

- I. Catalog description
 - A. Course description
This course covers current trends in the industry for operation, maintenance, and repair of light and heavy duty compressed natural gas (CNG) vehicles. CNG engines, design, tanks, and fuel systems will be analyzed. The course also serves as preparation for taking the fuel systems inspector exam and ASE – F1, Light Duty CNG Vehicles, and ASE – H1 Transit Bus CNG Vehicles.
 - B. Class hours: 3.0 lecture / 3.0 laboratory (54 lecture / 54 laboratory)
Units: 4.0
 - C. Prerequisite: None
Corequisite: None
 - D. Recommendation: AUTO 182, Introduction to Alternative Fuel
- II. Texts and other instructional materials
 - A. Required texts:
Automotive Technology: Principles, Diagnosis, and Service (5th Edition) by James D. Halderman, ISBN-13: 978-0133994612 / ISBN-10: 0133994619.
 - B. References:
 1. *F1 Light Vehicle – Compressed Natural Gas (ASE F1 Certification Training)* By Motor Age, ISBN# 978-1-934855-55-3
 2. *H1 Compressed Natural Gas Engines (ASE H1 Certification)*, By Delmar, ISBN- 13:978-1-4354-3939-9 -10: 1-4354-3939-2
 3. *NFPA 52 CNG Vehicular Fuel Systems Code* by the National Fire Protection Association (excerpts supplied)
 4. *CGA 6.4-2012 Methods for External Visual Inspection of Natural Gas Vehicle (NGV) Fuel Containers and their Installation* – 4th Edition by Compressed Gas Association handbook
 - C. Required materials: Safety glasses
- III. Course content
Lecture
 - A. General automotive safety
 - B. Fuel safety procedures
 - C. Design and operation of internal combustion engine
 - D. Origin, properties, and chemical structure of natural gas
 - E. Operation and function of high pressure fuels in vehicles
 - F. Design and function of compressed natural gas (CNG) fuel storage systems
 - G. Exhaust emissions produced by different fuels
 - H. CNG Fuel delivery systems
 - I. Electrical systems used in fuel delivery systems
 - J. Installation procedures
 - K. Maintenance procedures
 - L. CNG Fuel handling regulations

M. Refilling procedures

Lab

- A. General automotive safety
- B. Fuel safety procedures
- C. Design and operation of internal combustion engine
- D. Design and function of fuel storage systems
- E. Exhaust emissions produced by different fuels
- F. CNG Fuel delivery systems
- G. Electrical systems used in fuel delivery systems
- H. Installation procedures
- I. Maintenance procedures
- J. Diagnosis of different fuel system faults
- K. Comparative analysis of different fuel system faults
- L. Fuel handling regulations
- M. Refilling procedures for CNG vehicles

IV. Course objectives

- A. Identify hazardous materials in the automotive shop and their proper handling
- B. Identify fuel handling and safety procedures
- C. Locate the material safety data sheets (MSDS) for common automotive chemicals
- D. Identify and properly use personal equipment
- E. Identify the proper fire extinguisher for the type of fire
- F. Define automotive fuel systems and components
- G. Define compressed natural gas (CNG) and liquefied natural gas (LNG) systems and components
- H. Develop skills in recognizing which OSHA standards apply to fuel delivery systems
- I. Examine natural gas pressures at various stages in CNG/LNG system
- J. Determine accurate and appropriate fuel system pressures
- K. Relate how atmospheric pressure and temperature affect performance
- L. Identify principles of regulators and mixers
- M. Define closed and open loop systems
- N. Explain basic ignition and timing systems
- O. Interpret emission testing and decipher test data
- P. Explain general maintenance procedures
- Q. Find service information in automotive databases
- R. Identify fuel tank damage and determine necessary action
- S. Locate the "Manual Shut-Off Valve" for CNG vehicles
- T. Identify and diagram the components of a CNG System and their function
- U. Identify the equipment and procedures to perform a visual and detailed CNG Cylinder Inspection.
- V. Define CNG cylinder types and type of damages associated with each cylinder and its disposition

- W. Properly document CNG inspections
 - X. Compare differences in fuel, ignition and exhaust emissions systems for Natural Gas Vehicles (NGV)
 - Y. Installation requirements, operation and maintenance of all low-and high-pressure components in an NGV
 - Z. Perform system maintenance
 - AA. Repair procedures that are unique to NGVs
 - BB. Diagnose electrical related issues, sensors and solenoids using wiring diagrams, service information, digital multimeter (DMM) and scan tools; identify and interpret diagnostic data
 - CC. Diagnose hard starting and/or poor drivability caused by the NGV fuel system
 - DD. Test the proper operation of each original equipment manufacturer (OEM) system
 - EE. Set up and measure adjustments to various OEM systems
 - FF. Inspect and compare OEM system repair procedures
 - GG. Examine and investigate a variety of common problem failures with OEM systems
 - HH. Analyze various federal, state, and regulatory agency rules and relate them to specific vehicle installations
- V. Assignments
- A. Reading
 - 1. Weekly readings from required textbooks
 - 2. Magazine and journal articles
 - 3. Reference books
 - 4. Handouts
 - B. Writing or problem solving or skill attainment
 - 5. Create accurate sketches of systems and sub systems
 - 6. Compare different fuel systems and write about differences found
 - 7. Qualify different fuel systems installation procedures
 - 8. Create written automotive fuel system schematics
 - 9. Determine start-up, shutdown, and storage procedures of alternative fuel systems
 - C. Critical thinking
 - 1. Utilize proper documentation to determine schematic accuracy
 - 2. Analyze installation directions to determine appropriate procedures
 - 3. Determine the steps in utilizing equipment for proper testing procedures
 - 4. Select proper testing equipment and tools to monitor fuel system circuits
- VI. Methods of instruction may include
- A. Lecture
 - B. Demonstration
 - C. Overhead projections

- D. Written assignments and reports
 - E. Instruction utilizing Electronic Information technology (EIT) (i.e. video, audio, websites, web services and software) must comply with Cerritos College BP & AP 3720, Cerritos College BP & AP 3411 and Section 508 standards (law). When course materials are not compatible with a person's disability, the Instructor will develop an Equally Effective Alternative Access Plan (EEAAP).
- VII. Methods of evaluation may include
- A. Identification of alternative fuel systems components
 - B. Design projects
 - C. Written quizzes on lecture topics
 - D. Mid-term examination
 - E. Outside assignments
 - F. Evaluation of the safe use of equipment
 - G. Graded written assignments
 - H. Final examination
- VIII. Student learning outcomes
- A. Demonstrate safe working procedures in working with high pressure and low temperature fuels
 - B. Compare major fuel system components on light and heavy duty CNG vehicle chassis
 - C. Collect measurements and perform diagnostics in relation to the CNG fuel system chassis components
 - D. Identify major fuel system components on the Cummins engine model ISL-G heavy duty engine
 - E. Identify common circuit problems in relation to the electrical components of the Cummins model ISL-G heavy duty engine
 - F. Extract diagnostic information in relation to the electrical components of the Cummins model ISL-G heavy duty engine