COURSE OUTLINE

AUT 112  AUTOMOTIVE FUEL SYSTEMS  3
Course Number  Course Title  Credits

2/2  AUT 110 and AUT 111  Spring 2019
Hours:  Co- or Pre-requisite  Implementation
lecture/Lab/Other  sem/year

Catalog description (2018-2019 Catalog):
Examines automotive fuel systems in use today. Coverage includes fuel basics, 
electronic fuel injection systems, sequential port fuel injection and On-Board Diagnostics II 
(OBD II) with focus on theory of operation, driveability diagnostic procedures and the use of 
computerized diagnostic equipment.

Is course New, Revised, or Modified? Revised

Required texts/other materials: Halderman, James D., Automotive Fuel and Emissions Control 

Revision date:  Course coordinator:  Jason Evans evansj@mccc.edu, ext. 3776
January 2019

Information resources:
DealerConnect web-site, Service Manuals, Subaru of America resources, On-line and Self-study Courses 
and the AllData Online Service Information Database.

Other learning resources: (Describe any other student learning resources that are specific to this course, 
including any special tutoring or study group support, learning system software, etc.)
**Course Competencies/Goals:** [List the most important 5-8 overall student learning outcomes for your course. Course-level student learning outcomes (or Course Competencies/Goals) are statements that describe the specific, measurable knowledge, skills, and/or values that the student is expected to demonstrate, perform or exhibit after completion of the course. Student learning outcomes should focus on what the students will learn (rather than what the instructor will teach) and must include verbs (explain…, demonstrate…, analyze…) that reflect lower-order and higher-order learning goals.]

*The student will be able to:*
1. obtain service repair information and procedures from the appropriate online service information database using the computers found in the automotive facility.

2. research service procedures to repair program vehicles using the vehicle service manuals supplied by the program.

3. demonstrate an understanding of the proper use of diagnostic scan tools by successfully retrieving control module diagnostic trouble codes and sensor information.

4. demonstrate an understanding of the types of fuel management systems used on current vehicles by answering questions on a test or quiz.

5. given a live vehicle with a driveability problem, successfully diagnose the cause of the problem and return it to service.

6. demonstrate an understanding of the OBD II Emission Control requirements by successfully answering questions on a test or quiz.

**Course-specific General Education Knowledge Goals and Core Skills.** [To an extent consistent with its primary purposes, each course in every program is expected to reflect the college’s commitment to general education, as affirmed in the 2005 General Education Policy. A General Education Course is one whose primary purposes and overall design coincide strongly with one or more of the approved general education goals and objectives. For any approved (or proposed) General Education Course, the General Education Goals and Objectives form (the form identified as the "Gen Ed Attachment") should be completed and attached to the course outline. Below is a complete list of Mercer’s General Education Knowledge Goals and Core Skills. Retain on this course outline the Goals and Skills that pertain to your course and delete those that are not a central part of the course.]

**General Education Knowledge Goals**
- **Goal 1. Communication.** Students will communicate effectively in both speech and writing.
- **Goal 2. Mathematics.** Students will use appropriate mathematical and statistical concepts and operations to interpret data and to solve problems.
- **Goal 3. Science.** Students will use the scientific method of inquiry, through the acquisition of scientific knowledge.
- **Goal 4. Technology.** Students will use computer systems or other appropriate forms of technology to achieve educational and personal goals.
- **Goal 5. History.** Students will understand historical events and movements in World, Western, non-Western or American societies and assess their subsequent significance.
- **Goal 6. Diversity.** Students will understand the importance of a global perspective and culturally diverse peoples.
- **Goal 7. Ethical Reasoning and Action.** Students will understand ethical issues and situations.

**MCCC Core Skills**
- **Goal A. Written and Oral Communication in English.** Students will communicate effectively in speech and writing, and demonstrate proficiency in reading.
- **Goal B. Critical Thinking and Problem-solving.** Students will use critical thinking and problem solving skills in analyzing information.
- **Goal C. Ethical Decision-Making.** Students will recognize, analyze and assess ethical issues and situations.
- **Goal D. Information Literacy.** Students will recognize when information is needed and have the knowledge and skills to locate, evaluate, and effectively use information for college level work.
- **Goal E. Computer Literacy.** Students will use computers to access, analyze or present information, solve problems, and communicate with others.
Goal F. Collaboration and Cooperation. Students will develop the interpersonal skills required for effective performance in group situations.

Goal G. Intra-Cultural and Inter-Cultural Responsibility. Students will demonstrate an awareness of the responsibilities of intelligent citizenship in a diverse and pluralistic society, and will demonstrate cultural, global, and environmental awareness.

Units of study in detail. [Each unit should center around a topic, theme or skill that supports the Course Competencies/Goals (the course-level student learning outcomes [SLOs]) and general education student learning outcomes. For each unit, identify specific student learning outcomes that focus on content knowledge or process skills. Units of study are not simply the chapters of the textbook; they are independent of the selected textbook. Unit-level student learning outcomes should state (in terms that can serve as the frame of reference for ongoing assessment of both student achievement and of the course’s effectiveness) what successful students will be able to demonstrate, perform or exhibit at the end of the unit. Connect the unit-level SLOs back to the course-level SLOs and the General Education and Core Skills SLOs either by cross-referencing them by number or by explaining the connections in a brief narrative. It is not expected that every unit-level SLO will connect to the General Education and Core Skills SLOs; each unit-level SLO, however, must connect to at least one course-level SLO. See the attached examples.]

Unit I: THE BASIC OPERATION OF THE FUEL SYSTEM

Learning Objectives
The student will be able to...
• demonstrate his/her understanding of the types of fuel systems used on today’s vehicles by successfully answering questions on a test or quiz.
• identify the types of vehicle emissions, how they are produced and their effects on the environment, both verbally or written on a test.
• describe the advantages of using a computer controlled fuel management system, both verbally or written on a test.

A. Modern Vehicle Fuel Systems: Overview
   1. Throttle Body Electronic Fuel Injection (TBI)
   2. Multi-Point Electronic Fuel Injection (MPFI)
      a. Batch-fire
      b. Sequential-fire (SFI)
   3. Speed Density Fuel Management (MAP)
   4. Mass Air Flow Fuel Management (MAF)

B. System Components and Functions
   1. Fuel Tank
   2. Fuel Pump
   3. Fuel filter
   4. Fuel Lines and Hoses

HOMEWORK: Chapter 19
Read pages 238-254
Review Questions: 1-6 page 254
Chapter Quiz: Questions 1-10 page 255

C. Vehicle Emission Outputs
   1. Types of Emissions/ Sources
      a. Hydrocarbons
      b. Carbon Monoxide
      c. Oxides of Nitrogen
      d. Carbon Dioxide
      e. Oxygen
      f. Stoichiometric Ratio
Unit II: TYPES OF FUELS

Learning Objectives

The student will be able to...

- define the following terms and identify possible driveability problems related to them. This may be done verbally or in written form.
  1. Distillation
  2. Fuel Blending
  3. Octane Rating
  4. Volatility
  5. Cetane Rating
  6. Alternative Fuel
- describe the characteristics of gasoline as a motor fuel by successfully answering questions on test or quiz.

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
     c. Octane Boosters
     d. Oxygenated Fuels
     e. Driveability Problems
  3. Volatility Rating
     a. Reid Vapor Pressure
     b. Evaporative Emissions
     c. Fuel Foaming
     d. Driveability Problems

C. Diesel Fuel Characteristics
  1. Cetane Rating
  2. Particulates and Sulfur Content

D. Alternative Fuels
  1. Ethanol
  2. Hydrogen Fuel Cell
  3. Biodiesel

MasterTech Video: FUEL BASICS

Homework: Chapter 6
  Read pages 95-106
  Review Questions: 1-8 page 106
  Chapter Quiz Questions: 1-10 page 107
UNIT III: SPEED DENSITY ENGINE MANAGEMENT (MAP)

Learning Objectives
The student will be able to:
1. identify and describe the different types of electronic engine management systems used on modern vehicles, both verbally or written on a test.
2. describe the flow and function of the fuel delivery system components by successfully answering questions on a test.
3. using one of the program vehicles, identify, locate and interpret the operation of components used in a Speed Density Fuel system.
4. use an electronic computerized scan tool to interpret the signals generated by the various input sensors as displayed by these tools.
5. utilize service information found on the AllData or DealerConnect web-sites to properly diagnose electrical and mechanical malfunctions of inputs and outputs to the PCM.

A. Inputs to the PCM: Purpose and Operation
   01. Crankshaft Position Sensor (RPMs)
   02. Camshaft Position Sensor
   03. ASD Sense
   04. Manifold Absolute Pressure Sensor (MAP)
   05. Throttle position Sensor (TPS)
   06. Engine Coolant Temperature Sensor (ECT)
   07. Intake Air Temperature Sensor (IAT)
   08. Heated Oxygen Sensor (O2)
   09. Knock Sensor
   10. Transmission Output Speed Sensor/ Distance Sensor
   11. Park/Neutral Switch
   12. Brake Switch
   13. Sensed Battery Voltage
   14. A/C Select Switch/ Pressure Transducer

B. Outputs Controlled by the PCM: Purpose and Operation
   01. Automatic Shutdown Relay (ASD)
   02. Fuel Pump Relay
   03. Fuel Injectors/ Pulse Width
   04. Ignition Coil(s)
   05. Idle Air Control Motor (IAC)
   06. Generator Output/ Charging System
   07. EGR Solenoid
   08. EVAP Purge Solenoid
   09. Radiator Cooling Fan Relay
   10. Malfunction Indicator Lamp (MIL)
   11. A/C Compressor Clutch Relay

C. Modes of Operation
   1. Key “ON”, Crank
   2. Open Loop
   3. Closed Loop
   4. Wide Open Throttle (WOT)
   5. Decel
   6. PCM Operating Cells
a. Long Term Adaptive Memory
b. Short Term Adaptive Memory

D. Driveability Diagnosis
1. Using the DealerConnect or AllData Web-Site
   a. Accessing Information
   b. Following the Diagnostic Procedures
2. On-Board Diagnosis
   a. Diagnostic Trouble Codes (DTCs)
   b. DTC Fault Parameters
   c. Using the Computerized Electronic Scan Tools
   d. Diagnosing with the Digital Volt/Ohm Meter (DVOM)
e. “No Fault” Driveability Diagnosis
3. Component Inspection Replacement
   a. Sensor and Switch Tests
   b. Installation and Adjustments

HOMEWORK: Chapter 20
Read pages 256-268
Review Questions 1-5 page 268
Chapter Quiz Questions 1-10 page 268

UNIT IV: ON-BOARD DIAGNOSTICS II
Learning Objectives:
The student will be able to:
1. demonstrate an understanding of the OBD II Diagnostic System and the PCM Diagnostics Management system by correctly answering questions on a test or quiz.
2. using the Computerized Electronic Scan Tool, successfully access DTCs, and demonstrate a basic diagnostic strategy for an OBD II vehicle driveability concern.
3. given questions on a test, demonstrate an understanding of the Major System Monitors by successfully answering those questions.

A. Basis for OBD II
   1. Federal Legislation- 1990 Clean Air Act
   2. Federal Environmental Protection Agency
   3. California Air Resources Board (CARB)

B. OBD II Diagnostic Systems
   1. OBD I vs. OBD II
   2. Service Standardizations
      a. Terminology
      b. Diagnostic Trouble Codes (DTC)
      c. Data Link Connector (DLC)
      d. OBD II Scan Tool Requirements

C. PCM Diagnostics Management System
   1. Task Manager
      a. Responsibilities
   2. Test Sequences/ Trip Monitors
   3. Good Trip Counters
      a. Global Good Trip
      b. Fuel System Good Trip
      c. Misfire Good Trip
      d. Alternate Good Trip
   4. MIL Lamp Illumination
   5. DTC Erasure/ Priority
6. Freeze Frame Data

D. Major Monitors
1. Comprehensive Components
   a. Input Rationality Check
   b. Output Functionality Check
2. Fuel Control Monitor
   a. Operation
   b. Short-term Adaptive Fuel Trim
   c. Long-term Adaptive Fuel Trim
   d. Monitor Operation
3. Heated Oxygen Sensor Monitor
   a. Sensor Monitor Operation
   b. Sensor Thresholds
   c. Big Slope/ Half Cycle
   d. Heater Monitor
   e. 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/ RPM Error
      4. Enabling Conditions
6. EVAP Monitor
   a. Leak Detection Pump Method
   b. Natural Leakdown Method
   c. Enabling Conditions
7. EGR Monitor
   a. Operation/ Enabling Conditions

E. System Diagnosis
1. Accessing DTCs
2. Running Monitor Tests
3. Performing an EVAP Smoke Test

HOMEWORK: Chapter 11
Read pages 153-161
Review Questions 1-4 page 161
Chapter Quiz Questions 1-10 page 161

UNIT V: COURSE REVIEW/ FINAL EXAM

Learning Objective:
The student will be able to:
1. successfully complete the final exam with a grade of seventy per cent or better out of 100.

A. Course Review Subject Areas
1. Basic Operation of the Fuel System
2. Types of Fuels
3. Speed Density Engine Management
4. On-Board Diagnostics II

B. Final Exam
**Evaluation of student learning:**

A. Lab Work………………………………………………………………………………………………….50%
B. Quizzes/Exams……………………………………………………………………………………………50%

**TOTAL**………………100%

**Policy Statement for Missed Lab and Equipment Demonstrations:**
Due to the technical nature of the Automotive Program and hazards involved with the use of specialty tools and equipment, a student that is absent from lab instruction, where demonstrations are performed by the course instructor, will not be permitted to complete the related lab work upon their return. This includes full-day absences and partial-day absences that result in missing the lab demonstration(s). Enforcement of these policies will be at the discretion of the course instructor.

**Academic Integrity Statement:** [Include a statement affirming the college’s Academic Integrity policy and any specific implications for the course. See [http://mlink.mccc.edu/omb/OMB210.pdf](http://mlink.mccc.edu/omb/OMB210.pdf)]
A student who knowingly represents the work of others as his/her own, uses or obtains unauthorized assistance in the execution of any academic work, or give fraudulent assistance to another student is guilty of cheating. (See Student Handbook). Any student who violates this policy is subject to receive a failing grade for the assignment and will be reported to the Office of Student Affairs for further disciplinary action. Possible dismissal from the course could result.

**Reasonable Accommodations for Students with Documented Disabilities**
Mercer County Community College is committed to supporting all students in their academic and co-curricular endeavors. Each semester, a significant number of students document disabilities, which may require learning, sight, hearing, manual, speech, or mobility accommodations to ensure access to academic and co-curricular activities. The college provides services and reasonable accommodations to all students who need and have a legal entitlement to such accommodations.

For more information regarding accommodations, you may visit the Office of Academic Support Services in FA129 or contact them at 609.570.3422

Mercer County Community College is in compliance with both the ADA and section 504 of the Rehabilitation Act. If you have, or believe you have, a differing ability that is protected under the law, please see Arlene Stinson in LB216, at 570-3525 or at stinsona@mccc.edu for information regarding support services.