



UNIT 1: ELECTRICAL FUNDAMENTALS



LESSON 2 – BASIC THEORIES OF ELECTRICITY

LEARNING OUTCOME (LO 2): EXPLAIN BASIC THEORIES OF ELECTRICITY.



INTRODUCTION

Electricity powers all modern vehicles—from headlamps and wipers to electronic fuel injection and engine control units (ECUs). But what exactly is electricity? It begins at the atomic level, with the movement of electrons.

Understanding how electricity flows, and what affects it, is the foundation for all automotive electrical work. In this lesson, we break down the theory into real-world relevance for vehicle diagnostics and servicing.



LEARNING OBJECTIVES

1. Define the three basic electrical quantities: voltage, current, and resistance.
2. Describe how electrons flow in a circuit and what materials affect this flow.
3. Explain the importance of these basic concepts in real automotive systems.



SECTION I:WHAT IS ELECTRICITY?

- Electricity is the flow of electrons through a conductor (like copper wire).
- Electrons are negatively charged particles that orbit atoms. When they move in one direction along a wire, they create an electric current.

SECTION 2: CORE ELECTRICAL PROPERTIES

Quantity	Symbol	Unit	Description
Voltage	V	Volts (V)	The “pressure” or force that pushes electrons
Current	I	Amperes (A)	The flow rate of electrons
Resistance	R	Ohms (Ω)	The opposition to the flow of electrons

These three form the basis for diagnosing every electrical component in a vehicle.



REAL-WORLD ANALOGY: WATER PIPE SYSTEM

Electrical Concept	Water Analogy
Voltage	Water Pressure
Current	Flow of Water
Resistance	Blockage or Narrow Pipe

High pressure (voltage) = more flow (current)

Narrower pipe (higher resistance) = less flow





SECTION 3: CONDUCTORS AND INSULATORS

Conductors are materials that allow electricity to flow easily.
E.g., copper, aluminum (used in automotive wiring)

Insulators are materials that block electric flow.
E.g., rubber, plastic (used as wire coating)

Why it matters in auto work:

→ A cut in insulation may allow the current to jump to the chassis, causing a short circuit.





SECTION 4: TYPES OF CURRENT

Type	Description
DC (Direct Current)	Electrons flow in one direction (used in vehicles)
AC (Alternating Current)	Electrons switch direction back and forth (used in homes)

⚠ All automotive systems (battery, starter, ECU) use **DC** power.



SUGGESTED VIDEO

- Video: “Automotive Electrical Fundamentals – Part I”

YouTube Channel: Automotive Solutions



Watch here:

<https://www.youtube.com/watch?v=Q0WoHw46EcQ>

This video explains:

- Voltage, current, resistance
- How to recognize electrical flow
- Practical testing tips for beginners



SECTION 5: IMPORTANCE IN AUTOMOTIVE WORK

System	Electrical Principle Involved
Starter	Needs high current, low resistance
Lights	Must maintain voltage for brightness
ECU/Sensors	Sensitive to even small voltage drops
Battery	Stores voltage and supplies current

If a wire has **too much resistance** (from corrosion or damage), even a fully charged battery may not power a component correctly.

FREQUENTLY MISUNDERSTOOD CONCEPTS

- “12 volts is too low to be dangerous” → Current (amps), not voltage alone, causes danger.
- “Thicker wire = more power” → Thicker wire = less resistance → more efficient flow.
- “All wires carry same voltage” → Voltage can drop along wires if resistance is too high.



SUMMARY – KEY POINTS

- Electricity is electron flow affected by voltage, resistance, and current.
- All automotive circuits run on DC power, supplied by the battery.
- The relationship between these quantities is essential for troubleshooting wiring faults, sensor issues, or voltage drops.
- Understanding these principles allows technicians to predict, measure, and fix electrical issues confidently.



REFERENCES

Auto Electrical System Module – Competency-Based Learning Material

<https://www.scribd.com/document/601714455/Auto-Electrical-System-Module-PDF>

TESDA Training Regulations – Automotive Servicing NC II

<https://www.tesda.gov.ph>

YouTube – Automotive Solutions

“Automotive Electrical Fundamentals – Part I”

<https://www.youtube.com/watch?v=Q0WoHw46EcQ>