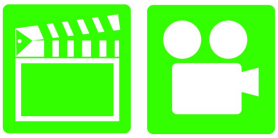
A6 Electricity & Electronics 4th Edition

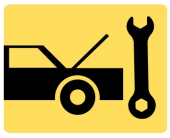
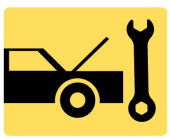
Chapter 28 Audio System Operation and Diagnosis

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 how AM, FM, and satellite radio works. 2. Describe antennas and their diagnosis. 3. Discuss the purpose, function, and types of speakers. 4. Discuss crossovers and voice recognition systems. 5. Explain how Bluetooth systems work. 6. List causes and corrections of radio noise and interference. **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	Ch28 Audio System Operation and Diagnosis
	**1. SLIDE 1 CH28 AUDIO SYSTEM OPERATION AND DIAGNOSIS**
	2. SLIDES 2-3 EXPLAIN OBJECTIVES
	**Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/**
	WEB SITE IS CONSTANTLY UPDATED
	**4. SLIDE 4 EXPLAIN Audio Fundamentals**
	5. SLIDE 5 EXPLAIN Figure 28-1 Audio systems use both electromagnetic radio waves and sound waves to reproduce sound inside the vehicle.
	6. SLIDE 6 EXPLAIN Figure 28-2 relationship among wavelength, frequency, and amplitude.
	7. SLIDE 7 EXPLAIN Audio Fundamentals
	8. SLIDE 8 EXPLAIN Figure 28-3 The amplitude changes in AM broadcasting & **FIGURE 28–4** The frequency changes in FM broadcasting and the amplitude remains constant
	9. SLIDE 9 EXPLAIN Radios and Receivers
	**DISCUSSION: HAVE STUDENTS DISCUSS TERMS RFI & EMI. HOW DO RFI & EMI RELATE TO AUDIO SYSTEMS? ASK THE STUDENTS TO DESCRIBE THE DIFFERENCE BETWEEN AM (AMPLITUDE MODULATION) & FM (FREQUENCY MODULATION)**
	**DISCUSSION: HAVE STUDENTS DISCUSS CORRELATION BETWEEN FREQUENCY & WAVELENGTH. HOW IS FREQUENCY MEASURED?**
	**DISCUSSION: HAVE STUDENTS' LIST MAIN COMPONENTS THAT MAKE UP AN AUDIO SYSTEM & BRIEFLY DISCUSS THEIR PURPOSE. WHO ADDRESSES AUDIO RELATED PROBLEMS?**
	10. SLIDE 10 EXPLAIN ANTENNAS
	**11. SLIDE 11 EXPLAIN Figure 28-5** Using upper and lower sidebands allows stereo to be broadcast. Receiver separates the signals to provide left and right channels.
	12. SLIDE 12 EXPLAIN Figure 28-6 Five types of antennas used on GM vehicles include the slot antenna, fixed mast antenna, rear window defogger grid antenna, a powered mast antenna, and an integrated antenna.

ICONS	Ch28 Audio System Operation and Diagnosis
	13. **SLIDE 13 EXPLAIN FIGURE 28–7** The ground plane is actually one-half of the antenna. 14. **SLIDE 14 EXPLAIN** Antenna Diagnosis
	**DEMONSTRATION: SHOW STUDENTS HOW TO REMOVE & REPLACE ANTENNAS AND HOW TO AVOID BODY/PAINT DAMAGE.**
	**DEMONSTRATION: SHOW STUDENTS HOW TO USE AN DMM OHMMETER FUNCTION TO TEST ANTENNAS FOR SHORTS & OPENS**
	15. **SLIDE 15 EXPLAIN FIGURE 28–9** Cutting a small hole in a fender cover helps to protect the vehicle when replacing or servicing an antenna.. 16. **SLIDE 16 EXPLAIN Figure 28-10** A typical power antenna assembly. Note the braided ground wire used to ensure that the antenna has a good ground plane
	17. **SLIDE 17 EXPLAIN** Speakers & Speaker Types 18. **SLIDE 18 EXPLAIN FIGURE 28–8** If all ohmmeter readings are satisfactory, the antenna is good
	**INSTRUCTOR NOTE: FIGURE 28-8 IS OUT OF SEQUENCE & COMES AFTER FIGURE 28-10. DONE BY THE POWER POINT DEVELOPER**
	19. **SLIDE 19 EXPLAIN Figure 28-11** Between 6 and 7 volts is applied to each speaker terminal, and the audio amplifier then increases the voltage on one terminal and at the same time decreases the voltage on the other terminal causing the speaker cone to move. The moving cone then moves the air, causing sound. 20. **SLIDE 20 EXPLAIN Figure 28-12** A typical automotive speaker with two terminals. The polarity of the speakers can be identified by looking at the wiring diagram in the service manual or by using a 1.5 volt battery to check. When the battery positive is applied to the positive terminal of the speaker, the cone will move outward. When the battery leads are reversed, the speaker cone will move inward.
	21. **SLIDE 21 EXPLAIN Figure 28-13** (a) Two 4 ohm speakers connected in series result in total impedance of 8 ohms. (b) Two 4 ohm speakers connected in parallel result in total impedance of 2 ohms.

ICONS	Ch28 Audio System Operation and Diagnosis
	**DISCUSSION:** HAVE STUDENTS DISCUSS BASIC SPEAKER OPERATION. HOW DO SPEAKERS CONVERT ELECTRICAL ENERGY INTO ACOUSTICAL ENERGY?
	**DEMONSTRATION:** SHOW STUDENTS EXAMPLES OF DIFFERENT TYPES OF SPEAKERS & EXPLAIN HOW TO DETERMINE THEIR USE
	**HANDS-ON TASK:** HAVE STUDENTS USE 1.5-VOLT BATTERY TO TEST SPEAKER POLARITY. POLARITY OF SPEAKERS CAN BE IDENTIFIED BY LOOKING AT WIRING DIAGRAM OR BY USING A 1.5 VOLT BATTERY TO CHECK. WHEN BATTERY POSITIVE IS APPLIED TO POSITIVE TERMINAL OF SPEAKER, CONE WILL MOVE OUTWARD. WHEN BATTERY LEADS ARE REVERSED, SPEAKER CONE WILL MOVE INWARD.
	**22. SLIDE 22** EXPLAIN Sound Levels **23. SLIDE 23** EXPLAIN Crossovers **24. SLIDE 24** EXPLAIN **Figure 28-14** Crossovers are used in audio systems to send high-frequency sounds to the small (tweeter) speakers and low frequency sounds to larger (woofer) speakers.
	**DISCUSSION:** REVIEW OHM'S LAW & WAY WIRING LOADS IN SERIES OR PARALLEL AFFECT CIRCUIT RESISTANCE & CURRENT. ASK STUDENTS HOW SPEAKER RESISTANCE AFFECTS SPEAKER'S PERFORMANCE
	**DEMONSTRATION: ON ELECTRICAL TRAINER:** BUILD SERIES & PARALLEL CIRCUITS SIMILAR TO SPEAKER ARRAYS & USE BULBS TO SIMULATE SPEAKER LOADS.
	**HANDS-ON TASK:** PROVIDE STUDENTS WITH SAMPLE SERIES & PARALLEL CIRCUITS ON ELECTRICAL TRAINER. ASSIGN VALUES TO LOADS AND SOURCE VOLTAGE. HAVE STUDENTS USE OHM'S LAW TO CALCULATE TOTAL RESISTANCE AND CURRENT IN EACH CIRCUIT.

ICONS	Ch28 Audio System Operation and Diagnosis
	**25. SLIDE 25 EXPLAIN** Aftermarket Sound System Upgrade **26. SLIDE 26 EXPLAIN Figure 28-15** Two capacitors connected in parallel provide the necessary current flow to power large subwoofer speakers
	**DISCUSSION: DISCUSS IMPORTANCE OF FUSE SIZE AND PLACEMENT IN AFTERMARKET AUDIO SYSTEMS. WHAT IS REASON FOR USING A FUSE?** **27. SLIDE 27 EXPLAIN Figure 28-16** powerline capacitor should be connected through the power wire to the amplifier as shown. When amplifier requires more electrical power (watts) than the battery can supply, capacitor will discharge into the amplifier and supply necessary current for fraction of a second it is needed by amplifier. At other times when capacitor is not needed, it draws current from the battery to keep it charged
	**DEMONSTRATION: SHOW STUDENTS EXAMPLES OF DIFFERENT TYPES OF CAPACITORS, & DEMONSTRATE HOW TO PROPERLY MATCH A CAPACITOR WITH AMPLIFIER OUTPUT**
	**DISCUSSION: ASK STUDENTS TO DESCRIBE HOW LOUD NOISES AFFECT HEARING, & DISCUSS WHEN HEARING PROTECTION SHOULD BE WORN.**
	
	**28. SLIDE 28 EXPLAIN** Voice Recognition **29. SLIDE 29 EXPLAIN Figure 28-17** Voice commands can be used to control many functions, including navigation systems, climate control, telephone, and radio. **30. SLIDE 30 EXPLAIN Figure 28-18** The voice command icon on the steering wheel of a Cadillac. **31. SLIDE 31 EXPLAIN Figure 28-19** Bluetooth earpiece that contains a microphone and speaker unit that is paired to a cellular phone. The telephone has to be within 33 ft (10 m) of the earpiece.

ICONS	Ch28 Audio System Operation and Diagnosis
  	**TERM BLUETOOTH COMES FROM THE KING OF DENMARK: HAROLD BLUETOOTH, WHO UNITED THE NETHERLANDS** **32. SLIDE 32** EXPLAIN Satellite Radio **33. SLIDE 33** EXPLAIN **Figure 28-20** SDARS uses satellites and repeater stations to broadcast radio. **34. SLIDE 34** EXPLAIN **Figure 28-21** An aftermarket XM radio antenna mounted on the rear deck lid. The deck lid acts as the ground plane for the antenna & EXPLAIN **Figure 28-22** A shark-fin-type factory antenna used for both XM and OnStar **35. SLIDE 35** EXPLAIN Radio Interference **36. SLIDE 36** EXPLAIN **Figure 28-23** radio choke and/or a capacitor can be installed in the power feed lead to any radio, amplifier, or equalizer. **37. SLIDE 37** EXPLAIN **Figure 28-24** Many automobile manufacturers install a coaxial capacitor, like this one, in the power feed wire to the blower motor to eliminate interference caused by the blower motor. **38. SLIDE 38** EXPLAIN **Figure 28-25** "sniffer" can be made from an old antenna lead-in cable by removing about 3 in. of the outer shielding from the end. Plug the lead-in cable into the antenna input of the radio and tune the radio to a weak station. Move the end of the antenna wire around the vehicle dash area. The sniffer is used to locate components that may not be properly shielded or grounded and can cause radio interference through the case (housing) of the radio itself. **39. SLIDE 39** EXPLAIN **FIGURE 28–26** The tip of this antenna was struck by lightning **40. SLIDES 40-41** EXPLAIN **SUMMARY** **ON-VEHICLE NATEF TASK: DIAGNOSE STATIC AND WEAK OR NO RECEPTION; DETERMINE NECESSARY ACTION.**