NUMBER: AUTO G130

TITLE: Engine Performance: Basic Theory/Diagnosis

ORIGINATOR: Eli Jaramillo

EFF TERM: Fall 2012

DATE OF OUTLINE/REVIEW: 02-24-2012

CROSS LISTED COURSE: TOP NO: 0948.00

SEMESTER UNITS: 4.5

HRS LEC: 63.0 HRS LAB: 54.0 HRS OTHER: 0.0

CONTACT HRS TOTAL: 117.0

STUDY NON-CONTACT HRS RECOMMENDED: 126.0

CATALOG DESCRIPTION:

This is an introductory course that covers theory, knowledge, and skills necessary to understand engine performance concepts. Instruction is given and lab experience provided which will enable students to successfully perform diagnostics and repair on engine management and related systems. Information presented 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. Lecture & Lab. Advisory: Auto G101 and Auto G120

JUSTIFICATION FOR COURSE:

PREREQUISITES:

COREQUISITES:

ADVISORIES:

• AUTO G101: Introduction To Automotive Technology
• AUTO G120: Electrical/Electronic Systems: Introductory

ASSIGNED DISCIPLINES:

Automotive technology

MATERIAL FEE: Yes [ ] No [X] Amount: $0.00

CREDIT STATUS: Noncredit [ ] Credit - Degree Applicable [X] Credit - Not Degree Applicable [ ]

GRADING POLICY: Pass/No Pass [ ] Standard Letter [X] Not Graded [ ] Satisfactory Progress [ ]

OPEN ENTRY/OPEN EXIT: Yes [ ] No [X]

TRANSFER STATUS: CSU Transferable[X] UC/CSU Transferable[ ] Not Transferable[ ]

BASIC SKILLS STATUS: Yes [ ] No [X] LEVELS BELOW TRANSFER: Not Applicable

CALIFORNIA CLASSIFICATION CODES: Y - Not Applicable

NON CREDIT COURSE CATEGORY: Y - Not applicable, Credit Course

OCCUPATIONAL (SAM) CODE: C

REPEATABLE ACCORDING TO STATE GUIDELINES: No [X] Yes [ ] NUMBER REPEATS:

REQUIRED FOR DEGREE OR CERTIFICATE: No [ ] Yes [X]

Engine Performance and Emission Specialist(Associate in Arts)
Engine Performance and Emission Specialist(Certificate of Achievement)

GE AND TRANSFER REQUIREMENTS MET:

COURSE LEVEL STUDENT LEARNING OUTCOME(S) Supported by this course:
1. Demonstrate an ability to self-assess progress and development in a specific area and to further design and pursue a course of action based on the self-assessment.

2. Analyze and diagnose automotive engines and related components for correct system operation.

3. Demonstrate mastery of diagnostic tools and equipment used for automotive repair.

4. Summarize and interpret engine performance concerns through 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 engine management control circuits.
4. Perform systematic analysis on electronic engine management systems and circuits using industry-accepted testing procedures, and diagnostic tools and equipment such as test lights, logic probes, digital volt ohm meters (DVOM’s), digital storage oscilloscopes (DSO’s), 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 engine management circuit analysis and repairs.
8. Apply learned safety concepts when servicing HEV’s, identifying the location of high voltage service disconnect switches, warning devices, and following proper safeguards and correct set-up procedures.

**COURSE CONTENT:**

**LECTURE CONTENT:**

A. Safety
   1. Basic auto technology shop safety instruction and demonstrations.
   2. SP-2 Mechanical Safety and Mechanical Pollution Prevention tests.

B. Review: Electrical fundamentals and basic test equipment.
   2. AC vs. DC voltage concepts.
   3. Ohm’s law: Computing voltage, current, and resistance values.
   4. Electro-mechanical concepts.
   5. AC / DC theory and diode rectification concepts.
   6. Voltage values and voltage drop concepts.
   7. Electrical malfunctions: Shorts, grounds, opens, and high resistance issues.
   8. Key-off battery parasitic drain.
   9. Basic diagnostics used on engine management circuits.
   11. Test lights, multimeters, logic probes.

C. Review: Theory and concepts of engine operation.
   1. Basic engine construction and operation.
   2. Computing torque, work, power, and horsepower.
   3. Air pressurizing (compression), combustion, theory and concepts.

D. Computer control of engine management systems.
   1. Fundamentals of control modules.
   2. Basic functions.
   3. Input sensors.
      a. Engine coolant temperature.
      b. Intake air temperature.
c. Manifold pressure.
d. Barometric pressure.
e. Throttle position.
f. Oxygen.
g. Mass air flow sensors.

4. Output actuators.

E. Basic ignition system concepts.
   3. Timing the spark.
   4. Analysis of ignition waveform.

F. Engine fuels and combustion

1. Gasoline
   b. Ratings and additives.
   c. Testing fuel for contaminants and quality.
   d. Combustion concepts and theory.

2. Other fuels
   a. Diesel, bio-diesel.
   b. Ethanol, methanol.
   c. E85 mixed fuels.

G. Basic electronic fuel-injection concepts.

1. Throttle body style.
2. Port fuel injection.
4. Controlling the air/fuel mixture.
5. Idle air controls.

H. Controlling excessive exhaust and other fuel-related emissions.

   a. Ozone from sunlight, NOX and VOC’s.
   b. Equipment and other contributors to smog.

   a. PCV (Positive Crankcase Ventilation).
   b. Air injection.
   c. Evaporative Emission Control System (EVAP).
   d. Exhaust gas recirculating system (EGR).

3. Science of electronics to control exhaust and other emissions.
   a. On-board Diagnostics (OBD) I and OBD II systems overview.
   b. Diagnostics task management.
   c. Monitors and enabling criteria.

I. Analysis and diagnostics of engine mechanical condition.

1. Testing and measuring against factory specifications to determine engine condition.
   a. Engine absolute (vacuum/boost) manifold pressure.
   b. Cylinder compression.
   c. Cylinder leakage.
   d. Cylinder power balance tests.
   e. Exhaust back pressure testing.
J. Engine performance diagnosis and testing.
   1. Retrieval and interpretation of service and repair information.
   2. Identification and interpretation of engine performance concerns.
   3. Retrieval of on board diagnostic (OBD) I and OBD II codes.
   4. Diagnosis using scan tools to analyze diagnostic trouble codes (DTC’s).
   5. Inspection and testing of ignition system pick-up sensor or trigger devices.
   6. Retrieval and recording of stored OBD II trouble codes and data.
   7. Analysis of inspection and testing results of inputs to body control module (BCM) and Power train module.
   8. Analysis of emissions vs. driveability.
   9. Power train control module (PCM) system analysis using a graphing multimeter (GMM), a digital storage oscilloscope (DSO).

K. Practice sample ASE (A8) engine performance certification test.
   b. Diagnostics task management
   c. Monitors and enabling criteria

LABORATORY CONTENT:

After acquiring the appropriate lecture information, the successful student will demonstrate skill accomplishment by completing worksheet-driven NATEF-approved tasks. NATEF (National Automotive Technicians Education Foundation) is a non-profit agency that evaluates technician training programs against standards developed by the automotive industry. All of the current NATEF approved tasks for this class are listed below, and are also contained in a separate document that is handed out on the first day of class.

ENGINE PERFORMANCE

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.

A. General Engine Diagnosis

1. Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction.
2. Identify and interpret engine performance concern; determine necessary action.
3. Research applicable vehicle and service information, such as engine management system operation, vehicle service history, service precautions, and technical service bulletins.
4. Locate and interpret vehicle and major component identification numbers.
5. Inspect engine assembly for fuel, oil, coolant, and other leaks; determine necessary action.
6. Diagnose abnormal engine noise or vibration concerns; determine necessary action.
7. Diagnose abnormal exhaust color, odor, and sound; determine necessary action.
8. Perform engine absolute (vacuum/boost) manifold pressure tests; determine necessary action.
9. Perform cylinder power balance test; determine necessary action.
10. Perform cylinder cranking and running compression tests; determine necessary action.
11. Perform cylinder leakage test; determine necessary action.
12. Diagnose engine mechanical, electrical, electronic, fuel, and ignition concerns; determine necessary action.
13. Prepare 4 or 5 gas analyzer; inspect and prepare vehicle for test, and obtain exhaust readings; interpret readings, and determine necessary action.
14. Verify engine operating temperature; determine necessary action.
15. Perform cooling system pressure tests; check coolant condition; inspect and test radiator, pressure cap, coolant recovery tank, and hoses; perform necessary action.
16. Verify correct camshaft timing.

B. Computerized Engine Controls Diagnosis and Repair
1. Retrieve and record diagnostic trouble codes, OBD monitor status, and freeze frame data; clear codes when applicable.
2. Diagnose the causes of emissions or driveability concerns with stored or active diagnostic trouble codes; obtain, graph, and interpret scan tool data.
3. Diagnose emissions or driveability concerns without stored diagnostic trouble codes; determine necessary action.
4. Check for module communication (including CAN/BUS systems) errors using a scan tool.
5. 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 necessary action.

7. Diagnose driveability and emissions 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.
8. Perform active tests of actuators using a scan tool; determine necessary action.
9. Describe the importance of running all OBDII monitors for repair verification.

C. Ignition System Diagnosis and Repair
1. Diagnose ignition system related problems such as no-starting, hard starting, engine misfire, poor driveability, spark knock, power loss, poor mileage, and emissions concerns; determine necessary action.
2. Inspect and test ignition primary and secondary circuit wiring and solid state components; test ignition coil(s); perform necessary action.
3. Inspect and test crankshaft and camshaft position sensor(s); perform necessary action.
4. Inspect, test, and/or replace ignition control module, powertrain/engine control module; reprogram as necessary.

D. Fuel, Air Induction, and Exhaust Systems Diagnosis and Repair
1. Diagnose hot or cold no-starting, hard starting, poor driveability, incorrect idle speed, poor idle, flooding, hesitation, surging, engine misfire, power loss, stalling, poor mileage, dieseling, and emissions problems; determine necessary action.
2. Check fuel for contaminants and quality; determine necessary action.
3. Inspect and test fuel pumps and pump control systems for pressure, regulation, and volume; perform necessary action.
4. Replace fuel filters.
5. Inspect throttle body, air induction system, intake manifold and gaskets for vacuum leaks and/or unmetered air.
6. Inspect and test fuel injectors.
7. Verify idle control operation.
8. Inspect the integrity of the exhaust manifold, exhaust pipes, muffler(s), catalytic converter(s), resonator(s), tail pipe(s), and heat shield(s); perform necessary action.
9. Perform exhaust system back-pressure test; determine necessary action.
10. Test the operation of turbocharger/supercharger systems; determine necessary action.

E. Emissions Control Systems Diagnosis and Repair
1. Diagnose oil leaks, emissions, and driveability concerns caused by the positive crankcase ventilation (PCV) system; determine necessary action.
2. Inspect, test and service positive crankcase ventilation (PCV) filter/breather cap, valve, tubes, orifices, and hoses; perform necessary action.
3. Diagnose emissions and driveability concerns caused by the exhaust gas recirculation (EGR) system; determine necessary action.
4. Inspect, test, service and replace components of the EGR system, including EGR tubing, exhaust passages, vacuum/pressure controls, filters and hoses; perform necessary action.
5. Inspect and test electrical/electronic sensors, controls, and wiring of exhaust gas recirculation (EGR) systems; perform necessary action.
6. Diagnose emissions and driveability concerns caused by the secondary air injection and catalytic converter systems; determine necessary action.
7. Inspect and test mechanical components of secondary air injection systems; perform necessary action.
8. Inspect and test electrical/electronically-operated components and circuits of air injection systems; perform necessary action.
9. Inspect and test catalytic converter efficiency.
10. Diagnose emissions and driveability concerns caused by the evaporative emissions control system; determine necessary action.

F. Engine Related Service

1. Adjust valves on engines with mechanical or hydraulic lifters.
2. Remove and replace timing belt; verify correct camshaft timing.
3. Remove and replace thermostat and gasket/seal.
4. Inspect and test mechanical/electrical fans, fan clutch, fan shroud/ducting, air dams, and fan control devices; perform necessary action.
5. Perform common fastener and thread repairs, to include: remove broken bolt, restore internal and external threads, and repair internal threads with a threaded insert.
6. Perform engine oil and filter change.
7. Identify hybrid vehicle internal combustion engine service precautions.

G. Practice sample ASE (A8) Engine Performance certification test. 
   a. Diagnostics task management  
   b. Monitors and enabling criteria 

METHODS OF INSTRUCTION:

A. Lecture:
B. Lab:
C. Audio – One Way:
D. Independent Study:

INSTRUCTIONAL TECHNIQUES:

COURSE ASSIGNMENTS:

Reading Assignments

Required reading:

Websites
Web-based assignments: Autoshop101.com, CTE Online.com, other topic-specific websites as needed.

Out-of-class Assignments

Writing Assignments

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

METHODS OF STUDENT EVALUATION:
Midterm Exam
Final Exam
Short Quizzes
Written Assignments
Essay Examinations
Objective Examinations
Report
Problem Solving Exercises
Oral Presentations
Skills Demonstration

**Demonstration of Critical Thinking:**
1. Analyze and troubleshoot electrical circuits which support engine operation and restore them to proper service.
2. Analyze, confirm, and diagnose 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 wiring diagrams to determine integrity of circuits which support engine operation.

**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 engine performance concepts by solving related mathematical problems.
3. Use information and concepts learned in class to successfully pass a practicum exam or written test or assignment.
4. Use web-based service and repair information to compare factory specifications with actual readings and measurements acquired during diagnostic activities.

**TEXTS, READINGS, AND RESOURCES:**
**TextBooks:**

**Other:**
1. GWC Auto Tech work shirt
2. Basic hand tool set

**LIBRARY:**
Adequate library resources include:

**Comments:**

**Attachments:**
[Attached Files]