

# Electricity and Electronics, 10th Edition Text

By: Richard M. Roberts (*legacy authors Gerrish and Dugger*)

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Electricity & Electronics presents solid, up-to-date information on the fundamentals of electricity and electronics. The dual approach of this text teaches principles and theory accompanied by hands-on learning. Text content provides a thorough grounding in electrical principles, circuitry, and components. Additional topics include electronic communication and data systems, such as radio, television, and computers. A full chapter in this edition is devoted to microcontrollers.

<http://www.RMRoberts.com> is a link to the Author's Web Site where you can find the newest updates to the rapidly changing technology.

Experiments are included in numerous chapters with step-by-step instructions.

This textbook is divided into five (5) major sections:

- Section 1 Fundamentals of Electricity and Electronics (Chapters 1-5)
- Section 2 Basic Circuits (Chapters 6-8)
- Section 3 Motors, Generator, and Power Distribution (Chapters 9-13)
- Section 4 Advanced Electronic Circuits (Chapters 14-21)
- Section 5 Electronic Communication & Data Systems (Chapters 22-26)

Course Outline (Textbook) Basics Include:

## Chapter 1 Science of Electricity and Electronics

- 1.1 The Nature of Matter
  - Molecule and the Atom
  - Electrons, Protons, and Neutrons
  - Ionization
- 1.2 Static Electricity
  - Law of Charges
  - Experiment 1-1 [Demonstrating the Law of Charges](#)
  - Applied E & E [Copy Machines](#)
  - Experiment 1-2 [Examining Electrical Induction and Conduction](#)
    - The Coulomb
    - Electrostatic Fields
    - Induction
    - Static Electricity Applications
- 1.3 Basic Electrical Circuit

- Voltage
- Current
- Resistance
- Current, AC and DC
- Conventional Flow vs. Electron Flow Theory
- Series and Parallel
- Fire Safety
- 1.4 Ohm's Law
  - Electrical Prefixes

## **Chapter 2 Basic Instruments and Measurements**

- 2.1 Basic Analog Meter Movement
  - Iron Vane Meter Movement
  - Meter Scales
- 2.2 Ammeter
- 2.3 Voltmeter
  - Voltmeter Sensitivity
  - Loading a Circuit
- 2.4 Ohmmeters
  - Ohmmeter Scales
- 2.5 The Volt-Ohm-Milliammeter (VOM)
  - Digital Multimeters
  - Computer Display Meters
  - AC Meter Readings
  - Important Meter Information
  - Electric Shock
- 2.6 Electrical Diagrams

## **Chapter 3 Introduction to Basic Electrical Circuit Materials**

- 3.1 Conductors
  - Conductor Sizes
  - Circular Mils
  - Conductor Insulation
  - Types of Conductors
  - Conductor Resistance
  - Safety Organizations and Standards
- 3.2 Special Conductor Pathways
  - Breadboards
  - Printed Circuit Board
  - Chassis

- 3.3 Common Circuit Devices
  - Switches
  - Connectors
  - Circuit Protection Devices
- 3.4 Lighting
  - Incandescent Lamp Principles
  - Discharge Lamp Principles
  - Lumen
- 3.5 Resistors
  - Potentiometers
  - Thermistors
  - Resistor Color Code

## **Chapter 4 Energy**

- 4.1 Work, Power, and Horsepower
- 4.2 Ohm's Law and Watt's Law
- 4.2 Wattmeter and Watt-Hours
- 4.3 Efficiency
  - Energy Efficiency Rating
  - Gears, Pulleys and Power

## **Chapter 5 Source of Electricity**

- 5.1 Chemical Action
  - Primary Cells
  - Types of Primary Cells
  - Secondary Cells
  - Batteries in Series and Parallel
  - Experiment 5-1 Voltage in Series*
  - Experiment 5-2 Voltages in Parallel*
  - Applied E&E Sound Navigation Ranging (Sonar)*
  - Battery Capacity
  - Material Safety Data Sheets
- 5.2 Other Sources of Electrical Energy
  - Electrical Energy from Light
  - Project 5-1 Photoelectric Controller*
  - Experiment 5-3 Building a Thermacouple*
  - Electrical Energy from Heat
  - Electrical Energy from Mechanical Pressure
  - Fuel Cells

Magnetohydrodynamic Power Generation  
Electricity from Magnetism

**Chapter 6 Series Circuits**

- 6.1 Series Circuit Principles
  - Voltage in a Series Circuit
  - Current in a Series Circuit
  - Resistance in a Series Circuit
  - Determining an Unknown Voltage
  - Power in a Series Circuit
- 6.2 Applications and Troubleshooting Series Circuits
  - Applying Ohm's Law
  - Airfield Lighting System
  - Troubleshooting a Series Circuit Using a Voltmeter

**Chapter 7 Parallel Circuits**

- 7.1 Parallel Circuit Principles
  - Parallel Circuit Voltage
  - Parallel Circuit Resistance
  - Power in a Parallel Circuit
- 7.2 Applications and Troubleshooting Parallel Circuits
  - Applying Ohm's Law to parallel Circuits
  - Troubleshooting a Parallel Circuit

**Chapter 8 Combination Circuits (Series-Parallel)**

- 8.1 Reducing a Complex Circuit
  - Reducing to a Simple Series Circuit
  - Reducing to a Simple Parallel Circuit
- 8.2 Solving for Voltage and Current Values
  - Power in a Combination Circuit
- 8.3 Troubleshooting a Combination Circuit

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### 9.1 Basic Magnetic Principles

Laws of Magnetism

*Experiment 9-1 Observing Magnetic Lines of Force*

Magnetic Flux

Third Law of Magnetism

### 9.2 Electric Current and Magnetism

Magnetic Circuits

The Solenoid

Electromagnets

*Experiment 9-2 Testing and Electromagnet*

### 9.3 The Relay

*Experiment 9-3 Residual Magnetism*

*Experiment 9-4 Testing a Solenoid*

Time Relays

The Reed Relay

Magnetic Circuit Breaker

Buzzer and Doorbell

Magnetic Shields

Magnetic Levitation Transportation

*Applied E&E Electric Guitar*

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### 10.1 Electrical Energy from Mechanical Energy

Magnetic Induction

DC versus AC

Construction of a Generator

Generator Losses

### 10.2 Types of Generators

Separately Excited Field Generator

*Applied E&E Motion Simulators*

Self Excited Generator

Voltage and Current Regulation

### 10.3 Alternating Current

Vectors

Average and Effective Values

Phase Displacement

Alternating Current Generator

*Experiment 10-1 Building a Generator*

- 10.4 Three-Phase Generators
  - Paralleling Generators
  - Troubleshooting Generators
- 10.5 The Oscilloscope
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  - Intensity and Focus
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## **Chapter 11 DC Motors**

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  - A Practical Motor
  - Counterelectromotive Force
  - Overload Protection
  - Applied E&E* *Submarine*
  - Commutation and Interpoles
  - Speed Regulation
- 11.2 DC Motors
  - Shunt DC Motor
  - Series DC Motor
  - Compound DC Motors
  - Motor Starting Circuits
  - Thyristor Motor Controls
  - The Universal Motor
  - Permanent Magnet Motor
  - DC Servo Motor

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- 12.1 Transformer Theory
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  - Turns Ratio Principle
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- 12.2 Typical Distribution System
  - Delta and Wye, Three-Phase Power Systems
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- 12.3 Special Transformer Applications
  - Autotransformers
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  - Types of Induction Motors
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  - Self Induction
  - Transient Responses
- Experiment 14-1 Self Inductance*
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  - Phase Relationship in Series and Parallel Inductance
- 14.3 Inductance in AC Circuits
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  - Power in Inductive Circuits
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Calculating Capacitance

Types of Capacitors

Tuner Circuits

### 15.2 Transient Response of the Capacitor

RC Time Constant

#### *Project 15-1 Flashing LED RC Circuit*

Capacitors in Series and Parallel

### 15.3 Capacitance in AC Circuits

Capacitance in AC Circuits

Power in Capacitive Circuits

Resistance and Capacitance in an AC Circuit

Parallel RC Circuit

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Acceptor Circuit

Tank Circuit

Reject Circuit

Q of Tuned Circuits

Loading of Tank Circuit

### 16.2 Filtering Circuits

Filtering Action

#### *Experiment 16-1 Demonstrate RC Coupling*

Bypassing

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High-Pass Filters

Tuned Circuit Filters

Nomograph

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Conduction of Electricity

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Doping



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  - Types of Semiconductor Diodes
  - Diode Characteristics and Ratings
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  - Power Transformers
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## Glossary of Terms

Note: All Textbook materials by Richard M. Roberts, including Laboratory Manual, with many additional lab activities, instructor resource material, power point presentation and more can be purchased at [G-W.com](http://G-W.com). List below.

## Recommended Textbook, Student Workbook, Instructor Manual, and Complete Classroom and Reference Materials

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