Automotive Electrical & Engine Performance 7/E

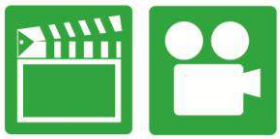
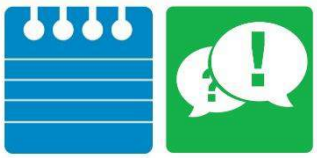
Chapter 4 Electrical Circuits & Ohm's Law

Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	**This course or class covers Automotive Electrical & Engine Performance. It correlates material to task lists specified by ASE and NATEF.**
Motivate Learners	Explain how the knowledge of how something works translates into the ability to use that knowledge to figure why the engine does not work correctly and how this saves diagnosis time, which translates into more money.
State the learning objectives for the chapter or course you are about to cover and explain this is what they should be able to do as a result of attending this session or class.	Explain the chapter learning objectives to the students. 1. Identify the parts of a complete circuit. 2. Describe the characteristics of different types of circuit. 3. Explain Ohm's law as it applies to automotive circuits. 4. Explain Watt's law as it applies to automotive circuits. This chapter will help you prepare for the ASE Electrical/Electronic Systems (A6) certification test content area "A" (General Electrical/Electronic System Diagnosis).
Establish the Mood or Climate	Provide a *WELCOME,* Avoid put downs and bad jokes.
Complete Essentials	Restrooms, breaks, registration, tests, etc.
Clarify and Establish Knowledge Base	Do a round robin of the class by going around the room and having each student give their backgrounds, years of experience, family, hobbies, career goals, or anything they want to share.

NOTE: This lesson plan is based on Automotive Electrical & Engine Performance 7/E Chapter Images found on Jim's web site @ www.jameshalderman.com

LINK CHP 4: Chapter Images

ICONS	Ch04 ELECTRICAL CIRCUITS/OHM'S LAW
       	**1. SLIDE 1 CH4 ELECTRICAL CIRCUITS/OHM'S LAW** **Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/** **WEB SITE IS CONSTANTLY UPDATED** **Videos** **At the beginning of this class, you can download the crossword puzzle & Word Search from the links below to familiarize your class with the terms in this chapter & then discuss them** **Crossword Puzzle (Microsoft Word) (PDF)** **Word Search Puzzle (Microsoft Word) (PDF** **2. SLIDE 2 EXPLAIN Figure 4-1** All complete circuits must have a power source, a power path, protection (fuse), an electrical load (light bulb in this case), and a return path back to the power source. **DEMONSTRATION: DEMO BASIC ELECTRICAL CIRCUIT ON TRAINER. SHOW (FIGURE 4-1)WHAT HAPPENS WHEN CIRCUIT IS SHORTED TO GROUND** **TRAINER TASK: ALLOW STUDENTS TO BLOW FUSE BY CREATING A SHORT CIRCUIT, OBSERVING WHAT IT TAKES TO CREATE SHORT CIRCUIT** **3. SLIDE 3 EXPLAIN Figure 4-2** return path back to the battery can be any electrical conductor, such as a copper wire or the metal frame or body of the vehicle. **4. SLIDE 4 EXPLAIN Figure 4-3** electrical switch opens the circuit and no current flows. The switch could also be on the return (ground) path wire. **5. SLIDE 5 EXPLAIN Figure 4-4** Examples of common causes of open circuits. Some are often difficult to find. **6. SLIDE 6 EXPLAIN Figure 4-5** short circuit permits electrical current to bypass some or all of resistance in circuit.

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	**DISCUSSION: Ask students to discuss ground path. Why doesn't a separate ground wire have to be run from the battery to each electrical load?** **Ask students to discuss how and why a short-to-voltage occurs. What is the reason that a short-to-voltage may or may not blow a fuse?** **EXPLAIN TECH TIP**
	
	7. **SLIDE 7 EXPLAIN Figure 4-6** A fuse or circuit breaker opens the circuit to prevent possible overheating damage in the event of a short circuit. 8. **SLIDE 8 EXPLAIN Figure 4-7 short-to-ground** affects power side of circuit. Current flows directly to ground return, bypassing some or all of electrical loads in the circuit. There is no current in circuit past the short. A short-to ground will also cause fuse to blow
	**DISCUSSION: Ask students to discuss effects of higher than-normal resistance on various components in an automotive electrical system. What can cause high resistance?** **Discuss REAL WORLD FIX**
	
	**HOMEWORK: Research on Internet opportunities for technicians who specialize in electrical systems in your area. Ask them to focus on following questions: What types of work are available? What are the training and job qualification requirements? What is salary range for technician who is trained in automotive electrical systems?** **EXPLAIN TECH TIP**
	
	**DEMONSTRATION: Use an inductive ammeter or charging system tester to show that *amount of current leaving battery on positive is returned on negative side.***
	9. **SLIDE 9 EXPLAIN FIGURE 4-8** Electrical flow through a circuit is similar to water flowing over a waterwheel. 10. **SLIDE 10 EXPLAIN Figure 4-9** To calculate one unit of electricity when the other two are known, simply use

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      	your finger and cover the unit you do not know. For example, if both voltage (E) and resistance (R) are known, cover the letter I (amperes). Notice that the letter E is above the letter R, so divide the resistor's value into the voltage to determine the current in the circuit. **DISCUSSION: Ask students to talk about Ohm's law. What is application of Ohm's law in automotive wiring circuits?** **Ohm's Law, Current (View) (Download)** **Ohm's Law, Resistance (View) (Download)** **Ohm's Law, Volt (View) (Download)** **Complete Task Sheet on Electrical Circuits** **Students can complete NATEF Task Sheet A6A5 on Ohm's Law: Diagnose electrical/electronic integrity of series, parallel & series-parallel circuits using principles of electricity (Ohm's Law). (P-1)** **11. SLIDE 11 EXPLAIN Figure 4-10** This closed circuit includes a power source, power-side wire, circuit protection (fuse), resistance (bulb), and return path wire. In this circuit, if battery has 12 volts & electrical load has 4 ohms, then current through circuit is 4 amperes. **DISCUSSION: Ask students to compare Ohm's & Watt's laws. Which law can be used to determine the diameter of wire needed for a circuit?** **12. SLIDE 12 EXPLAIN Figure 4-11** Calculate 1 unit when other 2 are known, cover unknown unit to see what unit needs to be divided or multiplied to arrive at solution. **13. SLIDE 13 EXPLAIN Figure 4-12** "Magic circle" of most formulas for problems involving Ohm's law. Each quarter of "pie" has formulas used to solve for a particular unknown value: current (amperes), in upper right segment; resistance (ohms), in lower right; voltage (E), in lower left; and power (watts), in upper left. **DISCUSSION: ASK STUDENTS TO DISCUSS GROUND PATH. WHY DOESN'T A SEPARATE GROUND WIRE HAVE TO BE RUN FROM THE BATTERY TO EACH ELECTRICAL LOAD?** **ASK STUDENTS TO DISCUSS HOW AND WHY A**

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 	**SHORT-TO-VOLTAGE OCCURS. WHAT IS THE REASON THAT A SHORT-TO-VOLTAGE MAY OR MAY NOT BLOW A FUSE?** **DEMONSTRATION: USE AN INDUCTIVE AMMETER OR CHARGING SYSTEM TESTER TO SHOW THAT *AMOUNT OF CURRENT LEAVING BATTERY ON POSITIVE IS RETURNED ON NEGATIVE SIDE.*** **DISCUSSION: ASK STUDENTS TO TALK ABOUT OHM'S LAW. WHAT IS APPLICATION OF OHM'S LAW IN AUTOMOTIVE WIRING CIRCUITS?**