AUTO-2450: AUTOMOTIVE ELECTRONIC ENGINE CONTROLS

Cuyahoga Community College

Viewing: AUTO-2450 : Automotive Electronic Engine Controls

Board of Trustees:
January 2022

Academic Term:
Fall 2022

Subject Code
AUTO - Automotive Technology

Course Number:
2450

Title:
Automotive Electronic Engine Controls

Catalog Description:
Operation and advanced diagnosis of modern automobile ignition, electrical, engine mechanical, and fuel and emission control systems which are computer controlled. Explore methods of analyzing and locating engine performance malfunctions using deductive methodology and diagnostic test equipment. Emphasis on OBD II (On-Board Diagnostic System) software, in-depth scan tool usage, five-gas analysis, and digital scope signal analysis of components and computer networks.

Credit Hour(s):
3

Lecture Hour(s):
1

Lab Hour(s):
6

Other Hour(s):
0

Requisites

Prerequisite and Corequisite
AUTO-2400 Engine Performance; or departmental approval: industry related experience.

Outcomes

Course Outcome(s):
Applying the terminology and engineering principles of the subject matter in Automotive Electronic Engine Controls, and using the correct tools, equipment and service information; students can evaluate, diagnose and maintain vehicle electronic engine control systems taking into account safety, work ethics and behaviors, proper repair techniques and customer needs.

Essential Learning Outcome Mapping:
Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

Objective(s):
1. Research vehicle service information including vehicle service history, service precautions, and technical service bulletins.
2. Apply knowledge of OBDII computerized controls to perform advanced diagnosis and repair of emission control systems.
3. Demonstrate knowledge of fuel trim monitors to assist in diagnosis of emission control system concerns.
4. Demonstrate knowledge of four or five gas analysis to assist in diagnosis of emission control system concerns.
5. Utilize a graphing multimeter (GMM)/digital storage oscilloscope (DSO) to inspect and test computerized engine control system sensors, powertrain modules, actuators, and network lines and connections.
6. Retrieve and record diagnostic trouble codes (DTC), OBD monitor status, and freeze frame data; clear codes when applicable.
7. Describe the use of OBD monitors for repair verification.
7. Interpret diagnostic trouble codes (DTCs) and scan tool data related to the emissions control systems; determine needed action.

7. Diagnose and repair vehicle emissions and driveability concerns presenting without a stored or active diagnostic trouble code.
8. Perform engine absolute manifold pressure tests (vacuum/boost); determine needed action.
9. Inspect, test, and/or replace ignition control module, powertrain/engine control module; reprogram/initialize as needed.
10. Diagnose emissions and driveablility concerns caused by the exhaust gas recirculation (EGR) system; inspect, test, service and/or replace electrical/electronic sensors, controls, wiring, tubing, exhaust passages, vacuum/pressure controls, filters, and hoses of exhaust gas recirculation (EGR) systems; determine needed action.
11. Diagnose emissions and driveablility concerns caused by the secondary air injection system; inspect, test, repair, and/or replace electrical/electronically-operated components and circuits of secondary air injection systems; determine needed action.
12. Diagnose emission and driveablility concerns caused by catalytic converter system; determine needed action.

Course Outcome(s):

Demonstrate shop and personal safety while in an automotive repair environment.

Objective(s):

1. Wear personal protective equipment in the automotive lab.
2. Identify and select appropriate personal protective items for working in the automotive lab.
3. Demonstrate safe handling and use of appropriate tools.
4. Identify safety precautions when working around supplemental restraints (SRS) or high voltage circuits.
5. Demonstrate knowledge of fire safety and evacuation routes.

Methods of Evaluation:

1. Participation and discussion
2. Observation
3. Written assignments
4. Exams
5. Quizzes
6. Lab tasks
7. Classroom recitations

Course Content Outline:

1. Electronic Engine Control Concepts
    a. On Board Diagnostics (OBD) II software terminology and structure
        i. Purpose and function of OBD II
        ii. Diagnostic executive and task manager software
        iii. Global OBD II definition and review of modes
    b. OBD II diagnostic trouble codes system
        i. OBD II code numbering system
        i. Enabling criteria definition and utilization in diagnosis
        ii. Trip definition and utilization in diagnosis
        iii. Warm-up cycles and utilization in diagnosis
        iv. Rationality testing and diagnostic trouble code system
        v. Types of diagnostic trouble codes (A, B, etc.), pending codes and prioritization
        vi. OBD II data link connector cavities and their function and testing
    c. OBD II system monitors
        i. Continuous monitors
            1. Comprehensive component monitor (CCM)
            2. Misfire monitor
            3. Fuel trim monitor
        ii. Noncontinuous monitors
            1. Oxygen sensor monitor
            2. Oxygen sensor heater monitor
            3. Catalyst monitor
            4. Exhaust Gas Recirculation (EGR) monitor
            5. Evaporative Emissions (EVAP) monitor
            6. Secondary Air Injection Reactor (AIR) monitor
            7. Transmission monitor
            8. Positive Crankcase Ventilation (PCV) system monitor
            9. Thermostat monitor

d. Fuel trim monitors and effects on emission systems
    i. Review of rich/lean symptom conditions on normal vehicle operation
    ii. Scan tool data involving fuel trim and fuel injector pulse width
    iii. Service tools to verify rich and lean diagnosis
e. Four/Five gas analysis theory and application
    i. Review of tailpipe emissions - CO, CO_2, O_2, NO_x, and HC
    ii. Four/five gas analyzer setup and operation
    iii. Diagnostics of vehicle emissions system by reviewing CO, CO_2, O_2, NO_x, and HC
f. Digital oscilloscope use in advanced vehicle diagnostics
    i. Digital oscilloscope setup and operation
    ii. Digital oscilloscope waveform interpretation
    iii. Digital scope use in verifying computer inputs
    iv. Digital scope use in verifying computer outputs
    v. Digital scope use in network communications
g. Module communications and network diagnostic techniques
    i. Module and network topology
    ii. Controller Area Network (CAN) networks basic structure and operation
    iii. Module communications diagnosis using a digital volt ohm meter (dvom), scope and scan tool
    iv. Service programming and J2534 reprogramming
    v. Ignition control
    vi. Powertrain/Engine
h. Diagnostic troubleshooting process for emission and driveability problems
    i. Engine driveability problems associated with trouble codes
        1. OBD II freeze frame utilization in diagnostics
        2. Global OBD II utilization in diagnostics
        3. Mode Six utilization in diagnostics
        4. Pinpoint and diagnostic test flow charts
        5. Drive cycle for resetting monitors and verify repairs
        6. Catalytic converter diagnostics
    ii. Engine driveability problems with no trouble codes present
        1. Eight step diagnostic process
        2. Utilization of engine performance diagnosis worksheets
        3. Absolute manifold pressure
        4. Technical service bulletin reviews
        5. Online auto info service providers like google, iATN or identifix in vehicle diagnosis

2. Work Place Concepts
    a. Shop and personal safety
    b. Tools and equipment
    c. Preparing vehicle for service
    d. Preparing vehicle for customer

Resources

Erjavec, Jack and Rob Thompson. *Automotive Technology: A Systems Approach*. 7th ed. Clifton Park, New York: Delmar/Cengage Learning, 2019.

Hatch, Steve V. *Computerized Engine Controls*. 10th ed. Boston, Massachusetts: Cengage Learning, 2017.

Halderman, James D. *Automotive Engine Performance.* 5th ed. New York, New York: Pearson, 2017.

Halderman, James, D. *Advanced Engine Performance Diagnosis.* 6th ed. New York, New York: Pearson, 2015.

Halderman, James D. *Automotive Electrical and Engine Performance.* 7th ed. New York, New York: Pearson, 2015.

Resources Other

1. http://obdii.com/ - OBD-II - On-Board Diagnostic System
2. http://www.obd-codes.com/faq/fuel-trims.php - Fuel Trims
3. http://www.autoserviceprofessional.com Benefits of Using a 5-Gas Analyzer | Auto Service Professional
4. http://www.freeautomechanic.com/diagnostictroublecodes6.html - Full List of OBDII Codes 1996 & Newer

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