

AORSI-100-ENGPS Workbook

Overview

This course provides a technical dive into how engines and drivetrains power off-road vehicles. Students learn to recognize systems, diagnose issues, and maintain reliability in the field. Mastery of these fundamentals improves both operator confidence and vehicle performance in diverse conditions.

Learning Objectives

- Differentiate between gas, diesel, and electric powertrains.
- Understand how 4WD/AWD systems work.
- Perform basic diagnostics on drivetrain systems.

Module 1: Engine Types & Basics (ICE vs Electric)

Internal combustion engines (ICE) and electric motors power most off-road vehicles. Gasoline engines offer high RPM and lighter builds, while diesel engines provide torque and efficiency. Electric drivetrains offer instant torque and fewer moving parts but depend on battery range and charging. Students should understand fuel systems, ignition, and cooling in ICE engines, as well as battery management and motor control in EVs.

Instructor Guidance: Display cutaway diagrams or real engine components for comparison. Highlight differences in torque curves and maintenance requirements.

Course Design Suggestion: Have students chart the pros and cons of gas, diesel, and electric power for off-road use.

Exercise: List three unique advantages of diesel engines in off-road applications.

Reflection Question: Why might electric drivetrains change the future of off-road power systems?

Module 2: Transmissions & Transfer Cases

Transmissions manage engine power delivery, while transfer cases split power to multiple axles. Manual transmissions offer control, automatics ease of use, and CVTs continuous adjustment. Transfer cases may feature high and low ranges for terrain adaptability. Students should learn how to engage 4WD systems properly and recognize common issues like gear grinding or fluid leaks.

Instructor Guidance: Demonstrate gear engagement and transfer case operation on real vehicles.

Course Design Suggestion: Provide hands-on practice shifting between high and low range, observing vehicle behavior.

Exercise: Explain the difference between part-time and full-time 4WD systems.

Reflection Question: Why is understanding transfer case function essential for safe recovery operations?

Module 3: Differentials & Lockers

Differentials allow wheels to rotate at different speeds, essential for cornering. Off-road, this can cause traction loss, which lockers solve by forcing equal wheel rotation. Students should explore open, limited-slip, and locking differential types. Proper use of lockers increases traction but requires operator knowledge to avoid drivetrain stress.

Instructor Guidance: Provide differential models or animations to show internal mechanics.

Course Design Suggestion: Stage a vehicle with one wheel lifted to demonstrate traction loss with an open differential vs locked differential.

Exercise: Identify three advantages of lockers in technical terrain.

Reflection Question: Why must lockers be disengaged during normal driving conditions?

Module 4: Field Diagnostics & Troubleshooting

Drivetrain and engine problems in the field can stop operations. Students must learn systematic troubleshooting—checking fluids, listening for noises, testing engagement of gears, and identifying leaks or overheating. Improvised fixes, like bypassing sensors or topping fluids, may be necessary to reach safety. Emphasis should be on safety, documentation, and follow-up repairs.

Instructor Guidance: Walk students through a diagnostic flowchart for common drivetrain issues.

Course Design Suggestion: Create simulated breakdowns (e.g., overheating engine, stuck in neutral) for teams to diagnose and resolve.

Exercise: Draft a troubleshooting checklist for drivetrain issues.

Reflection Question: Why is documenting temporary field repairs critical for long-term vehicle safety?

Final Assessment

Task: Perform a hands-on evaluation of drivetrain function, including shifting, transfer case operation, and differential engagement. Students will also complete a short written exam with questions such as:

1. What are the primary differences between gas, diesel, and electric powertrains?
2. How does a transfer case affect vehicle performance off-road?
3. What is the role of a locking differential in traction control?
4. List three common field diagnostic steps for drivetrain issues.
5. Why is it important to document and repair temporary fixes made in the field?

Duration: 8 hours (blended: classroom + shop time)