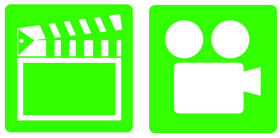
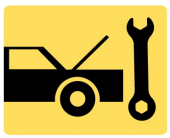
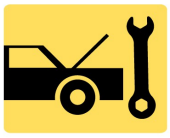
A6 Electricity & Electronics 4th Edition

Chapter 21 Charging System

Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	This course or class covers operation and service of **Automotive Electricity and Electronics Systems.** 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 "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.

ICONS	Ch21 Charging System
	**1. SLIDE 1 CH21 Charging System** **2. SLIDES 2-3 EXPLAIN OBJECTIVES**
	**Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/** **WEB SITE IS CONSTANTLY UPDATED**
	**Charging System** **Charging Circuit Volt Drop Ground Side** **Charging Circuit Volt Drop Power Side**
	**4. SLIDES 4-5: EXPLAIN PRINCIPLES OF ALTERNATOR OPERATION**
	6. SLIDE 6 EXPLAIN ALTERNATOR CONSTRUCTION **7. SLIDE 7 EXPLAIN Figure 21-1** typical alternator on a Chevrolet V-8 engine. **8. SLIDE 8 EXPLAIN Figure 21-2** 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.**
	**9. SLIDE 9: EXPLAIN ALTERNATOR OVERRUNNING PULLEYS**

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	**10. SLIDE 10 EXPLAIN Figure 21-3** OAP on a Corvette **11. SLIDE 11 EXPLAIN Figure 21-4** An exploded view of an overrunning alternator pulley showing all of the 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?**
	**12. SLIDE 12 EXPLAIN FIGURE 21–5** A special tool is needed to remove and install overrunning alternator pulleys or dampeners. **13. SLIDE 13: EXPLAIN ALTERNATOR COMPONENTS & OPERATION** **14. SLIDE 14 EXPLAIN Figure 21-6** 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 **15. SLIDE 15 EXPLAIN Figure 21-7** 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.
	**16. SLIDE 16 EXPLAIN Figure 21-8** exploded view of a typical alternator showing all of its internal parts including the stator windings. **17. SLIDE 17 EXPLAIN Figure 21-9** 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.**
	**DISCUSSION: HAVE THE STUDENTS DISCUSS HOW DIODES FUNCTION AS A VALVE. WHAT IS THE DIFFERENCE BETWEEN AN NPN AND A PNP?**
	**18. SLIDE 18 EXPLAIN**: HOW ALTERNATOR WORKS **19. SLIDE 19 EXPLAIN Figure 21-10** Magnetic lines of force cutting across a conductor induce a voltage and current in the conductor

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	**20. SLIDE 20 EXPLAIN Figure 21-11** 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. **21. SLIDE 21 EXPLAIN Figure 21-12** 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.
	**22. SLIDE 22 EXPLAIN Figure 21-13** Wye-connected stator winding. **23. SLIDE 23 EXPLAIN Figure 21-14** 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. **24. SLIDE 24 EXPLAIN Figure 21-15** 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: HAVE THE STUDENTS 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**
	**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?**

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	**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?**
	**25. SLIDE 25: EXPLAIN Alternator Output Factors** **26. SLIDE 26: EXPLAIN FIGURE 21–16** A stator assembly with six, rather than the normal three, windings. **27. SLIDE 27 EXPLAIN ALTERNATOR VOLTAGE REGULATION** **28. SLIDE 28 EXPLAIN Figure 21-17** Typical voltage regulator range. **29. SLIDE 29 EXPLAIN Figure 21-18** typical electronic voltage regulator with the cover removed showing the circuits inside. **30. SLIDE 30 EXPLAIN Figure 21-19** Typical General Motors SI-style alternator with an integral voltage regulator. Voltage present at terminal 2 is used to reverse bias the Zener diode (D2) that controls TR2. The positive brush is fed by ignition current (terminal I) plus current from the diode trio **31. SLIDE 31 EXPLAIN FIGURE 21–20** 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 21-20**
	**32. SLIDE 32 EXPLAIN: COMPUTER-CONTROLLED ALTERNATORS** **33. SLIDE 33 EXPLAIN Figure 21-21** Hall-effect current sensor attached to positive battery cable is used as part of EPM system.

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	34. **SLIDE 34 EXPLAIN Figure 21-22** amount of time current is flowing through field (rotor) determines alternator output 35. **SLIDE 35 EXPLAIN** Computer-Controlled Alternators 36. **SLIDE 36 EXPLAIN SUMMARY**
 	**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.**