survey course in electricity and electronics for electronics technology, computer technology, and telecommunications. This first edition is designed to give students the basic background that more closely relates to the needs of industry. With guided instruction it can provide the hands-on skills required by industry.

BACKGROUND OF THIS BOOK

This first edition objective is to provide a text and reference book that summarizes in understandable terms those principles and techniques that are the basic tools of electronics. In keeping with current trends, increased emphasis is placed on the general techniques of electronics.

During my teaching in public school I completed a study on what industry wanted from students graduating with a background in electronics. I found that industry valued students' ability to do more than their ability to know. I found that industry wanted less time spent on teaching theory and more time spent on instructing hands-on applications.

After I had rewritten my curriculum, I found I had to use several textbooks to teach it. This textbook is intended to provide the students with all the information required by the curriculum in one easy-to-use textbook. The curriculum I used is included in the Instructor's Guide.

TEXTBOOK ORGANIZATION

Due to the rapid growth of electronics, it becomes impossible to cover all of the important topics in

a one-year course. *Introduction to Basic Electricity and Electronics Technology* provides instructors with an opportunity to select those topics they wish to emphasize and at the same time provides the student with a reference book of basic electricity and electronics coverage and continuing value.

Teachers can guide students to concentrate on the material related to a particular course syllabus, leaving the remaining subject matter as enrichment should students wish to extend their knowledge. Alternatively, instructors can choose to cover a series of selected topics, such as DC and AC circuits.

Another possibility is to concentrate on the material related primarily to linear electronics circuits or another topic of choice. Many other combinations are possible.

The emphasis is the coverage of electronics combined with a presentation that allows the student to study a particular topic without having to read the entire text.

The textbook is divided into seven separate sections.

SECTION 1—Introduction to Electricity and Electronics discusses careers in electricity and electronics, certification in electricity and electronics, work habits and issues, calculators for electricity and electronics, electronic circuit design, software for electronics, safety, tools and equipment, and hazardous materials.

SECTION 2—DC Circuits discusses fundamentals of electricity, current, voltage, resistance, Ohm's law, electrical measurements meters, power, DC circuits, magnetism, inductance, and capacitance.

SECTION 3—AC Circuits discusses alternating current, AC measurement, resistive AC circuits, capacitive AC circuits, inductive AC circuits, resonance circuits, and transformers.

SECTION 4—Semiconductor Devices discusses semiconductor fundamentals, P–N junction

diodes, zener diodes, bipolar transistors, field effect transistors (FET), thyristors, integrated circuits, and optoelectric devices.

SECTION 5—Linear Electronic Circuits discusses power supplies, amplifier basics, amplifier applications, oscillators, and waveshaping circuits.

SECTION 6—Digital Electronic Circuits discusses binary number systems, basic logic gates, simplifying logic circuits, sequential logic circuits, combinational logic circuits, and microcomputer basics.

SECTION 7—Practical Applications discusses project design, printed circuit board fabrication, printed circuit board assembly and repair, and basic troubleshooting.

GLOSSARY—This valuable resource contains key terms and definitions.

Appendices—Included are the following:

APPENDIX 1—Periodic Table of Elements

APPENDIX 2—The Greek Alphabet

APPENDIX 3—Metric Prefixes Used in Electronics

APPENDIX 4—Electronics Abbreviations

APPENDIX 5—Common Reference Designators

APPENDIX 6—DC and AC Circuit Formulas

APPENDIX 7—Formula Shortcuts

APPENDIX 8—Resistor Color Codes

APPENDIX 9—Common Resistor Values

APPENDIX 10—Capacitor Color Code

APPENDIX 11—Electronics Symbols

APPENDIX 12—Semiconductor Schematic Symbols

APPENDIX 13—Digital Logic Symbols

APPENDIX 14—Activity Assessment Rubric

APPENDIX 15—Safety Test

Self-Test Answers are included for students.

FEATURES

The following list provides some of the significant features of the textbook:

- Chapters are brief and focused.
- Objectives are clearly stated with the learning goals at the beginning of each chapter.
- Colorful illustrations are generously used throughout the text to strengthen concepts learned.
- Four-color photographs are used to show the learner exactly what is addressed in the text.
- Four-color layouts focus attention to important features in the text.

- Cautions and notes are color coded for easy identification throughout the text.
- Many examples have been developed into Multisim version 12 to learn firsthand what is happening in a circuit.
- Review questions appear at the end of every chapter subdivision to allow a comprehension check.
- All formulas are written using fundamental formulas only.
- Many examples show math and formulas in use throughout the text.
- Summaries are included at the end of each chapter for reviewing important concepts.
- Self-tests are included at the end of each chapter as a learning tool.
- Numerous examples incorporate the chapters' material with real-life applications.
- Section activities provide an opportunity to reinforce concepts with hands-on problem-solving projects.

THE LEARNING PACKAGE

A robust complement of supplemental learning solutions has been developed to achieve two goals:

1. To assist students in learning the essential information needed to prepare for the exciting field of electronics
2. To assist instructors in planning and implementing their instructional programs for the most efficient use of time and other resources

The following components of this package are offered to help you achieve these goals:

Lab Manual

Labs provide students with the opportunity to learn the terminology and transfer theory provided in class to hands-on practical applications. Projects serve to reinforce the students' learning, providing opportunities to see theory become practice. (ISBN: 978-1-1339-4852-0)

CourseMate for Basic Electricity and Electronics

CourseMate for Basic Electricity and Electronics is an integrated, Web-based learning solution for building the knowledge and skills needed to succeed in electricity and electronics. The CourseMate Website

includes the following suite of resources and study tools:

- An interactive eBook with highlighting, note-taking, and search capabilities.
- Interactive quizzes
- A set of student-focused PowerPoint slides
- Flashcards, crosswords, and other skill-building games
- The CourseMate website also includes Multisim™ circuit files. Students can use these precreated files for troubleshooting and simulation. Textbook figures created as Multisim files are identified by a Multisim icon throughout the text.

HOW TO ACCESS THE COURSEMATE FOR BASIC ELECTRICITY AND ELECTRONICS SITE

To access these supplemental materials or to see a CourseMate demo, please visit <http://www.cengagebrain.com>. At the CengageBrain.com homepage, enter the ISBN of your title (from the back cover of this book), using the search box at the top of the page. This will take you to the product page where these resources can be found.

INSTRUCTOR'S COMPANION WEBSITE. This educational resource creates a truly electronic classroom with array of tools and instructional resources that will enrich the learning experience and expedite your preparation time. The instructor resources directly correlate with the text, so the text and website combine to provide a unified instructional system. With the following instructor resources, you can spend more time teaching and less time preparing to teach:

INSTRUCTOR'S GUIDE. The Instructor's Guide contains solutions to textbook section questions and to the lab manual experiments. To assist the instructor or teacher in preparing the program, a curriculum guide is provided in the Instructor's Guide. It helps instructors to provide a program that will develop a student's interest in the field of electronics.

POWERPOINT PRESENTATION. Slides cover every chapter in the text, providing the basis for a lecture outline that helps present concepts and material. Key points and concepts can be graphically highlighted for student retention.

COMPUTERIZED TESTBANK. The testbank includes questions in multiple-choice format, so students' comprehension can be assessed.

IMAGE LIBRARY. More than 200 images from the textbook are included to create transparency masters or

to customize PowerPoint slides. The Image Library comes with the ability to browse and search images with key words and allows quick and easy use.

ABOUT THE AUTHOR

- Retired as an Associate Professor from the State University of New York at Oswego, where he taught electronics technology
- Has 23 years experience in public education as a teacher and administrator
- Retired from the U.S. Navy as an Electronics Technician Senior Chief
- Recently, as an educator he taught VoTech at Choices Charter School of Florence and Darlington in Florence, South Carolina
- President of TEK Prep, a small business that does education consulting, training, and evaluation
- As an education consultant, provides training for teachers and adults in Florida, New York, and South Carolina

ACKNOWLEDGMENTS

I would like to thank John Millhouse, a retired Navy Chief Electronics Technician who served with me in the U.S. Navy. He has retired and now works as a consultant electronics engineer in Florida. He helped with the Multisim examples and sample problems used throughout the text. Thanks also to Lois Dodge for her help in proofing the manuscript.

I would also like to thank Avi Hadar, owner of Kelvin, the exclusive dealer in the United States for New Wave Concepts' Circuit Wizard, for his support; Jim Good, who helped shape the concept of the book when we were at Greece Central School; and Gerald Buss, retired president of EIC Electronics, who provided help by reading the book, answering questions, and lending his support from the industrial sector.

Thanks are also due to the numerous teachers who identified areas to include, expand, or improve in the textbook. Thanks to the staff at Delmar, Cengage Learning for their faith that the book could be done.

The author and Delmar, Cengage Learning wish to thank the reviewers for their suggestions and comments during development of this edition.

Finally, I would like to thank my wife, Shirley, who has supported me in the preparation and development of this textbook.

Earl D. Gates
Cincinnati, New York
2013

INTRODUCTION TO ELECTRICITY AND ELECTRONICS

CHAPTER

1 CAREERS IN ELECTRICITY AND ELECTRONICS

- 1-1 Careers in the Electrical and Electronics Field
- 1-2 Differences between a Technician and an Engineer
- 1-3 Preparation for Employment
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- 3-4 Workplace Discrimination
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- 3-6 Workplace Ethics
- 3-7 Teamwork

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- 5-3 Breadboarding

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6 SOFTWARE FOR ELECTRONICS

- 6-1 Software for Electricity and Electronics
- 6-2 Multisim
- 6-3 Circuit Wizard
- 6-4 Productivity Software for Electronics

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- 7-2 Preventive Measures
- 7-3 Electrostatic Discharge
- 7-4 Safety Practices

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- 8-2 Storing Hand and Power Tools
- 8-3 Using Hand and Power Tools
- 8-4 Using Test Equipment
- 8-5 Safety Issues

9 HAZARDOUS MATERIALS

- 9-1 Material Safety Data Sheet (MSDS)
- 9-2 Classification of Hazardous Materials
- 9-3 Handling Hazardous Materials
- 9-4 Disposing of Hazardous Materials

PEOPLE AND EVENTS IN ELECTRONICS

Age Discrimination in Employment Act (ADEA) of 1967 (December 15, 1967)

United States Public Law 90-202, 81 Statute 602 prohibits employment discrimination against persons 40 years or older. It also applied to standards for pensions and benefits provided by employers to be provided to the general public. The ADEA was later amended in 1986 and again in 1991.

American Disabilities Act (ADA) of 1990 (July 26, 1990)

Title I prohibits private employers, state and local governments, employment agencies, and labor unions from discriminating against qualified individuals with disabilities.

Earle C. Anthony (1880–1961)

Anthony is credited with the invention of the electronics breadboard; in 1922, he created a circuit using an actual breadboard on his kitchen table.

William Seward Burroughs (1857–1898)

Burroughs invented the first practical adding and listing machine and submitted a patent application for the machine in 1885.

Canadian Standards Association (CSA) (1944–)

CSA is a global organization that provides product testing and certification for products that conform to CSA standards.

Certified Electronics Technician (CET) Program (1965–)

The CET program was designed by the National Electronics Association to measure the theoretical knowledge and technical proficiency of practicing electronics technicians.

Civil Rights Act of 1964 (Enacted July 2, 1964)

United States Public Law 88-352, (78 Statute 241) outlawed all major forms of discrimination against racial, ethnic, national, and religious minorities and women.

Electronics Technicians Association, International (ETA-I) (1978–)

ETA-I is a professional association that promotes excellence through testing and certifying electronics technicians.

James Hodgson (1915–)

In 1970, Hodgson helped to craft the Occupational Safety and Health Act, which paved the way for the OSHA agency, established in 1971.

PEOPLE AND EVENTS IN ELECTRONICS (CONTINUED)

International Electrotechnical Commission (IEC) (1906–)

IEC is an international standards organization that prepares and publishes international standards for all electrical, electronic, and related technologies.

International Society of Certified Electronics Technicians (ISCET) (1975–)

ISCET is a professional organization whose main function is the direction and administration of the CET program; in addition, it promotes obtaining technical certification worldwide and provides a location for certified technicians to band together for professional advancement.

Jan Lukaszewicz (1878–1956)

Lukaszewicz invented reverse Polish notation around 1920.

National Electrical Code (NEC) (1897–)

The *NEC* is a U.S. standards guide that is regionally adopted for the safe installation of electrical wiring and equipment and is published by the National Fire Protection Association (NFPA).

OSHA (1970–)

In 1986, OSHA began requiring material safety data sheets (MSDSs) for all hazardous materials.

Ronald J. Portugal

In 1971, Portugal invented the solderless breadboard while working for EI Instruments.

Résumé (1066–)

The *résumé* originated in feudal England as a document created by a Lord or the head of a local guild to serve as a letter of introduction for someone traveling long distances.

Underwriters Laboratories (UL) (1894–)

UL develops standards and test procedures for products, materials, components, assemblies, tools, and equipment, for product safety.

Careers in Electricity and Electronics

OBJECTIVES

After completing this chapter, the student will be able to:

- Identify careers in the electrical and electronics field.
- Describe the difference between work done by an electronics engineer and by an electronics technician.
- Identify the traits for successful employment.
- Describe the parts of a basic résumé.
- Discuss the purpose of the résumé and the letter of application.
- Identify how experience in the workforce can be obtained.
- Describe the importance of an apprenticeship.
- Explain how a co-op program functions.
- Discuss the differences among an externship, an internship, and job shadowing.
- Identify the role a mentoring program plays in selecting a chosen career field.

KEY TERMS

- | | | | |
|-----|---|-----|--|
| 1-1 | automation mechanic | 1-2 | Institute of Electrical and Electronics Engineers (IEEE) |
| 1-1 | automotive mechanic | 1-3 | <i>Dictionary of Occupational Titles (DOT)</i> |
| 1-1 | computer engineer | 1-3 | job interview |
| 1-1 | computer technician | 1-3 | letter of application |
| 1-1 | electrical engineer | 1-3 | <i>Occupational Outlook Handbook</i> |
| 1-1 | electrician | 1-3 | résumé |
| 1-1 | electronics engineer | 1-4 | apprenticeship |
| 1-1 | <i>National Electrical Code® (NEC®)</i> | 1-4 | cooperative education |
| 1-1 | <i>NEC Guidebook</i> | 1-4 | externship |
| 1-2 | electronics engineering | 1-4 | internship |
| 1-2 | electronics technician | 1-4 | job shadowing |
| 1-2 | Federal Communications Commission (FCC) | 1-4 | mentoring |

This chapter looks at careers in the electrical and electronics industry. It also looks at some useful information for locating a job and developing skills to secure a job, as well as some pointers to keep a job. It is not realistic for an individual to make a career choice after reading this chapter; rather, this chapter is a starting point to help define the process of getting a job.

1-1

CAREERS IN THE ELECTRICAL AND ELECTRONICS FIELD

Many exciting career opportunities exist in the electrical and electronics field. The following pages provide a sample of the available opportunities. Check for other career opportunities at the career information center in your school or community.

Automation Mechanic

An **automation mechanic** maintains controllers, assembly equipment, copying machines, robots, and other automated or computerized devices (Figure 1-1). A person with this job installs, repairs, and services machinery with electrical, mechanical, hydraulic, or pneumatic components. Precision measuring instruments, test equipment, and hand tools are used. Knowledge of electronics and the ability to read wiring diagrams and schematics is required.

Becoming an automation mechanic requires formal training, which is offered by the military, two-year colleges, vocational-technical schools, and in-house

apprenticeship programs. Although most training is provided through formal classroom instruction, some may only be obtained through on-the-job training.

Automation mechanic is one of the fastest growing vocations in the industry. This rapid growth is expected to continue annually.

Automotive Mechanic

There are currently more computers aboard today's automobile than aboard our first spaceship. A typical automobile contains approximately 10 to 20 computers that operate everything from the engine and radio to the driver's seat. As a result, **automotive mechanics** now need a greater knowledge of electronics.

To be able to distinguish an electronic malfunction from a mechanical malfunction, automotive mechanics must be familiar with the minimum basic principles of electronics. In addition, they must be able to test and replace electronic components.

Becoming an automotive mechanic requires formal training, which is offered by the military, junior/community colleges, vocational-technical schools, and in-house apprenticeship programs. Although most training is provided through formal classroom instruction, some can only be obtained on the job. To reduce the amount of time invested in training a prospective mechanic, more employers are now looking for people who have completed a formal automotive training program.

Employment opportunities are good for automotive mechanics who have completed an automotive training program and better when certified by the National Institute for Automotive Service Excellence (ASE). People whose training includes basic electronics skills have the best opportunities. Employment growth is expected to increase at a normal rate annually, with a concentration in automobile dealerships, independent automotive repair shops, and specialty car-care chains. Employment in service stations will continue to decline, as fewer stations will offer repair services.

Computer Engineer

The rapid growth in computers has generated a demand for people trained in designing new hardware and software systems and incorporating new technologies into existing and new systems. These trained professionals are known as **computer engineers** and system analysts.

FIGURE 1-1

An automation mechanic needs knowledge of electricity and electronics as well as of computers, hydraulics, mechanics, and pneumatics.



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Computer engineers can be further broken down into hardware and software engineers. Computer hardware engineers design, develop, test, and supervise the manufacturing of computer hardware. Computer software engineers design and develop software systems for control and automation of manufacturing, business, and management processes. They also may design and develop software applications for consumer use at home or create custom software applications for clients.

There is no universally accepted preparation for a computer professional because the job often depends on the work that needs to be done. Most employers require that employees have at least a bachelor's degree. However, a passion for computers and proficiency in advanced computer skills will at times win out over a bachelor's degree.

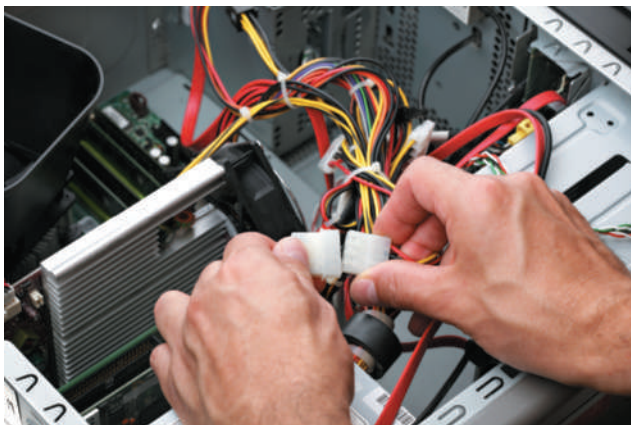
This field is one of the fastest-growing fields today. Technological advances are occurring so rapidly in the computer field that employers are struggling to keep up with the demand for trained professionals. As the technology becomes more sophisticated and complex, more expertise and a higher level of skills will be required. Computer engineers must be willing to continue their learning process to keep up. College graduates with a bachelor's degree in computer science, computer engineering, information science, or information systems will enjoy favorable employment opportunities.

Computer Technician

A **computer technician** installs, maintains, and repairs computer equipment and systems (Figure 1-2). Initially, the computer technician is responsible for laying cables and making equipment connections.

■ FIGURE 1-2

Computer technicians install, maintain, and repair computer equipment and systems.



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This person must thoroughly test the new system(s), resolving all problems before the customer uses the equipment. At regular intervals, the computer technician maintains the equipment to ensure that everything is operating efficiently. Knowledge of basic and specialized test equipment and hand tools is necessary.

Computer technicians spend much of their time working with people—listening to complaints, answering questions, and sometimes offering advice on both equipment system purchases and ways to keep equipment operating efficiently. Experienced computer technicians often train new technicians and sometimes have limited supervisory roles before moving into a supervisory or service managerial position.

A computer technician is required to have one or two years of training in basic electronics or electrical engineering from a junior college, college or vocational training center, or military institution. The computer technician must be able to keep up with all the new hardware and software.

Projections indicate that employment for computer technicians will be high. The nation's economy is expanding, so the need for computer equipment will increase; therefore, more computer technicians will be required to install and maintain equipment. Many job openings for computer technicians may develop from the need to replace technicians who leave the labor force, transfer to other occupations or fields, move into management, or retire.

Electrical Engineer

Electrical engineers make up the largest branch of engineering. An electrical engineer designs new products, writes performance specifications, and develops maintenance requirements. Electrical engineers also test equipment, solve operating problems within a system, and predict how much time a project will require. Then, based on the time estimate, the electrical engineer determines how much the project will cost.

The electrical engineering field is divided into two specialty groups: electrical engineering and electronics engineering. An electrical engineer works in one or more areas of power-generating equipment, power-transmitting equipment, electric motors, machinery control, and lighting and wiring installation. An **electronics engineer** works with electronic equipment associated with radar, computers, communications, and consumer goods.

The number of engineers in demand is expected to increase annually. This projected growth is attributed to an increase in demand for computers, communication equipment, and military equipment. Additional jobs are being created through research and development of new types of industrial robot control systems and aviation electronics. Despite this rapid growth, a majority of openings will result from a need to replace electrical and electronics engineers who leave the labor force, transfer to other occupations or fields, move into management, or retire.

Electrician

An **electrician** may specialize in construction, maintenance, or both. Electricians assemble, install, and maintain heating, lighting, power, air-conditioning, and refrigeration components (Figure 1-3). The work of an electrician is active and sometimes strenuous. An electrician risks injury from electrical shock, falls, and cuts from sharp objects. To decrease the risk of these job-related hazards, an electrician is taught to use protective equipment and clothing to prevent shocks and other injuries. An electrician must adhere to the **National Electrical Code® (NEC®)*** specifications and procedures, as well as to the requirements of state, county, and municipal electric codes.

A large proportion of electricians are trained through apprenticeship programs. These programs are comprehensive, and people who complete them are qualified for both maintenance and construction work. Most localities require that an electrician be licensed. To obtain the license, electricians must pass an examination that tests their knowledge of electrical theory, the *National Electrical Code®*, and local electrical and building codes. After electricians are licensed, it is their responsibility to keep abreast of changes in the **NEC guidebook**, with new materials, and with methods of installation.

Employment for electricians is expected to increase annually. As population increases and the economy grows, more electricians will be needed to maintain the electrical systems used in industry and in homes. Additionally, as both new and old homes are prepared for new technologies to make them smarter, the demand requires more electricians who are trained in the new technologies.

*NFPA 70(R), *National Electrical Code®*, and *NEC®* are registered trademarks of the National Fire Protection Association, Quincy, MA.

FIGURE 1-3

These students are training to become electricians.



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Electronics Technician

Electronics technicians develop, manufacture, and service electronic equipment, and they use sophisticated measuring and diagnostic equipment to test, adjust, and repair electronic equipment. This equipment includes radio, radar, sonar, television, and computers, as well as industrial and medical measuring and controlling devices.

One of the largest areas of employment for electronics technicians is in research and development. Technicians work with engineers to set up experiments and equipment and calculate the results. They also assist engineers by making prototypes of newly developed equipment and by performing routine design work. Some electronics technicians work as sales or field representatives to give advice on installation and maintenance of complex equipment. Most electronics technicians work in laboratories, electronics shops, or industrial plants. Ninety percent of electronics technicians work in private industry.

Becoming an electronics technician requires formal training, which is offered by the military, junior and community colleges, vocational-technical schools, or in-house apprenticeship programs.

Employment of electronics technicians is expected to increase annually due to an increased demand for computers, communication equipment, military electronics, and electronic consumer goods. Increased product demand will provide job opportunities, and the need to replace technicians who leave the labor force, transfer to other occupations or fields, move into management, or retire will also increase.

1-1 QUESTIONS

1. What types of jobs do automation mechanics perform?
2. What is the difference between a computer technician and an electronics technician?
3. Computer engineers require what type of training?
4. Where does an electrical engineer work?
5. Where do most electronics technicians work?

1-2 DIFFERENCES BETWEEN A TECHNICIAN AND AN ENGINEER

Electronics engineering is an electrical engineering discipline involved with designing electronic circuits, devices, and systems. It is a broad engineering field that can be broken into *analog electronics*, *digital electronics*, *consumer electronics*, and *power electronics*. Electronics engineering is also involved with the implementation of applications and principles within the many related fields. The **Institute of Electrical and Electronics Engineers (IEEE)** is an important and influential organization for electronics engineers. Advancement for electronics engineers will often be to management.

Electronics technicians are expected to repair, maintain, assemble, and test electronics equipment. Titles for technicians are often expanded and may include the following:

- *Bench electronics technician*—works offsite to assemble, test, or repair work at a workbench.
- *Computer electronics technician*—works at a job site to install, maintain, and repair equipment and provides computer and IT (information technology) support.
- *Field electronics technician*—works at a job site to install, maintain, and repair equipment in the field.

- *Metrology electronics technician*—works at a workbench to calibrate, repair, and maintain all types of electronic standards, test, and measuring equipment. Metrology is defined as “the science of measurement.”
- *Senior or Master electronics technician*—an in-house management position requiring extensive experience within an organization. A technician often has this position as a goal for advancement.

All electronics technician jobs include repair and maintenance of the employer’s electronics equipment. This requires the ability to read schematics and maintenance manuals, test and troubleshoot the equipment, solder and unsolder components, and research parts availability and costs.

Specialized licenses are required when working on equipment requiring **Federal Communications Commission (FCC)** licensing or working in physically hazardous environments such as nuclear power.

Most electronics technician positions require at least an associate degree, equivalent military training, or a diploma from a vocational or technical school. This could be followed by certification, depending on the employer.

1-2 QUESTIONS

1. What two areas do electronics engineers work in?
2. What is IEEE to an electronics engineer?
3. What tasks do electronics technicians perform?
4. List the types of electronics technicians.
5. What skills does an electronics technician require?

1-3 PREPARATION FOR EMPLOYMENT

The best job for an individual is one that matches his or her interests and abilities. When first thinking about a job, think of the following individual traits:

- **Abilities**—skill developed through school or training.
- **Aptitude**—focuses on natural abilities.
- **Interests**—things done for personal interest or enjoyment.
- **Personality**—identifies how well one relates to others.