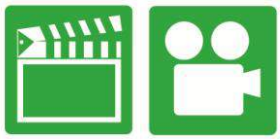
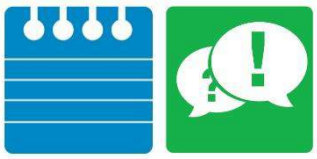
Automotive Electrical & Engine Performance 7/E

Chapter 19 Charging System Operation

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. Describe an alternator's overrunning pulleys. 2. Describe the components and operation of an alternator. 3. Discuss how an alternator works. 4. Explain how the voltage produced by an alternator is regulated. 5. Discuss computer-controlled alternators. This chapter will help you prepare for the ASE Electrical/Electronic Systems (A6) certification test content area "C" (Starting System Diagnosis and Repair)
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 19: Chapter Images

ICONS	Ch19 Charging System
         	**1. SLIDE 1 CH1 Charging System** **Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/** **WEB SITE IS CONSTANTLY UPDATED** **NO VIDEOS THIS CHAPTER GOTO WWW.YOUTUBE.COM** **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)** **Charging System** **Charging Circuit Volt Drop Ground Side** **Charging Circuit Volt Drop Power Side** 2. **SLIDE 2 EXPLAIN Figure 19-1** typical alternator on a Chevrolet V-8 engine. 3. **SLIDE 3 EXPLAIN Figure 19-2** end frame toward the drive belt is called the drive-end housing and the rear section is called the slip-ring-end housing. **DISCUSSION: HAVE STUDENTS TALK ABOUT FUNCTION OF GENERATOR, OR MOTOR, USED IN HYBRID VEHICLES. HOW CAN AN ALTERNATOR ALSO FUNCTION AS A MOTOR?** **ON-VEHICLE TASK: USE VOCABULARY SCAVENGER HUNT TASK SHEET TO IDENTIFY PARTS ON VEHICLE RELATED TO CHARGING SYSTEM THAT CORRESPOND WITH LETTER ON THE TASK SHEET & DESCRIBE PURPOSE OF EACH PART.** **HANDS-ON TASK: HAVE THE STUDENTS LOCATE THE STICKER OR STAMP THAT SHOWS THE ALTERNATOR AMPERAGE RATING ON SEVERAL DIFFERENT ALTERNATORS.**

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	**EXPLAIN ALTERNATOR OVERRUNNING PULLEYS**
	4. **SLIDE 4 EXPLAIN Figure 19-3** OAP on Corvette 5. **SLIDE 5 EXPLAIN Figure 19-4** exploded view of an overrunning alternator pulley showing internal parts.
	**DISCUSSION: DISCUSS THE PROS AND CONS OF USING AN OAP OR OAD PULLEY. WHY ISN'T AN OAP OR OAD BEING USED ON EVERY VEHICLE?**
	**EXPLAIN TECH TIP**
	**DISCUSS FREQUENTLY ASKED QUESTION**
	**EXPLAIN TECH TIP**
	6. **SLIDE 6 EXPLAIN FIGURE 19–5** A special tool is needed to remove and install overrunning alternator pulleys or dampeners. 7. **SLIDE 7 EXPLAIN Figure 19-6** A cutaway of an alternator, showing the rotor and cooling fan that is used to force air through the unit to remove the heat created when it is charging the battery and supplying electrical power for the vehicle 8. **SLIDE 8 EXPLAIN Figure 19-7** Rotor assembly of a typical alternator. Current through the slip rings causes the "fingers" of rotor to become alternating north and south magnetic poles. As rotor revolves, these magnetic lines of force induce a current in the stator windings.
	9. **SLIDE 9 EXPLAIN Figure 19-8** exploded view of a typical alternator showing all of its internal parts including the stator windings. 10. **SLIDE 10 EXPLAIN Figure 19-9** rectifier usually includes 6 diodes in one assembly and used to rectify AC voltage from stator windings into DC voltage suitable for use by battery and electrical devices in vehicle.
	**DEMONSTRATION: SHOW EXAMPLES OF ROTOR & STATOR WINDINGS. HAVE THEM HELP YOU IDENTIFY EACH COMPONENT & EXPLAIN PURPOSE.**

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	**DISCUSSION: HAVE THE STUDENTS DISCUSS HOW DIODES FUNCTION AS A VALVE. WHAT IS THE DIFFERENCE BETWEEN AN NPN AND A PNP?**
	11. **SLIDE 11 EXPLAIN**: HOW ALTERNATOR WORKS & **EXPLAIN Figure 19-10** Magnetic lines of force cutting across a conductor induce a voltage and current in the conductor
	12. **SLIDE 12 EXPLAIN Figure 19-11** A sine wave (shaped like the letter S on its side) voltage curve is created by one revolution of a winding as it rotates in a magnetic field.
	13. **SLIDE 13 EXPLAIN Figure 19-12** When three windings (A, B, and C) are present in a stator, the resulting current generation is represented by the three sine waves. The voltages are 120 degrees out of phase. The connection of the individual phases produces a three-phase alternating voltage.
	14. **SLIDE 14 EXPLAIN Figure 19-13** Wye-connected stator winding.
	15. **SLIDE 15 EXPLAIN Figure 19-14** As the magnetic field, created in the rotor, cuts across the windings of the stator, a current is induced. Notice that the current path includes passing through one positive (+) diode on the way to the battery and one negative (−) diode as a complete circuit is completed through the rectifier and stator.
	16. **SLIDE 16 EXPLAIN Figure 19-15** Delta-connected stator winding.
	**DISCUSSION: DRAW A PATTERN OF THREE PHASE VOLTAGE. SHOW STUDENTS WHAT HAPPENS TO THE GRAPH WHEN DIODES ARE USED TO RECTIFY THE CURRENT.**
	**HANDS-ON TASK: DRAW A SCHEMATIC OF A WYE CONNECTED STATOR. GRADE THEM ON THEIR ABILITY TO CREATE AN APPROPRIATE SCHEMATIC WITH ACCURATE INFORMATION.**
	**STUDENTS COMPLETE NATEF TASK SHEET: RESEARCH APPLICABLE VEHICLE AND SERVICE INFORMATION, SUCH AS ELECTRICAL ELECTRONIC SYSTEM OPERATION, VEHICLE SERVICE HISTORY, SERVICE PRECAUTIONS, & SERVICE BULLETINS**

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	**DISCUSSION: HAVE THE STUDENTS DISCUSS THE DIFFERENCE BETWEEN DELTA CONNECTED STATORS AND WYE CONNECTED STATORS. WHAT ARE ADVANTAGES OF EACH TYPE? WHICH TYPE HAS A HIGHER OUTPUT?**
	**DISCUSSION: HAVE THE STUDENTS TALK ABOUT THE THREE MAIN FACTORS THAT AFFECT THE OUTPUT OF AN ALTERNATOR. WHY IT IS IMPORTANT TO CHECK THE OUTPUT OF AN ALTERNATOR AT OFF-IDLE ENGINE SPEED?**
	17. **SLIDE 17: EXPLAIN Alternator Output Factors & EXPLAIN FIGURE 19–16** A stator assembly with six, rather than the normal three, windings. 18. **SLIDE 18 EXPLAIN Figure 19-17** Typical voltage regulator range. 19. **SLIDE 19 EXPLAIN Figure 19-18** typical electronic voltage regulator with the cover removed showing the circuits inside. 20. **SLIDE 20 EXPLAIN Figure 19-19** Typical GM SI-style alternator with integral voltage regulator. Voltage present at terminal 2 is used to reverse bias Zener diode (D2) that controls TR2. Positive brush is fed by ignition current (terminal I) plus current from diode trio **EXPLAIN ALTERNATOR COOLING** 21. **SLIDE 21 EXPLAIN FIGURE 19–20** A coolant-cooled alternator showing the hose connections where coolant from the engine flows through the rear frame of the alternator.
	**DISCUSSION: HAVE THE STUDENTS DISCUSS WHY VOLTAGE REGULATORS ARE A NECESSARY PART OF THE CHARGING SYSTEM. HOW IS THE FIELD CURRENT CONTROLLED? HAVE THE STUDENTS TALK ABOUT BATTERY CONDITION AND CHARGING VOLTAGE. WHY CAN IT BE SAID THAT THE BATTERY IS THE TRUE VOLTAGE REGULATOR?**
	**DEMONSTRATION: SHOW THE STUDENTS AN EXAMPLE OF AN INTERNAL ALTERNATOR FAN AND AN EXTERNAL ALTERNATOR FAN. EXPLAIN THE OPERATION OF EACH. FIGURE 19-20**
	22. **SLIDE 22 EXPLAIN Figure 19-21** Hall-effect current sensor attached to positive battery cable is used as part of EPM system.

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    	23. **SLIDE 23 EXPLAIN Figure 19-22** amount of time current is flowing through field (rotor) determines alternator output 24. **SLIDE 24 EXPLAIN CHART 19-1** The output voltage is controlled by varying the duty cycle as controlled by the PCM **EXPLAIN TECH TIP** **DISCUSSION: HAVE THE STUDENTS TALK ABOUT THE EPM SYSTEM USED ON GM VEHICLES. WHAT ARE SIX DIFFERENT MODES OF OPERATION?** **DEMONSTRATION: SHOW STUDENTS HOW TO PERFORM A QUICK CHECK ON A CHARGING SYSTEM BY CHECKING THE STATIC AND DYNAMIC VOLTAGES WITH A DMM. ALSO, DEMONSTRATE HOW TO CHECK THE SUPPLIED VOLTAGE AT THE ALTERNATOR CONNECTOR. ENGINE OFF, SHOULD BE 12.6 VOLTS. ENGINE RUNNING AT 1500 RPM ABOUT 14.5 VOLTS.**