

AORSI-100-ELE Workbook

Overview

Students learn the fundamentals of electrical systems in off-road vehicles, including charging systems, wiring, lighting, and safe troubleshooting. This course builds foundational skills for understanding and maintaining vehicle electronics, focusing on both reliability and safety.

Learning Objectives

- Identify major electrical system components.
- Understand safe wiring and load management.
- Select proper lighting for visibility and safety.
- Diagnose and repair common electrical failures.

Module 1: Electrical Basics – Batteries, Alternators, Circuits

The electrical system powers vehicle operations, from ignition to lighting and accessories. Batteries store energy, alternators recharge batteries, and circuits distribute power safely. Students should learn voltage basics, current flow, and resistance concepts. Improper handling of batteries or wiring can cause fires or equipment damage, so safety practices must be emphasized.

Instructor Guidance: Demonstrate battery inspection and alternator testing using real vehicles. Show safe handling of electrical components.

Course Design Suggestion: Provide lab sessions where students build simple circuits with switches, loads, and fuses.

Exercise: Diagram the path of current flow from the battery to headlights and back.

Reflection Question: Why must alternators and batteries be tested together rather than separately?

Module 2: Wiring, Fuses, and Relays

Wiring is the nervous system of the vehicle. Proper gauge selection, insulation, and routing prevent overheating and shorts. Fuses protect against overloads, while relays allow small switches to control large loads. Students should practice reading wiring diagrams and safely replacing blown fuses or damaged wires.

Instructor Guidance: Provide examples of undersized vs. properly sized wiring to highlight overheating risks.

Course Design Suggestion: Create a wiring board for students to practice connecting circuits with relays and fuses.

Exercise: Identify three common causes of blown fuses and their solutions.

Reflection Question: Why is relay use critical when adding auxiliary electrical components?

Module 3: Lighting Systems – OEM, Auxiliary, and Specialty Options

Lighting ensures visibility for drivers and makes vehicles visible to others. OEM lighting meets minimum legal requirements, but auxiliary lights (spot, flood, light bars) improve visibility in off-road conditions. Specialty lighting, such as rock lights or infrared, serves niche needs. Students should learn how to wire lights properly with relays and avoid overloading circuits.

Instructor Guidance: Display a variety of lighting types and discuss their appropriate uses.

Course Design Suggestion: Assign a project where students install an auxiliary light with proper wiring and fuse protection.

Exercise: Compare advantages of spot beams vs. flood beams in off-road driving.

Reflection Question: How can poorly installed lighting systems create safety risks?

Module 4: Troubleshooting & Safety in the Field

Electrical failures in the field are common and often preventable. Students must learn systematic troubleshooting: check fuses, inspect wiring, test components with a multimeter. Improvised fixes must be done safely to avoid further damage. Safety includes disconnecting batteries before working on wiring and carrying spare fuses, wire, and connectors.

Instructor Guidance: Walk students through step-by-step troubleshooting of a dead circuit using a multimeter.

Course Design Suggestion: Organize a field exercise where students troubleshoot staged electrical failures in vehicles.

Exercise: Create a field toolkit list for electrical troubleshooting.

Reflection Question: Why is safety even more critical during improvised electrical repairs in the field?

Final Assessment

Task: Complete a wiring troubleshooting exercise where students identify faults and restore function safely. Additionally, complete a written test with the following sample questions:

1. What is the role of the alternator in the vehicle's electrical system?
2. Why are fuses critical to electrical safety?
3. Compare spot, flood, and light bar auxiliary lights and their uses.
4. What are three common causes of electrical failure in the field?
5. Why must safety precautions be followed during troubleshooting?

Duration: 5 hours (lab-based strongly recommended)