Preface

As a student interested in the rapidly changing and expanding field of electricity and electronics, you will find that *Electricity & Electronics* provides the fundamentals in easy-to-understand language. Understanding of these principles is ensured through experimentation and demonstration. *Experiments* with step-by-step instructions are placed throughout the text to help convey the principles of study.

Illustrations of the principles covered throughout the text provide prevalent and familiar applications in the fields of electricity and electronics. These applications bring the concepts into an everyday focus for the reader. To further connect with the reader, many chapters contain an *Applied E & E* feature relating the electrical principles of electricity and electronics to state-of-the-art technology.

Electricity & Electronics has been carefully crafted to meet industry standards. The text is correlated to both ETA International's Student Electronics Technician (SET) Certification and YouScience's Electronics I Certification. These certifications will give you a competitive edge over your peers.

The electricity and electronics industry can be an exciting and fast-paced field. New technologies are constantly emerging and transforming industries. A career in this field will be a commitment to lifelong learning and staying up-to-date with the latest technologies.

When you have successfully completed this textbook and your course, you should have a thorough understanding of the concepts of electricity and electronics. You will also have a basis for applying the principles learned to other more advanced studies in these fields.

A bright outlook for the electronics industry in the future translates into opportunities for specialized education and a lifetime of challenging and rewarding employment. The world of electricity and electronics is a fascinating one, and we are pleased that you have chosen to explore it with us.

Howard H. Gerrish
William E. Dugger, Jr.
Richard M. Roberts
Mahesh K. Pallikonda

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About the Authors

Mahesh K. Pallikonda is a faculty member in Engineering Technology at Austin Peay State University (APSU). He holds a PhD and a master's degree in Mechanical Engineering from Cleveland State University, as well as a bachelor's degree in Manufacturing Engineering from the National Institute of Advanced Manufacturing Technology. Prior to joining APSU, he served as a faculty member at Ohio Northern University, where he taught courses on the fundamentals of electronics. At APSU, Dr. Pallikonda instructs courses specializing in robotics and its applications and CAD. Dr. Pallikonda is passionate about educating and inspiring the next generation of engineers, technologists, and innovators through his lectures. He is deeply committed to advancing the fields of robotics and manufacturing through interdisciplinary research in connected devices and the Industrial Internet of Things (IIoT).

Richard M. Roberts has designed curriculum; taught electricity, electronics, and computer technology; and supervised technical teachers for nearly 50 years. He is an adjunct instructor at South Florida State College. He divides his time between consulting, teaching students and instructors, and writing instructional materials. He also authored the ***Computer Service and Repair*** textbook and the *Networking Fundamentals* textbook.

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Reviewers

The authors and publisher wish to thank the following industry and teaching professionals for their valuable input into the development of *Electricity & Electronics*.

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Siecor Corporation
Siemens
U.S. Air Force
Werner Co.
XEROX Corporation

New to This Edition

The following changes have been made to the 12th edition of *Electricity & Electronics* to strengthen the integrated learning solution and provide up-to-date information on the latest technology.

- Learning Outcomes have been updated and numbered to align with modularly numbered sections in every chapter. This helps inform students where to find the discussion of the learning outcomes, as well as highlights key learning points for instructors.
- Chapter summary items have been streamlined to succinctly align with learning outcomes.
- New questions have been added to all end-of-chapter sections: Know and Understand; Apply and Analyze; and Critical Thinking.
- Chapter 1, *Safety*, includes a new section on electrical hazards, including contact with power lines, energized sources, and improper use of power cords. Also, the six-step lockout-tagout procedure is added in detail.
- The author emphasizes the reasons behind the switch from analog to digital devices in Chapter 4, *Basic Instruments and Measurements*, while keeping legacy discussions of analog instruments for instructors who prefer to include them. An additional section discusses clamp meters as a basic instrument of measuring current, voltage, and resistance.
- Chapter 8, *Series Circuits*, includes expanded discussion of Kirchhoff's current law and an additional numbered example on power in a series circuit.
- Chapter 9, *Parallel Circuits*, adds a detailed introduction that sets the stage for understanding parallel circuits. A summary of Kirchhoff's laws and additional numbered examples are added to reinforce student learning. The discussion of troubleshooting common problems in electrical circuits is expanded, and an explanation of how to identify a faulty resistor is added.
- Chapter 10, *Combination Circuits*, includes new numbered examples in the "Solving for Voltage and Current Values" section. Another new example is added on the power consumption of resistors in a combination circuit.
- Chapter 13, *DC Motors*, adds an expanded discussion on counter-electromotive force. A new section on "Reversing the Direction of Rotation" in a DC motor is added.
- A new numbered example is added in the section on "Taps" in Chapter 14, *Transformers*.
- The equation for percent slip and new numbered examples are added in the section on "Slip" in Chapter 15, *AC Motors*.
- Chapter 16, *Inductance and RL Circuits*, adds a summary table of mathematical equations for resistance, inductive reactance, and impedance in DC and RL circuits.
- Chapter 17, *Capacitance and RC Circuits*, adds a summary table of the mathematical equations for resistance, reactance, and impedance in DC and RC circuits.
- A brief history of computers and vacuum tubes is expanded in the introduction of Chapter 20, *Transistors and Amplifiers*. A numbered example is added for calculating voltage gain.
- Chapter 24, *Radio Communications*, includes an additional section on free space waves.

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- Significant detail is added to the laser classification section in Chapter 26, *Fiber Optics and Lasers*.
- Chapter 28, *Networking Fundamentals for Electronics*, includes a new section on the Internet of Things.
- The *Electricity & Electronics Lab Workbook* supplement has been updated with several new labs and revised questions throughout.

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Credentialing Partners and Support

Goodheart-Willcox appreciates the value of industry credentials, certifications, and accreditation. We are pleased to partner with leading organizations to support students and programs in achieving credentials. Integrating industry-recognized credentialing into a career and technical education (CTE) program provides many benefits for the student and for the institution. By achieving third-party certificates, students gain confidence, have proof of a measurable level of knowledge and skills, and earn a valuable achievement to include in their résumés. For educators and administrators, industry-recognized credentials and accreditation validate learning, enhance the credibility of programs, and provide valuable data to measure student performance and help guide continuous program improvement.

Electricity & Electronics is correlated to the Student Electronics Technician (SET) Certification offered by ETA International, as well as Electronics I Certification offered by YouScience®.

ETA® INTERNATIONAL

ETA® International is a not-for-profit organization dedicated to fostering excellence in certification with education providers and industry professionals. The Student Electronics Technician (SET) Certification allows students and entry-level technicians the opportunity to earn a certification in basic electronic applications. *Electricity & Electronics* covers all of the competencies required to pass this certification exam. For more information about ETA International, visit www.etai.org.

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Goodheart-Willcox is pleased to partner with YouScience®, correlating select Goodheart-Willcox titles to YouScience® Industry Certifications to the benefit of states, instructors, and students working to achieve them. YouScience® is the leading technology provider dedicated to solving the skills and exposure gap crisis for students and employers.

YouScience® Industry Certifications, part of the YouScience Brightpath academic and career guidance platform, offer students entry- to mid-level certifications that act as tangible proof of their skills and knowledge. For more information about YouScience, including a complete listing of their Industry Certifications, please visit https://www.youscience.com/certifications/.

To see how *Electricity & Electronics* correlates to credentialing and certification standards, visit the Correlations tab at www.g-w.com/electricity-and-electronics-2026.

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Features of the Textbook

The instructional design of this textbook includes student-focused learning tools to help you succeed. This visual guide highlights these features.

CHAPTER OPENING MATERIALS

Each chapter opener contains a list of learning outcomes and a list of key terms. An introduction presents a brief synopsis of the topics to be covered, often with historical tie-ins for background, providing you with a framework on which to build your learning.

SPECIAL FEATURES

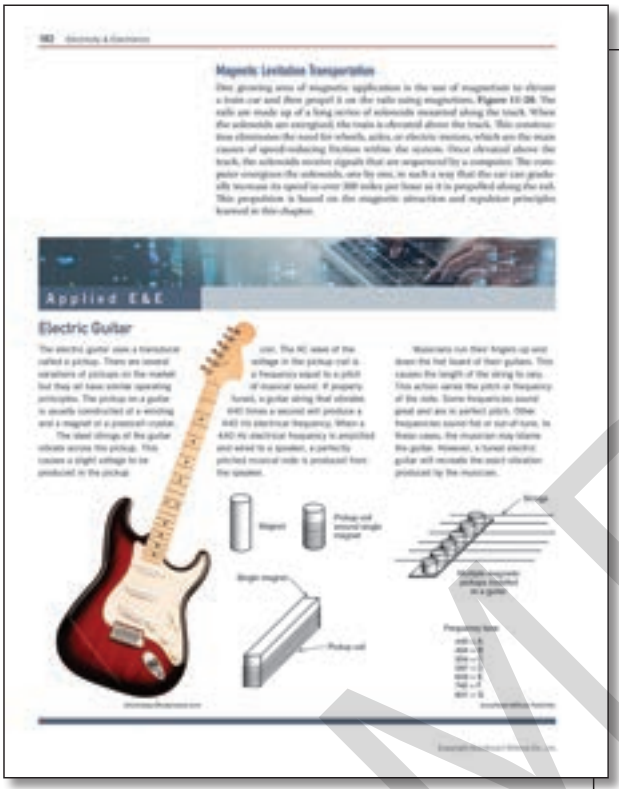
Learning Outcomes clearly identify the knowledge and skills to be gained when the chapter is completed. **Key Terms** list the key words to be learned in the chapter. Major sections are numbered and align with numbered learning outcomes.

ADDITIONAL FEATURES

Additional features are used throughout each chapter to further learning and knowledge. **Safety** features alert you to potentially dangerous materials and practices. **Cautions** alert you to practices that could potentially damage equipment or instruments. **Examples** demonstrate the mathematical concept just presented, showing the math skills required to solve real-world problems. **Section Reviews** provide opportunities to review what you have learned before moving on to additional content. **Experiments** throughout the textbook provide clear instructions for hands-on activities to assess concepts learned in the chapter. **Applied E & E** features provide an in-depth look at real-world technologies related to principles discussed in the chapter.



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Magnetic Levitation Transportation

Applied E&E

Electric Guitar



Electrostatic Discharge (ESD)

SECTION 1.2 REVIEW

SAFETY



Review and Assessment

SUMMARY

KNOW AND UNDERSTAND

APPLY AND ANALYZE

CRITICAL THINKING

END-OF-CHAPTER CONTENT

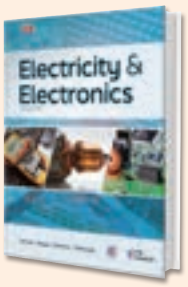
End-of-chapter material provides an opportunity for review and application of concepts. A concise **Summary** provides an additional review tool and reinforces key learning outcomes. This helps you focus on important concepts presented in the text. **Know and Understand** questions enable you to demonstrate knowledge, identification, and comprehension of chapter material. **Apply and Analyze** questions extend learning and develop your abilities to use learned material in new situations and to break down material into its component parts. **Critical Thinking** questions develop higher-order thinking and problem-solving, personal, and workplace skills.

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TOOLS FOR STUDENT AND INSTRUCTOR SUCCESS

Student Tools

Student Text



Electricity & Electronics provides basic instruction in the field of electricity and electronics. It covers a variety of relevant topics, from the scientific nature of electricity to the components of microcontrollers. The theory of electricity and electronics is taught alongside real-world examples and hands-on experiments.

Lab Workbook

The Lab Workbook that accompanies *Electricity & Electronics* includes instructor-created activities to help students recall, review, and apply concepts introduced in the book.

- Hands-on activities range from calculation problems and circuit-building to circuit simulation problems.
- Chapter review questions provide even more practice outside the core text review questions to solidify learning.

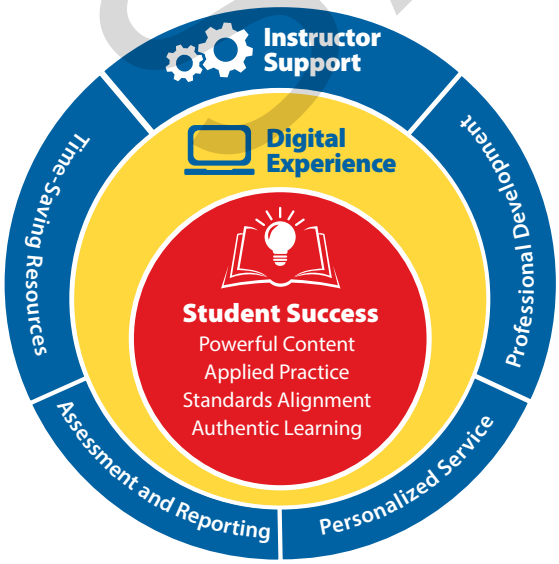
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See www.g-w.com/electricity-and-electronics-2026 for a list of all available formats.

Professional Development

- Expert content specialists
- Research-based pedagogy and instructional practices
- Options for virtual and in-person Professional Development

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