Mercer County Community College

Division of Business and Technology

AUT 112

AUTOMOTIVE FUEL SYSTEMS

COURSE DESCRIPTION

The automotive fuel systems used on today's Chrysler product line are discussed in detail. Material included will be today's Automotive Fuels and Additives, Computer Controlled Feedback Systems, and Electronic Fuel Injection (E.F.I.). Emphasis will be placed on Theory of Operation and Diagnosis Procedures, using Chrysler Diagnostic Equipment. The successful completion of the course depends on the student's performance of Lab Activities designed to expose the apprentice to each particular area, Proper Diagnosis Procedures, and Repair.

Text (s): **Reference Division Booklist**

Prerequisites: **AUT111 and EET118**

Co-requisites:

Credits: **3** Lecture Hours: **2** Studio/Lab Hours: **2**

Food and drink are strictly prohibited in classrooms as per health and safety laws. Students may not bring in chemicals or cleaning fluids of any kind without the appropriate MSD sheets.

Course Coordinator: Fred Bassini **Latest Review: Spring 2004**

GENERAL LEARNING OBJECTIVES

Upon completion of this course the student will be able to:

I. REVIEW OF THE BASIC OPERATION OF THE FUEL SYSTEM

A. Chrysler Systems and Components
   1. Demonstrate his/her understanding of the types of fuel systems used on Chrysler products by answering questions on a test or quiz.

B. Identify the types of emission control devices and their functions found on Chrysler vehicles. The devices listed below will be identified in written and verbal form.
   1. Exhaust Gas Re-circulation
   2. Air Pump
   3. Charcoal Canister
   4. Catalytic Converter

II. TYPES OF FUELS

A. Define the following terms and identify some driveability problems related to them. This may be done verbally or in written form.
   1. Distillation
   2. Fuel Blending
   3. Octane Rating
   4. Volatility

III. BASIC CARBURETION - REVIEW

A. Theory of Operation
   1. Define and identify the importance of the following terms:
      a. Venturi
      b. Fuel Discharge Nozzle
      c. Throttle Plate
      d. Vacuum
   2. Define in Written form and identify the importance of Bernoulli's principle.

B. Carburetor Circuits
   1. Describe the operation of each of the following circuits, both verbally and in written form.
      a. float
      b. idle and low speed
      c. main metering
      d. accelerator pump
      e. power enrichment
      f. choke

IV. COMPUTER FEEDBACK SYSTEMS

A. System Fundamentals

1. Identify the need for computer controlled fuel systems by answering questions on a test.
2. Identify the following inputs to the computer and explain their functions. This may be done verbally or in written form.
   a. oxygen (O_2) sensor
   b. coolant temperature sensor
   c. air charge temperature
   d. carburetor switch
   e. vacuum transducer
   f. hall-effect pick-up
   g. detonation sensor

B. Electronic Carburetor

1. Describe, in written form, the operation of the electronic carburetor through each of the following operating modes:
   a. cold engine
   b. hot engine restart
   c. low manifold vacuum
   d. idle
   e. high vacuum
   f. closed-loop

C. System Diagnosis

1. Successfully retrieve system fault codes and perform ATM tests on a vehicle following the procedure outlined in this driveability book.

V. ELECTRONIC FUEL INJECTION

General Learning Objectives

A. Types of E.F.I. Systems

1. Identify and describe the different types of E.F.I. Systems used on Daimler Chrysler vehicles

B. Theory of Operation

1. Describe the flow and function of the fuel delivery system components
2. Define the parameters and functions of engine management modes

VI. SPEED DENSITY ENGINE MANAGEMENT

A. Inputs to the PCM/Purpose and Operation
   1. Identify, locate, and interpret the operation of components used in a Speed Density System.

B. Driveability Diagnosis
   1. Use a DRB III and/or MDS2 to interpret the signals generated by the various input sensors as displayed on these tools
   2. Given the appropriate Service Manual and Powertrain Diagnostics Manual, the student will be able to properly diagnose electrical and mechanical malfunctions of inputs and outputs to the PCM.
   3. Use a DVOM on-vehicle to measure, record, and interpret the voltage/resistance of various PCM-related system inputs and outputs

VII. ON-BOARD DIAGNOSTICS II

A. Given questions on a test, the student should demonstrate an understanding of the OBD II Diagnostic System and the PCM Diagnostics Management System by correctly answering those questions

B. Given questions on a test, the student will demonstrate an understanding of the Major Monitor Systems by successfully answering those questions.

C. Using the DRB III and/or the MDS II, the student will be able to successfully access DTCs, and demonstrate a basic diagnostic strategy for an OBD II vehicle driveability concern.

VIII. COURSE REVIEW/FINAL EXAM

A. Successfully complete the final exam with a grade of seventy % (70) or better out of 100

TOPIC SUMMARY

I. **Basic Operation of the Fuel System**
   - A. Components
   - B. Emission Outputs

II. **Types of Fuels**

III. Basic Carburetion
   - A. Theory of Operation
   - B. Circuits

IV. **Computer Feedback Systems**
   - A. System Fundamentals
   - B. System Diagnosis

V. **Electronic Fuel Injection**
   - A. Theory of Operation
   - B. Diagnostic Tools

VI. **Speed Density Engine Management**
   - A. Inputs to the PCM
   - B. Outputs controlled by PCM
   - C. Modes of Operation
   - D. Driveability Diagnosis

VII. **On-Board Diagnostic II**
   - A. Basis for OBD II
   - B. OBD II Diagnostics Systems
   - C. PCM Diagnostics Management
   - D. Major Monitors
   - E. Diagnostics

VIII. **Course Review/Final Exam**

EVALUATION

50% DIRECT Evaluation of Shop Work
40% Quizzes, midterm and final exams
10% Class participation

Performance Tasks

I. REVIEW OF THE BASIC OPERATION OF THE FUEL SYSTEM

A. Chrysler Systems and Components
   1. Basic Carburetion
   2. Computer Feedback Carburetion
   3. Electronic Fuel Injection (TBI)
   4. Multi-Point Fuel Injection (MPFI)

B. Emission Outputs
   1. Types of Emissions
      a. Hydrocarbons
      b. Carbon Monoxide
      c. Oxides of Nitrogen
      d. Stoichiometric Ratio
   2. Emission Control Components
      a. Exhaust Gas Re-circulation (EGR)
         1. Function and Problems
      b. Evaporative Emissions
         1. Purpose and Problems
      c. Catalytic Converter
         1. Purpose and Functions

II. TYPES OF FUELS

A. Distillation of Crude Oil
   1. Distillation Process
      a. Petroleum By-Products
   2. Cracking Process
B. Gasoline Characteristics
   1. Octane Rating
      a. Driveability Problems
   2. Fuel Additives and Blending
      a. Tetra-Ethyl Lead
      b. Alcohol and Methanol
         1. Driveability Problems
      c. Oxygenated Fuels
   3. Volatility
      a. Hot Foaming
      b. Fuel Puddling
C. Driveability Problem Diagnosis EP32

III. BASIC CARBURETION - REVIEW

A. Theory of Operation
   1. Basic Carburetor
      a. Purpose
      b. Venturi
      c. Fuel Discharge Nozzle
      d. Throttle Plate
   2. High Pressure/Low Pressure
      a. Bernoulli's Principle
      b. Types of Vacuum
         1. Manifold
         2. Ported
         3. Venturi
   3. Fuel Flow and Air Flow

B. Carburetor Circuits
   1. Float
      a. Purpose
      b. Components
      c. Driveability Problems
   2. Idle and Low Speed
      a. Purpose
      b. Components
   3. Main Metering (High Speed)
      a. Purpose
      b. Components
   4. Accelerator Pump
      a. Purpose
      b. Components
      c. Driveability Problems
   5. Power Enrichment
      a. Primary and Secondary
      b. Purpose
      c. Components
      d. Driveability Problems
   6. Choke
      a. Purpose
      b. Components
      c. Driveability Problems

IV. COMPUTER FEEDBACK SYSTEMS

A. System Fundamentals
   1. Introduction and Purpose
      a. Emissions and CAE Standards
      b. Stoichiometric Ratio
      c. Catalytic Converter Efficiency

Performance Tasks

   2. Principle of Operation
      a. Open Loop and Closed Loop
      b. Monitoring Oxygen Content
         1. Oxygen Sensor Principles
         2. Heated O_2 Sensor
      c. Sensors/Switches
         1. Coolant Temperature
            a. Thermistor-Engine Temperature
            b. Two-Position Switch
         2. Air Charge Temperature
         3. Carburetor Switch
         4. Vacuum Transducer
         5. Hall-Effect Pick-Up
            a. RPMs and Crankshaft Position
         6. Detonation Sensor
   3. Combustion Control Computer

B. Electronic Carburetor
   1. Fuel Control Solenoid
      a. Holley and Carter
      b. Metering Control and Duty Cycle
      c. Duty-Cycle Measurement
   2. Operating Modes
      a. Open-Loop Mode
         1. Cold Engine
         2. Hot Engine Restart
         3. Low Manifold Vacuum
         4. Idle Operation
         5. High Vacuum Cancel
      b. Closed-Loop Mode
         1. O_2 Feedback Fuel Control
   3. O_2 Feedback Carburetor Applications

C. System Diagnosis
   1. Use of Driveability Books
      a. ATM Tests
      b. Trouble Codes
      c. Idle Speed/Fuel Mixture Adjustments EP39, EP47

V. ELECTRONIC FUEL INJECTION

A. Types of E.F.I. Systems
   1. Throttlebody (TBI)
   2. Multi-Point Fuel Injection (MPFI) - Batch - Fire
   3. Sequential-Fire Fuel Injection

B. Benefits of Fuel Injection

C. Theory of Operation
   1. Review of Components/PCM Operation
   2. Engine Management Strategies

D. Diagnostic Tools
   1. Mopar Diagnostic System 2 (MDS2) Analyzer
   2. Diagnostic Readout Box III (DRBIII) Scan Tool
   3. Digital Volt/OHM Meter (DVOM)

VI. SPEED DENSITY ENGINE MANAGEMENT

A. Inputs to the PCM/Purpose and Operation
   1. Crankshaft Position Sensor (RPMs)
   2. Camshaft Position Sensor
   3. Sync Signal Generator (Optical or Hall Effect Distributor)
   4. ASD Sense
   5. Manifold Absolute Pressure (MAP) Sensor
   6. Throttle Position (TPS) Sensor
   7. Engine Coolant Temperature Sensor (ECT)
   8. Intake Air Temperature (IAT) Sensor
   9. Oxygen (O_2) Sensors
   10. Knock Sensor
   11. Transaxle Control Module (TCM)
   12. Transaxle Output Speed Sensor
   13. Park/Neutral Switch
   14. Brake Switch
   15. Battery Voltage Signal
   16. A/C Select Switch
   17. A/C Pressure Transducer

VI. SPEED DENSITY ENGINE MANAGEMENT (cont'd)

B. Outputs Controlled by the PCM
1. Automatic Shutdown Relay (ASD)
2. Fuel Pump Relay
3. Injectors/Pulse Width
4. Ignition Coils/Timing — Performance Tasks
5. Idle Air Control (IAC) Motor
6. Generator Output
7. EGR Solenoid
8. EVAP Purge Solenoid
9. A/C Compressor Clutch Relay
10. Radiator Fan Relays
11. Torgue Converter Clutch (TCC) Solenoid
12. Malfunction Indicator Lamp (MIL)

C. Modes of Operation
1. Key "On"
2. Crank
3. Open Loop
4. Closed Loop
5. Wide-Open Throttle (WOT)
6. Decel
7. Computer Operating Cells
   a. Purpose/Theory of Operation
   b. Long Term Adaptive Memory
   c. Short Term Adaptive Memory

D. Driveability Diagnosis
1. Using the Driveability Manual — EP 14
   a. Following the Diagnostic Charts
   b. Accessing Information for the MDS2 — EP 15
2. On-Board Diagnosis I
   a. Diagnostic Trouble Codes (DTCs)
   b. DTC Fault Parameters
   c. "No Fault" Driveability Diagnosis
   d. Using the DRB III Scan Tool — EP12, EP13, EP33
   e. Diagnosing with the Digital Volt/OHM Meter (DVOM) — EP16
3. Component Inspection/Replacement — EP31, EP35, EP36
   a. Sensor/Switch Tests — EP37, EP38, EP40
   B. Installation and Adjustments

VII. ON-BOARD DIAGNOSTICS II

A. Basis for OBD II
1. Federal Legislation

2. Environmental Protection Agency
3. California Air Resources Board (CARB)

B. OBD I vs. OBD II
   1. System Monitors
   2. OBD II Hardware and Software

C. OBD II Diagnostic Systems
   1. Service Standardizations
      a. Terminology
      b. Diagnostic Trouble Codes
      c. Hex ID Code
      d. Diagnostic Trouble Code Text
      e. Data Link Connector (DLC)
      f. OBD II Scan Tool Requirements

D. PCM Diagnostics Management System
   1. Task Manager
      a. Responsibilities
   2. Test Sequences
      a. Trip Monitors
   3. Good Trip Counters
      a. Global Good Trip
      b. Fuel System Good Trip
      c. Misfire Good Trip
      d. Alternate Good Trip
   4. Warm-up Cycles
      a. Parameters
   5. MIL Lamp Illumination
   6. DTC Erasure
      a. DTC Priority
   7. Freeze Frame

E. Major Monitors
   1. Comprehensive Components
      a. Circuit Continuity
      b. Input Rationality
      c. Output Functionality
   2. Fuel Control Monitor
      a. Operation
      b. Short Term Adaptive
      c. Long Term Adaptive
      d. Monitor Operation
         1. Enabling Conditions

3. Heated Oxygen Sensor Monitor
    a. Sensor Monitor
    b. Sensor Thresholds
    c. Big Slope
    d. Half Cycle
    e. Monitor Operation
        1. Enabling Conditions
    f. Heater Monitor
        1. Enabling Conditions
4. Catalyst Monitor
    a. Theory of Operation
    b. Enabling Conditions
5. Misfire Monitor
    a. Misfire Detection
        1. 200 RPM Counter
        2. 1000 RPM Counter
        3. Adaptive Numerator
        4. RPM Error
    b. Enabling Conditions
6. EVAP Monitor
    a. Theory of Operation
    b. Leak Detection Pump
    c. Enabling Conditions
7. EGR Monitor
    a. Theory of Operation
    b. Enabling Conditions
8. Monitor Diagnostics
    a. Accessing DTGs
    b. Running Monitor Tests

VIII. Course Review/Final Exams

A. Course Review Subject Areas
    1. Types of Fuels
    2. Carburetion Review
    3. Computer Feedback Systems
    4. Electronic Fuel Injection
    5. Speed Density Engine Management
    6. On-board Diagnostics (OBDII)

B. Final Exam