AUME-791: ENGINE PERFORMANCE II

Effective Term
Fall 2024

BOT Approval Date
12/14/2023

Discipline
AUME - Automotive/Transportation Tech
Course Number
791

Course Title
Engine Performance II

Short Title
Engine Performance II

Credit Status (CB 04)
D - Credit - Degree applicable

Units

Lecture Units
3.00

Lab Units
1.00

Total Units
4.00

Hours

Lecture Contact Hours
48-54
Out of Class Hours Lecture
96-108

Lab Contact Hours
48-54
Out of Class Hours Lab
0.00

Total Contact Hours
96 - 108

Total Out of Class Hours
96 - 108

Total Student Learning Hours
192 - 216

Is this an existing Extensive Lab?
No

Do you want to propose this for Extensive Lab?
Yes

Distance Education
No

Catalog Description
This course provides an intense study of the design and operation of fuel management systems including fuel injection, electronic ignition, and other computer controlled systems. Emphasis in this course is placed on the correct diagnostic method used to repair those systems.

Attach Supporting Documents
ASE PROGRAM STANDARDS Engine Performance.pdf

Requisites

Prerequisite(s)

Prerequisite(s) (must be taken before)
AUME-790 (with a grade of C or better).

Recommended Preparation

Recommended Preparation (note that students can enroll in the class even if they haven't take the recommended course)
AUME-700 or AUME-780.

Codes

TOP Code (CB 03)
0948.00* - *Automotive Technology

CIP Code
47.0604 - Automobile/Automotive Mechanics Technology/Technician.

Student Accountability Model (SAM) Priority Code (CB 09)
C - Clearly Occupational

Noncredit Category (CB 22)
Y - Credit Course

Repeatability Code
No

Grading Option
Letter grade OR P/NP

Minimum Qualifications

Minimum Qualifications	And/Or
Automotive Technology	End

CSU Area(s)

IGETC Area(s)

Learning Objectives

Learning Objectives

Learning Objective
1. Organize an engine management system diagnosis procedure according to the industry standard eight-step process.
2. Analyze the operational efficiency of the engine management system using fuel trim data.
3. Evaluate the condition of engine management input sensors using data supplied by a scan tool..
4. Prepare a repair order in accordance with Bureau of Automotive Repair standards.
5. Assess the condition of a vehicle and its owner and conclude whether it would be best to retire the vehicle from service.
6. Evaluate equity issues related to eligibility for and the advantages of the DMV Vehicle Retirement Program.
7. Analyze the condition of an internal combustion engine (ICE) by evaluating emissions data with a five-gas analyzer.

Learning Outcome Information

Course Learning Outcomes

Learning Outcome
1. The student will be able to test the operation of common engine management sensors.
2. The student will be able to interpret scan tool fuel trim data to assess the operation of the engine management system.
3. The student will be able to discuss how equity issues can be addressed by the California DMV Vehicle Retirement Program.
4. The student will be able to diagnose a fault in an engine management system on a trainer or an actual vehicle.

Program Learning Outcomes

Learning Outcome
Complete all NATEF (National Automotive Technician Education Foundation) task sheets.
Enter the workforce in the automotive industry.
Pass all eight areas in the ASE certification.

Institutional Learning Outcomes

Communication: The student will effectively express and exchange ideas through listening, speaking, reading, writing, visual works, and other modes of interpersonal expression.
Critical Thinking: The student will analyze problems, gather and synthesize relevant information, evaluate ideas, information, and evaluate alternative points of view to create, innovate and implement effective solutions.
Information and Technology Literacy: The student will access, interpret, evaluate, and apply relevant information sources and digital media effectively, and in an ethical and legal manner.
Scientific Awareness: The student will apply the scientific method of inquiry to assess potential solutions for real-life challenges by employing science-based knowledge and methodologies in daily life.
Social Awareness: The student will recognize and analyze the interconnectedness of global, national, and local concerns, analyzing cultural, political, social, and environmental issues from multiple perspectives and appreciate similarities and differences among cultures.
Civic
Personal
and Professional Responsibility

Content

Course Lecture Content

1. Automotive Service Safety and Hazardous Material Pollution Prevention
    a. S/P2 Certifications
        i. S/P2 Automotive Service Safety Certification
        ii. S/P2 Automotive Hazardous Pollution Prevention Certification

iii. Automotive Lift Institute's "Lifting it Right" Certification
iv. S/P2 Ethics and You in the Automotive Industry Certification
b. Automotive Repair Information Database Navigation
i. Alldata
ii. Mitchell Prodemand
2. Introduction to Strategy-Based Diagnosis
a. Verification of the Concern
b. Visual Inspection and Simple Testing
c. Retrieve Diagnostic Trouble Codes (DTCs)
d. Check Manufacturer Technical Service Bulletins (TSBs)
e. Retrieve and Interpret Scan Tool Data
f. Narrow the Possibilities
g. Find and Fix the Root Cause
h. Verify the Repair
3. Sensor Operating Principles
a. Analog Sensors
i. Speed and Position Sensors
ii. Thermistors
iii. Potentiometer-Type Sensors
iv. Signal Generators
b. Digital Sensors
i. Crankshaft Position Sensors (CKP)
ii. Camshaft Position Sensors (CMP)
4. Theory of Actuator Operation
a. Solenoids
b. Stepper Motors
5. Exhaust Gas Analysis
a. The Five Gases
i. Hydrocarbons
ii. Carbon Monoxide
iii. Carbon Dioxide
iv. Oxides of Nitrogen
v. Oxygen
6. How to Analyze Repair Costs and Benefits
a. An Overview of Total Repair Costs
b. How to Estimate the Remaining Useful Service Life of a Vehicle
c. How to Determine the Needs of Individual Customers
i. Determine Eligibility for the DMV Vehicle Retirement Program
ii. Determine the Driving Habits of Individual Customers
1. How Long They will be Able to Keep the Car Based on their Driving Habits
2. Determine Whether the Continuing Maintenance and Repair Costs Exceed the Cost of Simply Replacing the Vehicle
7. Methods Used for Repair Verification
a. OBD II System Monitors
b. Scan Tool Data
c. Volumetric Efficiency Testing

Course Lab Content

1. Repair Order Preparation
a. The Three C's
i. Customer Complaint
ii. Cause of the Complaint
iii. Correction of the Complaint
2. Performing Strategy-Based Diagnostics
a. Sensor Diagnostics
i. Analog Sensors
1. Speed and Position Sensors
a. Throttle Position Sensors (TPS)

2. Oxygen and Air/Fuel Ratio Sensors
3. Thermistors
4. Mass Air Flow Sensors (MAF)
5. Manifold Absolute Pressure Sensors (MAP)

ii. Digital Sensors
1. Camshaft Position Sensors (CMP)
2. Crankshaft Position Sensors (CKP)

3. Actuator Testing
   a. Solenoids
      i. Fuel Injectors
      ii. Other Types of Solenoids
   b. Stepper Motors
4. Repair Cost/Benefit Analysis
   a. Determine the Needs and the Circumstances of Individual Customers
   b. Determine the Total Cost of the Repair and the Remaining Useful Service Life of the Vehicle
   c. Conclude Whether Repair or Vehicle Retirement Would be the Better Option for the Customer on an Individual Basis, with Emphasis Placed on the Special Needs of Disadvantaged Customers.
5. Repair Verification
   a. Verify Repairs Using OBD II System Monitors
   b. Verify Repairs Using other Scan Tool Data
   c. Volumetric Efficiency Testing
   d. Five-Gas Exhaust Analysis

Methods of Instruction

Method

Film/video Viewing and Discussion

Integration

This course makes extensive use of accessible training videos covering a wide variety of engine management subjects. The students will be encouraged to discuss the implications of the material presented in the videos and the instructor will ask probing questions in order to enhance our student's understanding of the material.

Method

Observation and Demonstration

Integration

The instructor will demonstrate the procedures used to perform many of the inspection and diagnostic techniques that are used as a part of the course. Student engagement will be enhanced by the use of worksheets that they will be asked to fill out while they are observing the demonstrations.

Method

Lab Activities

Integration

Students will be asked to participate in lab activities using either an actual vehicle or one of the department's specialized automotive systems trainers. Student engagement in these exercises will be encouraged by having them fill out a worksheet that will record the data they have observed as a result of the experiment that they have participated in.

Method

Directed Study

Integration

Students will be directed to investigate the relationship between equity issues related to vehicle ownership and the State of California DMV's Consumer Assistance (CAP) program. This course will place particular emphasis on CAP's Vehicle Retirement Program.

Methods of Evaluation

Method

Quizzes

Integration

Quizzes will be given periodically in order to assess student understanding of the material being presented. The quizzes will be written in the same style as the official certification tests which are administered by the department's third-party accrediting body, the ASE Education Foundation and will cover the same material. Assessment of student understanding will be based upon the accuracy of their responses to the quiz questions.

Method

Class Performance

Integration

Various lab exercises will include an assessment of student ability to perform different engine management diagnostic and repair tasks according to industry standard. Evaluation will be based upon the level of mastery that the student displays in performing the task as well as the student's ability to perform the task in the amount of time allotted to it.

Method

Role-playing/Simulation

Integration

Students will be asked to participate in at least one role-playing situation during which one of them will act as a customer presenting a complaint about a vehicle engine management system--preferably this will be an actual fault on one of their own vehicles--while others in the group will interpret the complaint, verify it, perform research about the vehicle and the system, narrow the issue down and perform the repair. Evaluation will be based on the ability of the students to resolve the original complaint.

Method

Research Projects

Integration

Students will be asked to research how the State of California's DMV Vehicle Retirement Program might be used to help to address equity issues related to the burdens of vehicle ownership. Evaluation of the student's understanding will be made on the basis of how accurately they can apply the requirements of the program and assess its advantages to individual consumers.

Assignments

Assignment Type

Reading

In-class and/or outside of class

Outside of class

Formative or Summative

Formative

Assignment

Read the textbook chapters assigned by your instructor which are intended to familiarize you with the operation of modern engine management systems. The emphasis in this course will be on computer electronics; therefore, you need to be familiar with the input sensors and output actuators used by the computer systems to control the engine operation and possess a familiarity with the way in which the various control modules used on modern automobiles communicate along a network; therefore, the readings used in this course will focus upon the operation of computer systems, inputs, and outputs.

Assignment Type

Writing

In-class and/or outside of class

In-class

Formative or Summative

Formative

Assignment

Prepare a repair order according the the standards demanded by the State of California's Bureau of Automotive Repair (BAR). The repair order will display required items of information about both the customer and the vehicle being inspected or repaired. The repair order will also include an information section in which the customer complaint or complaints will be summarized in a form referred to in our industry as the "3Cs"–a brief summary of the customer complaint, a description of the cause of that complaint, and an explanation of the correction of that complaint. The assignment is intended to encourage students to utilize a logical process when performing diagnosis and repair. The assignment will be evaluated by how well it meets the BAR standards.

Assignment Type

Other

In-class and/or outside of class

In-class

Formative or Summative

Formative

Assignment

Assess a consumer's eligibility to take advantage of the State of California DMV's Vehicle Retirement Program and determine when a consumer would be better off taking advantage of it rather than proceed with vehicle repairs.

Assignment Type

Other

In-class and/or outside of class

In-class

Formative or Summative

Summative

Assignment

Diagnose an engine management system problem on a bugged vehicle and recommend the proper repair procedures necessary to restore the vehicle the proper operation.

Course Materials

Textbooks

Johanson, Chris. (2021) Auto Engine Performance and Driveability, 5th edition. Goodheart and Willcox. ISBN: 978-1-64564-171-1

Class Size Information

Class Size

32

Class Size Category

G - Large lab 32

Diversity and Inclusion

Explain how diversity and inclusion(e.g., gender, culture/race, sexuality, etc.) is infused into the course.

This course is the second part of a two-course series. The first part of the series focused on how equity issues related to vehicle ownership can be addressed by the State of California DMV's Consumer Assistance Program, or, CAP. CAP is divided into two separate components: the first is the Repair Assistance Program, which is designed to help disadvantaged consumers afford necessary vehicle repairs. The second component, which is emphasized in this course, focuses on deciding when it is no longer advantageous or desirable to perform repairs on a vehicle an explore ways to retire the car and assist disadvantaged consumers in purchasing a replacement.
Since this course is presented in the Automotive Department's SJC auto shop facility, it is worth noting here that extensive efforts have been made to provide a warm, welcoming and inclusive environment for students in this and our other courses as well. An extensive effort to sanitize and reorder the facility and the grounds surrounding it has been ongoing for the past five years; in addition, posters and signage has been added which is intended to make the members of special populations feel especially welcome.
Finally, emphasis is placed on the employment and entrepeneurship opportunities that the course makes available to its students; the apprenticeship section of the course opens that vital first step for any who will put their foot forward.

Describe how assignments, instruction, evaluation, course content, and interactions are contextualized for diverse learners promoting an equitable course.

This course makes extensive use of accessible training videos as well as online training modules which are hosted by vehicle manufacturers such as Ford and Audi. Students are able to supplement the materials presented in the textbook with information supplied by the manufacturers themselves; most of them strive to assure that the modules are presented by individuals who are members of special populations, so someone who is most like the student is right up at the front of the class.
The assignments for this course and their assessment has been carefully structured to provide the greatest possibility of success for all students, regardless of whatever learning style they are the most comfortable with. Textbook reading assignments and written assessments are a part of the course, but so are the assignments that are based in the lab-these assignments are weighted on an equal basis, so individuals who perform well on written testing will not have any particular advantage over those who can perform well working with their hands.
Finally, the material is contextualized in terms of determining what is best for the individual consumer, based on their circumstances and the condition of the car they drive.
Sometimes it simply isn't either advantageous or desirable to repair a vehicle, and our students will need to apply what they have learned in order to make that determination. Emission system related repairs, for example, such as the replacement of a catalytic convertor, can easily exceed the value of a vehicle; students will need to become sensitive to the circumstances and needs of individual vehicle owners to recommend the best course of action.-

Interactions

Explain how the course will incorporate student-to-student interaction.

The students are generally encouraged to work in teams of four or five individuals. The tasks that are required in order to successfully complete the course require a considerable amount of teamwork on the part of the students; for example, some of the members of a certain team will have to verify the fault complaint, while one or more of the others work to prepare a repair order for the vehicle under study. As the actual lab exercise begins, part of the team will be responsible for making a diagnosis of the problem, if that is required by the exercise, while another part of the team will perform the actual work required to repair the fault. Finally, another part of the team will verify that the fault is indeed repaired while other members of that team will prepare a final invoice version of the repair order. These responsibilities will rotate between different individuals or pairs of students from one laboratory exercise to another. The students will need positive interaction with one another in order to successfully perform the task at hand.

Explain how the course will incorporate instructor-to-student interaction.

The instructor will interact with the students in a number of different ways. The Instructor's primary responsibility is to explain the operation of various automotive engine management systems; the Automotive Department utilizes a combination of accessible

visual presentations, instruction using specialized automotive trainer units and physical demonstration of diagnostic and repair procedures on an actual vehicle. In addition, the instructor will act as a coach to either encourage the students when they are performing their work correctly or suggest that they use better methods when they are not. Finally, the instructor will provide feedback about the cumulative value of student performance on lab exercises and final performance functions.

Explain how the course will incorporate student-to-content interaction.

The course content is delivered in a progressive fashion--first, students are instructed to identify the component parts of a specific engine management system and asked to identify those components on a worksheet. After this is completed successfully, the theory of operation of that system will be discussed; the students will generally be asked to perform an experiment and complete a worksheet on one of our specialized automotive systems trainer units. That experiment will allow the students to practice and to improve their skills in applying the course content. Finally, students are generally asked to demonstrate their ability to perform system diagnosis and repair on an actual vehicle, which requires that they be able to apply the content of the course to an actual situation.

Explain how the course will incorporate student-to-self interaction (metacognitive).

One of the concepts that our students are introduced to is an eight-step process that is generally accepted as the industry standard for performing diagnosis and repair on modern vehicles. The eight steps include verification of a problem or complaint, performing a thorough visual inspection, using a diagnostic scan tool to retrieve any available diagnostic information and checking for any Technical Service Bulletins that the vehicle manufacturer might have issued concerning the fault in question. The student will then use the scan tool to look at specific data that would assist in the diagnosis or repair; that will help to narrow the problem down to a specific system or defective component. The last two steps are to repair the problem and verify that it has indeed been repaired. Periodically, students will be asked to reflect on how the procedures that they have employed align with the flow of that diagnostic process, and that will provide the metacognitive interaction.

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