AUTO G121: ELECTRICAL/ ELECTRONIC SYSTEMS: ADVANCED

Item	Value
Curriculum Committee Approval Date	10/19/2021
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 advanced level course that provides students with theory, knowledge, and skills necessary to understand electrical flow and advanced automotive electronic diagnostic and repair concepts through lecture and lab. Coursework 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. ADVISORY: AUTO G120. Transfer Credit: CSU.

Course Level Student Learning Outcome(s)

1. Course Outcomes
2. Analyze automotive electrical systems and related components for correct system operation, at an advanced level.
3. Demonstrate use of diagnostic tools and equipment used for electrical diagnosis, at an advanced level.
4. Utilize precision electrical measurements to determine an appropriate course of action, at an advanced level.

Course Objectives

- 1. Pass all assigned safety test and certifications.
- 2. Use complex wiring diagrams and electrical power flow on automotive system circuits, at an advanced level.
- 3. Perform systematic analysis on advanced automotive electrical systems using industry-accepted testing procedures, and diagnostic tool, at an advanced level.
- 4. Interpret service and repair information, at an advanced level
- 5. Perform precision electrical measurements and compare against factory specifications, at an advanced level.
- 6. Apply industry-accepted processes and principles for advanced circuit analysis and repairs, at an advanced level

Lecture Content

Safety Instruction Review of Electrical Fundamentals and Basic Test Equipment Current flow in electrical circuits AC vs. DC voltage concepts Insulators vs. conductors Ohms law to figure voltage, current, and resistance values Circuit protection: Fusible links, circuit breakers and fuses Switches, connectors, wires types and sizes Electrical sensors Electrical malfunctions: Shorts, grounds, opens, and high resistance issues Key-off battery parasitic drain Diagnosis of electrical circuits using fused jumper wires Voltmeters, Ammeters, Ohmmeters Test lights, multimeters, logic probes Electrical Circuit Analysis Series circuits Parallel circuits Series-parallel circuits Circuits that perform work Control circuits Circuit diagnostics Advanced Electronics Fundamentals Analog vs. digital circuits Concepts of Kirchhoffs law Solid state principles Electronic Control Devices Electronic Control Units (ECU) Body Control Modules (BCM) Inputs vs. outputs Actuators Advanced Circuitry: Concepts and Principles Integrated circuits Multiplex circuits Controller Area Network (CAN) concepts Local Area Network (LAN) circuits Binary Unit System (BUS) concepts Other advanced on-board circuits Supplemental Restraint System (SRS) Timer-controlled circuits Duty cycle and pulse width Advanced Diagnostic Equipment Digital Storage Oscilloscope (DSO) Reading and interpreting a DSO pattern Pulsing DC voltage signal and frequency Using a current probe with a DSO Analyzing the DSO multiple-trace function Scan tools: Factory and aftermarket Practice sample ASE (A6) Electrical/Electronic Systems 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 electricity (Ohm 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 repairs. 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, solenoid 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 loc ation of hybrid vehicle high voltage circuit disconnect (service plug) location and safety procedures. Battery Diagnosis 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 vehicles and related safety precautions. Identify electronic modules, security systems, radios, and other accessories that require reinitialization or code entry following battery disconnect. Identify hybrid vehicle 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 tests; determine necessary

action. Inspect and test starter relays and solenoids; 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 condition. Charging System Diagnosis and Repair Perform charging system output test; determine necessary action. Diagnose charging system for the cause of undercharge, no-charge and overcharge conditions. Inspect, adjust, or replace generator (alternator) drive belts, pulleys, and tensioners; check pulley and belt alignment. Remove, inspect, and install genera tor (alternator) Perform charging circuit voltage drop tests; determine necessary action. Lighting Systems Diagnosis and Repair Diagnose the cause of brighter than normal, intermittent, dim, or no light operation; determine necessary action. Inspect, replace, aim headlights and bulbs. Inspect and diagnose incorrect turn signal or hazard light operation; perform necessary action. Inspect and diagnose incorrect turn signal or hazard light operation; perform necessary action. Identify system voltage and safety precautions associated with high intensity discharge headlight. Gauges, Warning Devices, and Driver Information Systems 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 systems; determine necessary action. Inspect and test sensors, connectors, and wires of electronic (digital) instrument 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.

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 repair orders, perform complex math exercises for flat rate labor, parts, and materials totals.2.Demonstrate an understanding of advanced electrical concepts, perform math exercises to validate voltage, current flow, and resistance in a circuit.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 diagnostics.

Out-of-class Assignments

Textbook assignments Interactive web based training

Demonstration of Critical Thinking

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

Required Writing, Problem Solving, Skills Demonstration

1.Create repair orders, perform complex math exercises for flat rate labor, parts, and materials totals.2.Demonstrate an understanding of advanced electrical concepts, perform math exercises to validate voltage, current flow, and resistance in a circuit.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 diagnostics.

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

Other Resources

1. GWC Auto Tech work shirt