



ILLINOIS VALLEY COMMUNITY COLLEGE

COURSE OUTLINE

DIVISION: Workforce Development

COURSE: ATO 2220 Fuel Systems and Emission Controls

Date: Spring 2022

Credit Hours: 4.5

Complete all that apply or mark "None" where appropriate:

Prerequisite(s): ATO 1220, ATO1250

Enrollment by assessment or other measure? Yes No

If yes, please describe:

Corequisite(s): None

Pre- or Corequisite(s): None

Consent of Instructor: Yes No

Delivery Method: **Lecture** **2 Contact Hours** (1 contact = 1 credit hour)
 Seminar **0 Contact Hours** (1 contact = 1 credit hour)
 Lab **5 Contact Hours** (2-3 contact = 1 credit hour)
 Clinical **0 Contact Hours** (3 contact = 1 credit hour)
 Online
 Blended
 Virtual Class Meeting (VCM)

Offered: **Fall** **Spring** **Summer**

CATALOG DESCRIPTION and IAI NUMBER (if applicable):

The theory, service, diagnosis of gasoline fuel systems (fuel injection and direct fuel injection) will be the main emphasis of this class. Other areas studied will be computer controls, sensors, forced induction intake systems and exhaust systems. The following emission control systems will be covered: positive crankcase ventilation, exhaust gas recirculation, air management, catalytic converters and evaporative control systems.

ACCREDITATION STATEMENTS AND COURSE NOTES:

The Automotive Technology program at Illinois Valley Community College is a ASE Education Foundation Master Certified Automotive Technology Program.

The program goes through an on-site evaluation every five years and the ASE Education Foundation tasks that are taught in this course are also updated every five years to align with any changes made by the ASE Education Foundation national automotive advisory council.

COURSE TOPICS AND CONTENT REQUIREMENTS:

- I. Engine Operating Principles
 - A. Atmospheric Pressure
 - B. Air Pump
 - C. Vacuum
 - D. Pressure Differential
 - E. Four Stroke Cycle
 - F. Engine Displacement
 1. Compression Ratio
 2. Bottom Dead Center
 3. Top Dead Center
- II. Air – Fuel Requirement
 - A. Volumetric Efficiency
 - B. Air – Fuel Ratio
 1. Stoichiometric
 2. Power vs. Economy
 - C. Gasoline
 1. Hydrocarbon
 2. Chemical impurities
 3. Octane Rating
 4. Atomization
 5. Vaporization
 6. Reid Vapor Pressure (RVP)
 7. Oxygenated Fuels
- III. Fuel Pumps and Filters
 - A. Mechanical Pumps
 - B. Electric Pumps
 - C. Fuel Filters
 - D. Pump Operation
 - E. Testing
 1. Pressure
 2. Volume
 3. Flow
 4. Current draw
 5. Pump Speed
 6. Dead Head Pressure
- IV. Intake and Exhaust Manifolds
 - A. Manifold Principles
 - B. Manifold Types
 - C. Exhaust Manifolds
 - D. Testing

1. Leaks
2. Back Pressure
3. Restriction

V. Electronic Fuel Injection

A. Injection Fuel Injection

B. Types

1. Port Fuel Injection
 - a. Injector types
 - b. Synchronized mode
 - c. Non-synchronized mode
 - d. Gang fired
 - e. Sequential
 - f. Testing
 - g. Cleaning
 - h. Service
2. Gasoline Direct Injection
 - a. Components
 - b. Safety (High Pressure System)
 - c. Classifications
 1. Wide vs. Narrow injector spacing
 2. Creating a Stratified Charge
 3. Charge Motion
 4. Injector Location
 5. Injector Types
 6. Fuel Distribution
 7. Injection Timing
 8. Air/Fuel Ratio
 - d. Testing
 - e. Service

C. Powertrain Control Module

D. Input Sensors

E. Theory of Operation

F. Service

G. Diagnosis

VI. Superchargers and Turbochargers

A. Supercharging

B. Turbochargers

1. Controls
2. Service
3. Types
4. Overhaul

VII. Emission Control Systems

A. Air Pollutants

1. Combustion
2. Clean Air Act
3. Government Standards
4. Emission Testing

B. Thermostatic Air Cleaners

1. Fresh Air Intakes
 2. Air Filter Elements
 3. Testing and Servicing
- C. Positive Crankcase Ventilation
1. Draft tube
 2. PCV Systems
 3. Testing and Servicing
- D. Air Injection
1. Air Pumps
 2. Pulse Air Injection
 3. Diverter Valves
 4. Switching Valves
 5. Testing and Servicing
- E. Exhaust Gas Recirculation
1. Nox Formation
 2. System Components
 3. Operating Principles
 4. Testing and Servicing
- F. Catalytic Converters
1. Converting Operation
 2. Converter Types
 3. By-pass Systems
 4. Precautions
 5. Testing and Servicing
 6. EPA Regulations
- G. Evaporative Controls
1. Charcoal canisters
 2. System Operation
 3. Non-Enhanced Systems
 4. Enhanced Systems
 5. Testing and Servicing

INSTRUCTIONAL METHODS:

Lecture

Demonstrations

Videos

Practical Operations

Power Point Presentations

Class discussion

Handout material

Quizzes and tests

EVALUATION OF STUDENT ACHIEVEMENT:

Complete all lab objectives (ASE Education Foundation Tasks)

Satisfactory performance on written exams

Attitude

Attendance

Work Habits

Safety Practices
Class participation

INSTRUCTIONAL MATERIALS:

Textbooks

1. Electude Online software

Resources

1. Pro-Demand – Information System
2. All Data Pro - Information System

LEARNING OUTCOMES AND GOALS:

Institutional Learning Outcomes

- 1) Communication – to communicate effectively;
- 2) Inquiry – to apply critical, logical, creative, aesthetic, or quantitative analytical reasoning to formulate a judgement or conclusion;
- 3) Social Consciousness – to understand what it means to be a socially conscious person, locally and globally;
- 4) Responsibility – to recognize how personal choices affect self and society.

Course Outcomes and Competencies

VIII. ENGINE PERFORMANCE

A. General

2. Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed.
5. Identify and interpret engine performance concerns; determine needed action.
6. Diagnose abnormal engine noises or vibration concerns; determine needed action.
8. Perform engine manifold pressure tests (vacuum/boost); determine needed action.
9. Perform cylinder power balance test; determine needed action.
10. Perform cylinder cranking and running compression tests; determine needed action.
12. Diagnose engine mechanical, electrical, electronic, fuel, and ignition concerns; determine needed action.

VIII. ENGINE PERFORMANCE

B. Computerized Controls

1. Identify computerized control system components and configurations.
2. Access and use service information to perform step-by-step (troubleshooting) diagnosis.
3. Perform active tests of actuators using a scan tool; determine needed action.
4. Describe the use of OBD monitors for repair verification.
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), and/or scan tool; determine needed action.
7. Diagnose the causes of emissions or driveability concerns with stored or active diagnostic trouble codes (DTC); obtain, graph, and interpret scan tool data.
8. Diagnose emissions or driveability concerns without stored or active diagnostic trouble codes; determine needed action.

9. Diagnose driveability and emissions problems resulting from malfunctions of interrelated systems (cruise control, security alarms, suspension controls, traction controls, HVAC, automatic transmissions, non-OEM installed accessories, or similar systems); determine needed action.

VIII. ENGINE PERFORMANCE

D. Fuel, Air Induction, and Exhaust Systems

1. Identify fuel, air induction, and exhaust system components and configurations.
2. Replace fuel filter(s) where applicable.
3. Inspect, service, or replace air filters, filter housings, and intake duct work.
4. Inspect integrity of the exhaust manifold, exhaust pipes, muffler(s), catalytic converter(s), resonator(s), tail pipe(s), and heat shields; determine needed action.
5. Inspect condition of exhaust system hangers, brackets, clamps, and heat shields; determine needed action.
6. Check and refill diesel exhaust fluid (DEF).
7. Check fuel for quality, composition, and contamination; determine needed action.
8. Inspect and test fuel pump(s) and pump control system for pressure, regulation, and volume; determine needed action.
9. Inspect throttle body, air induction system, intake manifold and gaskets for vacuum leaks and/or unmetered air.
10. Inspect, test, and/or replace fuel injectors on low- and high-pressure systems.
11. Verify proper idle speed; determine needed action.
12. Perform exhaust system back-pressure test; determine needed action.
13. 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 needed action.
14. Test the operation of turbocharger/supercharger systems; determine needed action.

VIII. ENGINE PERFORMANCE

E. Emissions Control Systems

1. Identify emission control system components and configurations.
2. Inspect, test, service, and/or replace positive crankcase ventilation (PCV) filter/breather, valve, tubes, orifices, and hoses; determine needed action.
3. Diagnose oil leaks, emissions, and driveability concerns caused by the positive crankcase ventilation (PCV) system; determine needed action.
4. Diagnose emissions and driveability 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.
5. Inspect and test electrical/electronically operated components and circuits of secondary air injection systems; determine needed action.
6. Diagnose emission and driveability concerns caused by catalytic converter system; determine needed action.
7. Diagnose emissions and driveability concerns caused by the evaporative emissions control (EVAP) system; determine needed action.
8. Interpret diagnostic trouble codes (DTCs) and scan tool data related to the emissions control systems; determine needed action.

FOUNDATIONAL TASKS – 2022

Shop and Personal Safety

1. Identify general shop safety rules and procedures.
2. Utilize safe procedures for handling of tools and equipment.
3. Identify and use proper placement of floor jacks and jack stands.
4. Identify and use proper procedures for safe lift operation.
5. Utilize proper ventilation procedures for working within the lab/shop area.
6. Identify marked safety areas.
7. Identify the location and the types of fire extinguishers and other fire safety equipment; demonstrate knowledge of the procedures for using fire extinguishers and other fire safety equipment.
8. Identify the location and use of eye wash stations.
9. Identify the location of the posted evacuation routes.
10. Comply with the required use of safety glasses, ear protection, gloves, and shoes during lab/shop activities.
11. Identify and wear appropriate clothing for lab/shop activities.
12. Secure hair and jewelry for lab/shop activities.
13. Identify vehicle systems which pose a safety hazard during service such as: supplemental restraint systems (SRS), electronic brake control systems, stop/start systems, and remote start systems.
14. Identify vehicle systems which pose a safety hazard during service due to high voltage such as: hybrid/electric drivetrain, lighting systems, ignition systems, A/C systems, injection systems, etc.
15. Locate and demonstrate knowledge of safety data sheets (SDS).

Tools and Equipment

1. Identify tools and their usage in automotive applications.
2. Identify standard and metric designation.
3. Demonstrate safe handling and use of appropriate tools.
4. Demonstrate proper cleaning, storage, and maintenance of tools and equipment.

Preparing for Vehicle Service

1. Identify information needed and the service requested on a repair order.
2. Identify purpose and demonstrate proper use of vehicle protection such as: fender covers, mats, seat, and steering wheel covers.
3. Perform a vehicle walk-around inspection; identify and document existing vehicle conditions such as body damage, paint damage, windshield damage.
4. Perform a vehicle multi-point inspection and complete a vehicle inspection report.
5. Demonstrate use of the three C's (concern, cause, and correction).
6. Create a plan of action for each specific service or diagnostic situation.
7. Review vehicle service history.
8. Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction.

Preparing Vehicle for Customer

1. Ensure vehicle is prepared to return to customer per school/company policy (floor mats, steering wheel cover, etc.).

Personal Standards

1. Reports to work daily on time; able to take directions and motivated to accomplish the task at hand.
2. Dresses appropriately and uses language and manners suitable for the workplace.
3. Maintains personal hygiene appropriate for the workplace.
4. Meets and maintains employment eligibility criteria, such as drug/alcohol-free status, clean driving record, etc.
5. Demonstrates honesty, integrity, and reliability.

Work Habits / Ethic

1. Complies with workplace policies/laws.
2. Contributes to the success of the team, assists others and requests help when needed.
3. Works well with all customers and coworkers.
4. Negotiates solutions to interpersonal and workplace conflicts.
5. Contributes ideas and initiative.
6. Follows directions.
7. Communicates effectively, both in writing and verbally, with customers and coworkers.
8. Reads and interprets workplace documents; writes clearly and concisely.
9. Analyzes and resolves problems that arise in completing assigned tasks.
10. Organizes and implements a productive plan of work.
11. Uses scientific, technical, engineering and mathematics (STEM) principles and reasoning to accomplish assigned tasks.
12. Identifies and addresses the needs of all customers, providing helpful, courteous, and knowledgeable service and advice as needed.
13. Respectful of tools and property used in school and workplace environment.
14. Contributes to an inclusive environment where every coworker and customer feels welcomed, heard, and valued.