

# **COURSE OUTLINE**

**DIVISION:** Workforce Development (WFD)

COURSE: ATO 2220 - Fuel Systems and Emission Controls

Effective Date: Fall 2025

Submitted Date: Apr-25

Credit Hours: 4.5

IAI Number (if applicable): N/A

Complete all that apply or mark "None" where appropriate: Prerequisite(s): ATO 1220, ATO1250, or consent of the instructor

Enrollment by assessment or other measure?  $\Box$  Yes  $\Box$  No

If yes, please describe:

Corequisite(s): None.

Pre- or Corequisite(s): None.

Consent of Instructor:  $\Box$ Yes  $\boxtimes$ No

⊠Lecture	2 Contact Hours (1 contact = 1 credit hour)
□Seminar	<b>Contact Hours</b> (1 contact = 1 credit hour)
⊠Lab	5 Contact Hours (2-3 contact = 1 credit hour)
□Clinical	<b>Contact Hours</b> (3 contact = 1 credit hour)
□Practicum	<b>Contact Hours</b> (5 contact = 1 credit hour)
□Internship	<b>Contact Hours</b> (5 contact = 1 credit hour)
	<ul> <li>□ Lecture</li> <li>□ Seminar</li> <li>□ Lab</li> <li>□ Clinical</li> <li>□ Practicum</li> <li>□ Internship</li> </ul>

Offered: ⊠Fall □Spring □Summer

#### CATALOG DESCRIPTION:

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. **IAI Number (if applicable): N/A** 

## ACCREDITATION STATEMENTS AND COURSE NOTES:

The Automotive Technology program at Illinois Valley Community College is an 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
    - i. Compression Ratio
    - ii. Bottom Dead Center
    - iii. Top Dead Center
- II. Air Fuel Requirement
  - a. Volumetric Efficiency
  - b. Air Fuel Ratio
    - i. Stoichiometric
    - ii. Power vs. Economy
  - c. Gasoline
    - i. Hydrocarbon
    - ii. Chemical impurities
    - iii. Octane Rating
    - iv. Atomization
    - v. Vaporization
    - vi. Reed Vapor Pressure (RVP)
    - vii. Oxygenated Fuel
- III. Fuel Pumps and Filters
  - a. Mechanical Pumps
  - b. Electric Pumps
  - c. Fuel Filters
  - d. Pump Operation
  - e. Testing

- i. Pressure
- ii. Volume
- iii. Flow
- iv. Current draw
- v. Pump Speed
- vi. Dead Head Pressure
- IV. Intake and Exhaust Manifolds
  - a. Manifold Principles
  - b. Manifold Types
  - c. Exhaust Manifolds
  - d. Testing
    - i. Leaks
    - ii. Back Pressure
    - iii. Restriction
- V. Electronic Fuel Injection
  - a. Injection Fuel Injection
  - b. Types
    - i. Port Fuel Injection
      - 1. Injector types
      - 2. Synchronized mode
      - 3. Non-synchronized mode
      - 4. Gang fired
      - 5. Sequential
      - 6. Testing
      - 7. Cleaning
      - 8. Service
      - 9. Gasoline Direct Injection
        - a. Components
        - b. Safety (High Pressure System)
        - c. Classifications
          - i. Wide vs. Narrow injector spacing
          - ii. Creating a Stratified Charge
          - iii. Charge Motion
          - iv. Injector Location
          - v. Injector Types
          - vi. Fuel Distribution
          - vii. Injection Timing
          - viii. Air/Fuel Ratio
            - 1. Testing
            - 2. Service

- c. Powertrain Control Module
- d. Input Sensors
- e. Theory of Operation
- f. Service
- g. Diagnosis
- VI. Superchargers and Turbochargers
  - a. Supercharging
  - b. Turbochargers
    - i. Controls
    - ii. Service
    - iii. Types
    - iv. Overhaul
- VII. Emission Control Systems
  - a. Air Pollutants
    - i. Combustion
    - ii. Clean Air Act
    - iii. Government Standards
    - iv. Emission Testing
  - b. Thermostatic Air Cleaners
    - i. Fresh Air Intakes
    - ii. Air Filter Elements
    - iii. Testing and Servicing
  - c. Positive Crankcase Ventilation
    - i. Draft tube
    - ii. PCV Systems
    - iii. Testing and Servicing
  - d. Air Injection
    - i. Air Pumps
    - ii. Pulse Air Injection
    - iii. Diverter Valves
    - iv. Switching Valves
    - v. Testing and Servicing
  - e. Exhaust Gas Recirculation
    - i. Nox Formation
    - ii. System Components
    - iii. Operating Principles
    - iv. Testing and Servicing
  - f. Catalytic Converters
    - i. Converting Operation
    - ii. Converter Types

- iii. By-pass Systems
- iv. Precautions
- v. Testing and Servicing
- vi. EPA Regulations
- g. Evaporative Controls
  - i. Charcoal canisters
  - ii. System Operation
  - iii. Non-Enhanced Systems
  - iv. Enhanced Systems
  - v. 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

 $\boxtimes$  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.
- $\boxtimes$  4) Responsibility to recognize how personal choices affect self and society.

## Course Outcomes and Competencies:

#### ASE Education Foundation 2024 Tasks completed in this course.

<u>Note</u>: The numbering of these tasks correlates with the ASE 2024 Master Automobile Service Technology task list.

#### 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.

- 6. Diagnose the causes of emissions or drivability concerns with stored or active diagnostic trouble codes (DTC); obtain, graph, and interpret scan tool data.
- 7. Diagnose emissions or drivability concerns without stored or active diagnostic trouble codes; determine needed action.
- 8. Diagnose drivability 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.
- 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 drivability, 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 drivability concerns caused by the positive crankcase ventilation (PCV) system; determine needed action.
- 4. Diagnose emissions and drivability 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 drivability concerns caused by catalytic converter system; determine needed action.
- 7. Diagnose emissions and drivability 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.