

AUTO G131: ENGINE PERFORMANCE: ADVANCED

Item	Value
Curriculum Committee Approval Date	10/17/2023
Top Code	094800 - Automotive Technology
Units	4.5 Total Units
Hours	117 Total Hours (Lecture Hours 63; 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
Open Entry/Open Exit	No
Grading Policy	Standard Letter (S), • Pass/No Pass (B)

Course Description

This course is an advanced level diagnostics course covering theory, knowledge, and skills necessary to understand advanced engine performance concepts. The lecture and lab instruction will enable students to successfully perform diagnostics and repairs on complex engine management and related systems. The course material is based on the Automotive Service Excellence (ASE) Engine Performance Tasks and Standards intended to prepare students for the ASE A-8 Engine Performance certification examination. ADVISORY: AUTO G120 and AUTO G130. Transfer Credit: CSU.

Course Level Student Learning Outcome(s)

1. Course Outcomes
2. Diagnose automotive engine performance and emission systems for correct system operation.
3. Analyze automotive engine performance and emission system concerns using diagnostic tools and equipment.
4. Interpret complex engine performance concerns through advanced measurement and diagnosis.

Course Objectives

- 1. Pass the SP-2 Mechanical Safety and Mechanical Pollution Prevention Test.
- 2. Retrieve and interpret service and repair information.
- 3. Analyze and interpret wiring diagrams, schematics, and electrical power flow on advanced engine management control circuits.
- 4. Perform systematic analysis on advanced electronic engine management systems and circuits using industry-accepted testing procedures, and diagnostic tools and equipment such as test lights, logic probes, digital volt ohmmeters (DVOMs), digital storage oscilloscopes (DSOs), and scan tools.
- 5. Perform related electrical measurements and compare against factory specifications.
- 6. Identify component failures using analytical skills, processes, and industry-accepted procedures.

- 7. Apply industry-accepted processes and principles for advanced engine management circuit analysis and repairs.
- 8. Apply safety concepts when servicing Hybrid and Electric Vehicles (HEVs), identifying the location of high voltage service disconnect switches, warning devices, and following proper safeguards and correct set-up procedures.

Lecture Content

Safety Basic automotive technology shop safety instruction and demonstrations SP-2 Mechanical Safety and Pollution Prevention tests General Engine Diagnosis Completing a Repair Order Technical Service Bulletins (TSBs) and scan tool data Types of TSBs Electronic retrieval systems Symptom-based diagnosis Driveability concerns No start, hard to start Poor fuel economy Advanced starting and charging systems diagnosis Battery tests Pinpoint voltage, current, and resistance tests Computerized Engine Controls Diagnosis and Repair Advanced computer sensor diagnosis Pinpoint testing sensors Electronic Coolant Temperature (ECT) Intake Air Temperature (IAT) Manifold Absolute Pressure (MAP) Throttle Position Sensor (TPS) Oxygen Sensors (O2) Mass Air Flow (MAF) Vehicle Speed Sensor (VSS) Wheel Speed Sensor (WSS) Advanced computerized diagnosis Circuit diagnosis and service Diagnostic Trouble Codes (DTCs) retrieval How (DTCs) are set Methods for clearing (DTCs) Advanced scan tool testing Advanced engine management controls: Concepts and principles Integrated circuits Multiplexed circuits Controller Area Network (CAN) Local Area Network (LAN) Binary Unit System (BUS) Other advanced onboard circuits Supplemental Restraint System (SRS) Timer-controlled circuits Duty cycle and pulse width modulated Advanced ignition system diagnosis and repair Pinpoint testing of primary and secondary circuit systems and components Pinpoint testing of ignition system related sensors Fuel system, air induction, and exhaust system diagnosis and repair Fuel delivery systems Pinpoint electronic component tests Idle air control diagnosis and service Advanced electronic fuel injection diagnosis and service Engine fuels and driveability diagnosis Rich or lean exhaust Excessive exhaust gas emissions Carbon Monoxide (CO) Hydrocarbons (HC) Oxides of Nitrogen (NOX) Emissions control system diagnosis and repair Advanced emission control device diagnosis and service Positive Crankcase Ventilation (PCV) Secondary Air Injection (AIR) Evaporative Emissions (EVAP) Catalytic Converter (CAT) Advanced five-gas exhaust analysis (HC) (CO) Carbon dioxide (CO2) Oxygen (NOX) Engine related service Engine condition diagnosis Vacuum, compression, and cylinder leakage tests General engine diagnosis Troubleshooting fundamentals The 8-step diagnostic procedure Troubleshooting computerized engines Typical non-computer related failures. Practice sample ASE advanced level (L1) engine performance certification

Lab Content

For every task in Electrical/Electronic systems, the following safety requirement must be strictly enforced: comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations. General Engine Diagnosis Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction Identify and interpret engine performance concern; determine necessary action Research applicable vehicle and service information, such as engine management system operation, vehicle service history, service precautions, and technical service bulletins

Locate and interpret vehicle and major component identification numbers
 Inspect engine assembly for fuel, oil, coolant, and other leaks; determine necessary action Diagnose abnormal engine noise or vibration concerns; determine necessary action Diagnose abnormal exhaust color, odor, and sound; determine necessary action Perform engine absolute (vacuum/boost) manifold pressure tests; determine necessary action Perform cylinder power balance test; determine necessary action Perform cylinder cranking and running compression tests; determine necessary action Perform cylinder leakage test; determine necessary action. Diagnose engine mechanical, electrical, electronic, fuel, and ignition concerns; determine necessary action Prepare 4 or 5 gas analyzer; inspect and prepare vehicle for test, and obtain exhaust readings; interpret readings, and determine necessary action Verify engine operating temperature; determine necessary action Perform cooling system pressure tests; check coolant condition; inspect and test radiator, pressure cap, coolant recovery tank, and hoses; perform necessary action Verify correct camshaft timing Computerized Engine Controls Diagnosis and Repair Retrieve and record diagnostic trouble codes, OBD monitor status, and freeze frame data; clear codes when applicable Diagnose the causes of emissions or drivability concerns with stored or active diagnostic trouble codes; obtain, graph, and interpret scan tool data Diagnose emissions or drivability concerns without stored diagnostic trouble codes; determine necessary action Check for module communication (including CAN/BUS systems) errors using a scan tool Inspect and test computerized engine control system sensors, powertrain/engine control module (PCM/ECM), actuators, and circuits using a graphing multimeter (GMM/digital storage oscilloscope (DSO); perform the necessary action Access and use service information to perform step-by-step diagnosis Diagnose drivability and emission problems resulting from malfunctions of interrelated systems (cruise control, security alarms, suspension controls, traction controls, A/C, automatic transmissions, non-OEM-installed accessories, or similar systems); determine necessary action Perform active tests of actuators using a scan tool; determine necessary action Describe the importance of running all OBDII monitors for repair verification Ignition System Diagnosis and Repair Diagnose ignition system-related problems such as no-starting, hard starting, engine misfire, poor drivability, spark knock, power loss, poor mileage, and emissions concerns; determine necessary action Inspect and test ignition primary and secondary circuit wiring and solid-state components; test ignition coil(s); perform necessary action Inspect and test crankshaft and camshaft position sensor(s); perform necessary action Inspect, test, and/or replace ignition control module, powertrain/engine control module; reprogram as necessary Fuel, Air Induction, and Exhaust Systems Diagnosis and Repair Diagnose hot or cold no-starting, hard starting, poor drivability, incorrect idle speed, poor idle, flooding, hesitation, surging, engine misfire, power loss, stalling, poor mileage, dieseling, and emissions problems; determine necessary action Check fuel for contaminants and quality; determine necessary action Inspect and test fuel pumps and pump control systems for pressure, regulation, and volume; perform necessary action. Replace fuel filters Inspect throttle body, air induction system, intake manifold and gaskets for vacuum leaks and/or unmetered air Inspect and test port fuel injectors, and gasoline direct injector system (GDI) Verify idle control operation Inspect the integrity of the exhaust manifold, exhaust pipes, muffler(s), catalytic converter(s), resonator(s), tailpipe(s), and heat shield(s); perform necessary action Perform exhaust system back-pressure test; determine necessary action Test the operation of turbocharger/supercharger systems; determine necessary action Emissions Control Systems Diagnosis and Repair Diagnose oil leaks, emissions, and drivability concerns caused by the positive crankcase ventilation (PCV) system; determine necessary action Inspect, test and service positive crankcase ventilation (PCV) filter/breather cap, valve, tubes, orifices, and hoses; perform necessary action Diagnose emissions

and drivability concerns caused by the exhaust gas recirculation (EGR) system; determine necessary action Inspect, test, service and replace components of EGR system, including EGR tubing, exhaust passages, vacuum/pressure controls, filters, and hoses; perform necessary action Inspect and test electrical/electronic sensors, controls, and wiring of exhaust gas recirculation (EGR) systems; perform necessary action Diagnose emissions and drivability concerns caused by the secondary air injection and catalytic converter systems; determine necessary action Inspect and test mechanical components of secondary air injection systems; perform necessary action Inspect and test electrical/electronically-operated components and circuits of air injection systems; perform necessary action Inspect and test catalytic converter efficiency Diagnose emissions and drivability concerns caused by the evaporative emissions control system; determine necessary action Engine Related Service Adjust valves on engines with mechanical or hydraulic lifters Remove and replace timing belt; verify correct camshaft timing Remove and replace thermostat and gasket/seal Inspect and test mechanical/electrical fans, fan clutch, fan shroud/ducting, air dams, and fan control devices; perform necessary action Perform common fastener and thread repairs, to include: remove broken bolt, restore internal and external threads, and repair internal threads with a threaded insert Perform engine oil and filter change Identify hybrid vehicle internal combustion engine service precautions Practice sample ASE (A8) Engine Performance certification test

Method(s) of Instruction

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

Reading Assignments

Textbook reading of assigned chapters.

Writing Assignments

1. Create vehicle repair orders, perform math exercises for flat rate labor, parts, and materials totals.
2. Demonstrate advanced engine performance diagnostic concepts by solving complex mathematical problems.
3. Use information and concepts learned in class to successfully pass a practicum exam or written test or assignment.
4. Use online service and repair information to compare factory specifications with actual readings and measurements acquired during diagnostic activities.

Out-of-class Assignments

Manufacture computer based training modules.

Demonstration of Critical Thinking

1. Analyze and troubleshoot complex electrical circuits that support engine operation and restore them to proper service.
2. Analyze, confirm, and diagnose complex engine performance-related 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 complex wiring diagrams to determine the integrity of circuits that support engine operation.

Required Writing, Problem Solving, Skills Demonstration

After acquiring the appropriate lecture information, the successful student will demonstrate skill accomplishment by completing worksheet-driven Automotive Service Excellence Education Foundation (ASEEF)-approved tasks. ASEEF is a non-profit agency that evaluates technician training programs against standards developed by the automotive

industry. Use information and concepts learned in class to successfully pass a practicum exam or written test or assignment. Use online service and repair information to compare factory specifications with actual readings and measurements acquired during diagnostics. Create vehicle repair orders, perform math exercises for flat rate labor, parts and materials totals.

Eligible Disciplines

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

Textbooks Resources

1. Required Halderman, James D. Advanced Engine Performance Diagnosis, 7th ed. Pearson, 2020

Other Resources

1. GWC automotive uniform and safety glasses.