AUTO 190: ALTERNATIVE FUELS FOR INTERNAL COMBUSTION ENGINES

Citrus College Course Outline of Record

Heading	Value
Effective Term:	Fall 2021
Credits:	4
Total Contact Hours:	128
Lecture Hours :	54
Lab Hours:	74
Hours Arranged:	0
Outside of Class Hours:	108
Prerequisite:	AUTO 148 or AUTO 168 or MTRK 159 or with department consent.
Strongly Recommended:	ENGL 101; Integrated Math 3 or algebra.
Transferable to CSU:	Yes
Transferable to UC:	No
Grading Method:	Standard Letter, Pass/No Pass

Catalog Course Description

This course introduces students to the role, function, and application of compressed natural gas (CNG), propane (LPG), methanol, and ethanol as alternatives for today's usual internal combustion engine fuels. Emerging technology including other renewable fuel sources will also be discussed. Course prepares students to take the ASE F1 exam. 54 lecture hours, 74 lab hours.

Course Objectives

- Identify and describe components and systems unique to internal combustion engines utilizing fuel sources other than gasoline and diesel.
- Analyze and describe combustion chemistry of various fuels and their impact on local issues such as pollution and global concerns such as the greenhouse effect, carbon cycle and economics.
- Identify and describe safety concerns associated with high pressure fuel storage systems such as those used with LNG, CNG and LPG.
- Perform inspection of operation and safety of high pressure fuel storage and fuel delivery systems.
- Analyze exhaust emissions and determine corrective actions for elevated levels of Hydrocarbons, Carbon Monoxide, and Oxides of Nitrogen.

Major Course Content

1. Review internal combustion engine operation.
   a. Consequences of forced induction
   b. Gasoline and Diesel fuel delivery
2. Combustion Chemistry
   a. Stoichiometry
   b. Exhaust Emissions
   c. Carbon Cycle
   d. Energy Density
3. Fuel storage and delivery systems
   a. Low pressure liquid
   b. High pressure gas
   c. High pressure liquid
4. Vehicle Inspection for Condition, Suitability and Compliance
   a. Vehicle inspection for fitness (weight, mileage, applicable emissions standards, and safety standards).
   b. Engine performance analysis
   c. Size, weight and capacity of compressed natural gas cylinder(s)
   d. Proper location and mounting of compressed natural gas cylinders and fuel system components.
   e. Location, condition and compliance of venting system(s)
5. Equipment Installations and Inspection
   a. Inspection of fuel storage cylinders and system components prior to installation.
   b. Fuel storage system
   c. Regulator assembly(ies) and coolant lines.
   d. Underhood fuel delivery system components.
   e. Electrical and electronic components.
   f. Fuel lines, clamps, filters, and fittings.
   g. Pressure relief devices, venting systems, lines and fittings.
   h. Fuel fill receptacle(s) and check valve(s).
   i. System documentation.
6. Leak Testing and Repairs
   a. Low and high-pressure natural gas leaks.
   b. Coolant leaks.
   c. Venting system integrity.
7. Emissions, Performance Verification and Adjustments
   a. Base ignition timing.
   b. Regulator(s) pressure(s).
   c. Mixture settings
   d. Verify Power Train Control Module(s) (PCM) calibration.
   e. Check operation of electronic components.
   f. Road test vehicle for acceptable drivability.
   g. Manual and automatic fuel changeover operation (bi-fuel vehicles).
   h. Verify gaseous fuel management operation

Lab Content

1. Equipment Installation and Inspection
   a. Inspection of fuel storage cylinders and system components prior to installation.
   b. Fuel storage system; secure with recommended brackets, reinforcements, and fasteners; inspect fuel storage system.
   c. Install/inspect regulator assembly(ies) and coolant lines as required.
   d. Install/inspect underhood fuel delivery system components
   e. Install and connect/inspect system wiring.
   f. Install/inspect electrical and electronic components.
   g. Install/inspect instrument panel components.
   h. Install / inspect fuel lines, clamps, filters, and fittings.

   i. Install / inspect valves, pressure relief devices, venting systems, lines and fittings; secure with recommended fasteners.
   j. Install / inspect fuel fill receptacle(s) and check valve(s).
   k. Install / inspect required labels. 12. Complete system documentation as required.
2. Leak Testing and Repairs
   a. Check for low and high-pressure natural gas leaks; repair as needed.
   b. Pressurize cylinders with natural gas.
   c. Check for coolant leaks; repair as needed.
   d. Check venting system integrity as required.
3. Emissions, Performance Verification and Adjustments
   a. Check base ignition timing; adjust where applicable.
   b. Check regulator(s) pressure(s); adjust where applicable.
   c. Check mixture settings; adjust where applicable
   d. Verify Power Train Control Module(s) (PCM) calibration.
   e. Check operation of electronic components. 6
   f. Check operation of fuel gauge; make repairs as required.
   g. Perform emission tests; make repairs and document where applicable.
   h. Road test vehicle for acceptable driveability; check starting/ restarting abilities. 9
   i. Check manual and automatic fuel changeover operation (bi-fuel vehicles).
   j. Check fuel system for abnormal noises.
   k. Verify gaseous fuel management operation
4. System Diagnosis Maintenance and Repair
   a. Interpret and verify operational complaint; determine needed repair.
   b. Visually inspect gaseous fuel system components; determine needed repairs.
   c. Retrieve and interpret Diagnostic Trouble Codes (DTC) through the use of recommended PC based software, DMM, and/or scan tool.
   d. Diagnose driveability and emissions problems related to the ignition system; determine needed repairs.
   e. Diagnose driveability and emissions problems related to fuel and air induction systems, and exhaust systems; determine needed repairs.
   f. Diagnose driveability and emissions problems related to electronic engine controls; determine needed repairs.
   g. Check vacuum/electrical/electronic component operation; repair or replace as needed.
   h. Check gaseous fuel delivery system pressures, component operation; repair or replace as needed.
   i. Remove and/or replace fuel lines, manual and electrical valves, fittings, and pressure relief devices.
   j. .De-fuel CNG system.
   k. Check for signs of fuel contamination; inspect, replace and/or service fuel system filters as required.
5. General Cylinder Safety and Maintenance
   a. Visually inspect fuel storage cylinder(s), shields and mounting.
   b. Remove and replace cylinders; de-fuel according to recommended procedures; replace shields, brackets, and hardware as required.
   c. Handle and store cylinders in accordance with recommended procedures.
   d. Interpret cylinder label information; determine necessary action.
   e. Inspect pressure relief devices (PRD) and related hardware; determine necessary action.
   f. Inspect condition and operation of cylinders / tank valves; determine necessary action.
   g. Decommission cylinders according to recommended procedures.

Suggested Reading Other Than Required Textbook

Society of Automotive Engineers Whitepaper on Alternative Fuels.

Examples of Required Writing Assignments

Term Paper on the impact of Alternative Fuels.

Examples of Outside Assignments

Answer chapter review questions.

Instruction Type(s)

Lecture, Lab