AUTO G120: ELECTRICAL/ ELECTRONIC SYSTEMS: INTRODUCTORY

Item	Value
Curriculum Committee Approval Date	10/05/2021
Top Code	094800 - Automotive Technology
Units	5 Total Units
Hours	126 Total Hours (Lecture Hours 72; Lab Hours 54)
Total Outside of Class Hours	0
Course Credit Status	Credit: Degree Applicable (D)
Material Fee	No
Basic Skills	Not Basic Skills (N)
Repeatable	No
Grading Policy	Standard Letter (S)

Course Description

This course is an introduction to automotive electrical systems that provides students theory, knowledge, and skills necessary to understand electrical flow and electronic concepts. Lecture content is reinforced through lab experience, which will enable students to successfully perform diagnostics and repair on vehicle electrical and electronic circuits. Content presented is based on the Automotive Service Excellence (ASE) A-6 Electrical/Electronics Tasks and Standards intended to prepare students for the ASE Certification Examination. Transfer Credit: CSU.

Course Level Student Learning Outcome(s)

1. Course Outcomes
2. Analyze automotive electrical systems for correct system operation.
3. Demonstrate proper use of diagnostic tools and equipment used for automotive repair.
4. Utilize precision electrical measurements to determine an appropriate course of action.

Course Objectives

- 1. Pass all assigned safety tests and certifications.
- 2. Analyze wiring diagrams.
- 3. Perform systematic analysis on automotive electrical systems using industry-accepted testing procedures, and diagnostic tools.
- 4. Interpret service and repair information.
- 5. Perform precision electrical measurements and compare against factory specifications.
- 6. Apply learned safety concepts when servicing hybrid electric vehicles (HEVs).

Lecture Content

Safety Basic auto technology shop safety instructions and demonstrations Pass instructor provided safety test(s) General Electrical System Theory and Concepts Electrical basics: Electron theory, Ohms law, magnetic induction concepts Wiring diagrams Electrical circuits Voltages and voltage drops in electrical/electronic circuits Current flow in electrical/electronic circuits and components Shorts, grounds, opens and high resistance problems in electrical/electronic circuits Parasitic current draw Circuit protective devices Circuit components: switches, connectors, insulators, conductors Units of measure and conversion processes used in electricity and electronics. Battery theory and science Battery state-of-charge Battery capacity (load, high-rate discharge) Electronic memory concepts Battery cables, connectors, clamps and hold-downs Theory and accepted practices of applying auxiliary vehicle electrical power sources Starting System Concepts of magnetism, induction, and torque Starter current draw and circuit voltage drop Relays, solenoids, and magnetic induction theory Charging System concepts and theory of operation Electro-mechanical theory and concepts AC/DC theory and diode rectification concepts Concepts and analysis of undercharge, no-charge or an overcharge condition Voltage regulation Lighting Systems power flow concepts Headlights, taillights, and stoplights Clearance and auxiliary lighting Turn signal or hazard light operation Module control of daytime running lights Voltage drop and lighting sytems functionality Driver Info rmation System Theory and Operation Concepts and causes of intermittent, high, low, or no gauge readings Circuit voltage regulators (limiters) Gauges and gauge sending units Printed circuit board concepts Constant intermittent or no warning light and driver information system operation Intermittent, high, low, or no readings on electronic digital instrument clusters Sensors, sending units, connectors and wires of electronic digital instrument circuits Horn and Wiper/Washer Circuitry layout and structure Electrical concepts and theories associated with these circuits Accessories Analysis and diagnostics Slow, intemittent or no operation of motor-driven accessory circuits Poor, intermittent or no heated glass operation Poor, intermittent or no electrical door and hatch/ trunk lock operation Unregulated, intermittent or no operation of cruise control systems Supplemental restraint system warning light staying on or flashing Safety procedurs to prevent accidental deployment Practice sample ASE (A6) Electrical/Electronics certification test

Lab Content

General Electrical System Diagnosis Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction Identify and interpret electrical/electronic system concern; determine necessary action Research applicable vehicle and service information, such as electrical/electronic system operation, vehicle service history, service precautions, and technical service bulletins Locate and interpret vehicle and major component identification numbers Diagnose electrical/ electronic integrity of series, parallel and series-parallel circuits using principles of electricy (Ohms Law) Use wiring diagrams during diagnosis of electrical circuit problems Demonstrate the proper use of a digital multimeter (DMM) during diagnosis of electrical circuit problems, including: source voltage, voltage drop, current flow, and resistance Check electrical circuits with a test light; determine necessary action Check electrical/electronic circuit waveforms; interpret readings and determine needed reparis Check electrical circuits using fused jumper wires; determine necessary action Locate shorts, grounds, opens, and resistance problems in electrical/electronic circuits; determine necessary action Measure and diagnose the cause(s) of excessive parasitic draw; determine necessary action Inspect and test fusible links, circuit breakers, and fuses; determine necessary action Inspect and test switches, connectors, relays, soleonid solid state devices, and wires of electrical/electronic circuits; perform necessary action Remove and replace terminal end from connector; replace connectors and terminal ends Repair wiring harness (including CAN/BUS systems) Perform solder repair of electrical wiring Identify location of hybrid v ehicles high voltage circuit disconnect (service plug) location and safety procedures

Battery Diagnosis and Service Perform battery state-of-charge test; determine necessary action Perform battery capacity test; confirm proper battery capacity for vehicle application; determine necessary action Maintain or restore electronic memory functions Inspect, clean, fill, and/or replace battery, battery cables, connectors, clamps, and hold-downs Perform battery charge Start a vehicle using jumper cables or an auxiliary power supply Identify high voltage circuits of electric or hybrid electric vehicle and related safety precautions Identify high voltage circuits of electric or hybrid electric vehicle and related safety precautions Identify electronic modules, security systems, radios, and other accessories that require reinitialization or code entry following battery disconnect Identify hybrid vehicles auxiliary (12v) battery service, repair and test procedures Starting System Diagnosis and Repair Perform starter current draw tests; determine necessary action Perform starter circuit voltage drop test; determine necessary action Remove and install starter in a vehicle Inspect and test switches, connectors, and wires of starter control circuits; perform necessary action Differentiate between electrical and engine mechanical problems that cause a slow-crank or no-crank condintion Lighting Systems Diagnosis and Repair Diagnose the cause of brighter than normal, intermittent, dim, or no light operation; determine necessary action Inspect, replace, and aim headlights and bulbs Inspect and diagnose incorrect turn signal or hazard light operation; perform necessary action Identify system voltage and safety precaution associated with high intensity discharge headlight Gauges, Warning Devices, and Driver Information System Diagnosis and Repair Inspect and test gauges and gauge sending units for cause of abnormal gauge readings; determine necessary action Inspect and test connectors, wires, and printed circuit boards of gauge circuits; determine necessary action Diagnose the cause of incorrect operation of warning devices and other driver information system; determine necessary action Inspect and test sensors, connectors, and wires of electronic (digital) instruments circuits;determine necessary action Horn and Wiper/Washer Diagnosis and Repair Diagnose incorrect horn operation; perform necessary action Diagnose incorrect wiper operation; diagnose wiper speed control and park problems; perform necessary action Diagnose incorrect washer operation; perform necessary action Accessories Diagnosis and Repair Diagnose incorrect operation of motor-driven accessory circuits; determine necessary action Diagnose incorrect heated glass, mirror, or seat operation; determine necessary action Diagnose incorrect electric lock operation (including remote keyless entry); determine necessary action Diagnose incorrect operation of cruise control systems; determine necessary action Diagnose supplemental restraint system (SRS) concerns; determine necessary action Disarm and enable the airbag system for vehicle service Diagnose radio static and weak, intermittent, or no radio reception; determine necessary action Remove and reinstall door panel Diagnose body electronic system circuits using a scan tool; determine necessary action Check for module communication (including CAN/BUS systems) errors using a scan tool Diagnose the cause of false, intermittent, or no op eration of anti-theft systems Describe the operation of keyless entry/remote-start systems Perform software transfers, software updates, or flash reprogramming on electronic modules

Method(s) of Instruction

- Lecture (02)
- DE Live Online Lecture (02S)
- Lab (04)
- DE Live Online Lab (04S)

Reading Assignments

Textbook reading assignments

Writing Assignments

1. Create vehicle repair orders, perform math exercises for flat rate labor, parts and materials totals.2. Demonstrate an understanding of Ohms Law by performing math exercises to validate voltage, current flow, and resistance values.3.Use information and concepts learned in class to successfully pass a practicum or written test or assignment.4.Use on-line service and repair information to compare factory specifications with actual readings and measurements acquired during electrical diagnostic activities.

Out-of-class Assignments

Textbook assignments Interactive web based training

Demonstration of Critical Thinking

1. Analyze and troubleshoot electrical circuits and restore them to proper service.2. Analyze, confirm, and diagnose electrical and electronic system faults based on symptoms indicated on repair orders.3. Relate diagnostic test results directly to circuit or component failures based on readings or measurements.4. Analyze wiring diagrams to determine integrity of vehicle electrical and electronic circuits.

Required Writing, Problem Solving, Skills Demonstration

1. Create vehicle repair orders, perform math exercises for flat rate labor, parts and materials totals.2. Demonstrate an understanding of Ohms Law by performing math exercises to validate voltage, current flow, and resistance values.3.Use information and concepts learned in class to successfully pass a practicum or written test or assignment.4.Use on-line service and repair information to compare factory specifications with actual readings and measurements acquired during electrical diagnostic activities.

Eligible Disciplines

Automotive technology: Any bachelors degree and two years of professional experience, or any associate degree and six years of professional experience.

Textbooks Resources

1. Required James Halderman. Automotive Electricity and Electronics, 6th ed. Pearson, 2021