Automotive Technology 6th Edition
Chapter 47 MAGNETISM & ELECTROMAGNETISM
Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	This Automotive Technology 6th text provides complete coverage of automotive components, operation, design, and troubleshooting. It correlates material to task lists specified by ASE and ASEEducation (NATEF) and emphasizes a problem-solving approach. Chapter features include Tech Tips, Frequently Asked Questions, Case Studies, Videos, Animations, and ASEEducation (NATEF) Task Sheets.
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 learning objectives to students as listed BELOW: 1. Discuss the fundamentals of electromagnetism. 2. Explain how an electromagnet works and discuss its uses. 3. Discuss electromagnetic induction, ignition coils, and EMI suppression devices.
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: Lesson plan is based on 6th Edition Chapter Images found on Jim's web site @ www.jameshalderman.com

DOWNLOAD Chapter 47 Chapter Images: From

http://www.jameshalderman.com/automotive_principles.html

NOTE: You can use Chapter Images or possibly Power Point files:

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	**1. TITLE SLIDE 1 MAGNETISM AND ELECTROMAGNETISM** **6. SLIDE 6 EXPLAIN Figure 47-1** Freely suspended natural magnet (lodestone) will point toward magnetic north pole. **Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/** **WEB SITE IS CONSTANTLY UPDATED** **http://www.jameshalderman.com/automotive_principles.html** **DOWNLOAD** **Crossword Puzzle (Microsoft Word) (PDF)** **Word Search Puzzle (Microsoft Word) (PDF** **Videos** **DEMONSTRATION: Show students how to magnetize a small object such as a nail or paper clip. Have students magnetize a small object.**
	**EXPLAIN TECH TIP: *A Cracked Magnet Becomes Two Magnets.* Magnets are commonly used in vehicle crankshaft, camshaft, and wheel speed sensors. If a magnet is struck and cracks or breaks, result is 2 smaller-strength magnets. Because the strength of the magnetic field is reduced, sensor output voltage is also reduced. A typical problem occurs when a magnetic crankshaft sensor becomes cracked, resulting in a no-start condition. Sometimes cracked sensor works well enough to start an engine that is cranking at normal speeds, but does not work when the engine is cold. • SEE FIGURE 47–2.** **3. SLIDE 3 EXPLAIN Figure 47-2** Magnet breaks or is cracked, it becomes 2 weaker magnets.

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	4. **SLIDE 4 EXPLAIN Figure 47-3** Magnetic lines of force leave north pole & return to south pole of bar magnet. 5. **SLIDE 5 EXPLAIN Figure 47-4** Iron filings and a compass can be used to observe magnetic lines of force. 6. **SLIDE 6 EXPLAIN Figure 47-5** Magnetic poles behave like electrically charged particles—unlike poles attract and like poles repel. **EXPLAIN TECH TIP: *Magnetize a Steel Needle*** **A piece of steel can be magnetized by rubbing a magnet in one direction along steel. This causes atoms to line up in steel, so it acts like a magnet. The steel often does not remain magnetized, whereas true magnet is permanently magnetized. When soft iron or steel is used, such as a paper clip, it loses its magnetism quickly. The atoms in a magnetized needle can be disturbed by heating it or by dropping the needle on a hard object, which causes the needle to lose its magnetism. Soft iron is used inside ignition coils because it does not keep its magnetism.** **Magnetic Induction (View) (Download)** **Magnets (View) (Download)** **Electron Travel, Magnet (View) (Download)** 7. **SLIDE 7 EXPLAIN Figure 47-6** crankshaft position sensor and reluctor (notched wheel). 8. **SLIDE 8 EXPLAIN Figure 47-7** magnetic field surrounds a straight, current-carrying conductor. **DEMONSTRATION: Wrap a number 16 nail with 20 turns of insulated wire. Connect ends of the wire to a D cell battery. Show students how the nail is now a magnet and can pick up small metal objects.** **HANDS-ON TASK: Have students build their own electromagnets. Let them try more than one battery, more turns of wire, or a larger core. Have them document the strength of each version of the electromagnet to decide what produces a stronger magnet and what does not.**

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	9. **SLIDE 9 EXPLAIN** Figure 47-8 left-hand rule for magnetic field direction is used with electron flow theory. 10. **SLIDE 10 EXPLAIN Figure 47-9 right-hand rule** for magnetic field direction is used with the **conventional theory** of electron flow. **DISCUSSION: Have students talk about right-hand & and left-hand rules of magnetism. Which rule is used to determine the direction of the magnetic flux lines in most automotive circuits?** 11. **SLIDE 11 EXPLAIN Figure 47-10** Conductors with opposing magnetic fields will move apart into weaker fields. 12. **SLIDE 12 EXPLAIN Figure 47-11** Electric motors use interaction of magnetic fields to produce mechanical energy. 13. **SLIDE 13 EXPLAIN Figure 47-12** magnetic lines of flux surrounding a coil look similar to those surrounding a bar magnet. 14. **SLIDE 14 EXPLAIN Figure 47-13** left-hand rule for coils is shown. 15. **SLIDE 15 EXPLAIN Figure 47-14** iron core concentrates magnetic lines of force surrounding a coil. **EXPLAIN TECH TIP: *Electricity and Magnetism*** **Electricity and magnetism are closely related because any electrical current flowing through a conductor creates a magnetic field. Any conductor moving through magnetic field creates electrical current. This relationship can be summarized as follows:** • **Electricity creates magnetism.** • **Magnetism creates electricity.** **This relationship is important because wires carrying current should always be routed as factory intended to avoid causing interference with another circuit or electronic component. This is important when installing or servicing spark plug wires, which carry high voltages and can cause high electromagnetic interference.**

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 	**16. SLIDE 16 EXPLAIN Figure 47-15** electromagnetic switch that has a movable arm is referred to as a relay. **17. SLIDE 17 EXPLAIN Figure 47-16 (a)** A starter with attached solenoid. All of the current needed by the starter flows through the two large terminals of the solenoid and through the solenoid contacts inside. **DISCUSS FREQUENTLY ASKED QUESTION: *Solenoid or Relay?* Often, either term is used to describe the same part in service information. • SEE CHART 47–1 for Summary of differences.** **DISCUSS CHART 47-1 Comparison between a relay and a solenoid.** **18. SLIDE 18 EXPLAIN Figure 47-16 (b)** A relay is designed to carry lower current compared to a solenoid and uses a movable arm. **19. SLIDE 19 EXPLAIN Figure 47-17** Voltage can be induced by the relative motion between a conductor and magnetic lines of force. **20. SLIDE 20 EXPLAIN Figure 47-18** Maximum voltage is induced when conductors cut across the magnetic lines of force (flux lines) at a 90-degree angle. **21. SLIDE 21 EXPLAIN Figure 47-19** Mutual induction occurs when expansion or collapse of a magnetic field around one coil induces a voltage in a second coil. **22. SLIDE 22 EXPLAIN Figure 47-21** A GM waste-spark ignition coil showing the section of laminations that is shaped like the letter E . These mild steel laminations improve the efficiency of the coil. **23. SLIDE 23 EXPLAIN Figure 47-22** coil-on-plug (COP) design typically uses a bobbin-type coil. **24. SLIDE 24 EXPLAIN Figure 47-23** To help prevent underhood electromagnetic devices from interfering with the antenna input, it is important that all ground wires, be properly grounded.

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Education Foundation	**ASEEDUCATION Task Sheet Inspect and test switches, connectors, relays, solenoid solid state devices, and wires of electrical/electronic circuits; perform necessary action**