AUME-790: ENGINE PERFORMANCE I

Effective Term
Fall 2024

BOT Approval Date
12/14/2023

Discipline
AUME - Automotive/Transportation Tech
Course Number
790

Course Title
Engine Performance I

Short Title
Engine Performance I

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 covers theory of operation, diagnosis and service of automotive engines and related sub-systems. The use of test equipment and the repair or replacement of major components of passenger vehicles is also covered. Areas of study include the induction, ignition and other engine management systems. This course is designed for learners wishing to develop skills in diagnosis and repair of current and emerging technologies. This course will assist in preparation for ASE A-8 exam.

Attach Supporting Documents
ASE PROGRAM STANDARDS Engine Performance.pdf

Requisites

Recommended Preparation

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

Requisite Course Attachment(s)
ASE PROGRAM STANDARDS Engine Performance.pdf

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. Practice shop safety and hazardous materials pollution prevention techniques according to industry standards.
2. Compare and contrast the different types of engine management systems.
3. Analyze and evaluate engine management diagnostic scan tool data.
4. Exhibit the ability to perform repairs of defective engine management system components.
5. Investigate the State Department of Motor Vehicles' (DMV) Consumer Assistance Program (CAP).
6. Relate the assistance available through the DMV Consumer Assistance Program to equity issues surrounding motor vehicle repair costs.
7. Document the cost of repairs necessary to restore a vehicle's engine management system to manufacturer specifications.

Learning Outcome Information

Course Learning Outcomes

Learning Outcome
1. The student will apply shop safety and hazardous material pollution prevention protocols according to industry standards.
2. The student will be able to identify the various component parts of the engine management system.
3. The student will be able to use a diagnostic scan tool, digital multi-meter (DMM) and Graphing Multi-Meter (GMM) to diagnose engine management faults.
4. The student will be able to perform mechanical testing on the engine (Compression, vacuum and exhaust backpressure) to assess an engine's overall mechanical condition.
5. The student will be able to describe the assistance available from the DMV CAP program and its ability to address equity issues related to automobile repair costs.

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. Shop Safety and Hazardous Pollution Prevention
    a. S/P2 Certifications
        i. Automotive Service Safety
        ii. Automotive Hazardous Pollution Prevention
        iii. Automotive Lift Institute's "Lifting it Right"
        iv. Ethics and You in the Automotive Industry
2. Researching Vehicle Service Information
    a. ALLDATA
    b. Mitchell ProDemand
3. Cooling and Lubrication Systems
    a. Component Parts
    b. Theory of Operation
    c. Diagnostic Techniques
4. Basic Engine Design
    a. Induction Systems
        i. Naturally Aspirated Engines
        ii. Forced Induction Engines
    b. The Four-Cycle Process
5. Gasoline Engine Classifications
    a. Spark Ignition
    b. Compression Ignition
    c. Engine Displacement
    d. Torque, Horsepower and KwH
    e. The Compression Ratio
6. Computerized Engine Controls
    a. Component Identification
    b. Theory of Operation
    c. Basic Diagnostic Techniques
        i. Scan Tool Diagnostics
        ii. Mechanical Tests and Visual Inspection Techniques
7. The Ignition System
    a. Component Identification
    b. Theory of Operation
        i. Distributor Ignition Systems
        ii. Waste Spark Ignition Systems
        iii. Coil-Per-Plug Ignition Systems
    c. Types of Speed and Position Sensors
        i. Crankshaft Position Sensors (CKP)
        ii. Camshaft Position Sensors (CMP)
        iii. Analog Sensors (Passive Sensors)
        iv. Digital Sensors (Active Sensors)
8. Fuel Delivery, Induction and Exhaust Systems
    a. Fuel Injection Systems
        i. Component Identification
        ii. Theory of Operation
        iii. Basic Service Techniques
    b. Induction System Design
        i. Types of Induction Manifolds
            1. Standard
            2. Tuned
            3. Variable Runner
        ii. Theory of Operation
        iii. Basic Diagnostic and Inspection Techniques

c. Exhaust Systems
    i. Components
    ii. Basic Inspection Techniques
        1. Visual Inspection
        2. Smoke Testing
9. Turbocharger Operation
    a. Boost Testing
    b. Scan Tool Testing
10. Emissions Systems
    a. Fuel Evaporative Systems (EVAP)
    b. Positive Crankcase Ventilation (PCV)
    c. Exhaust Gas Recirculation (EGR)
    d. Secondary Air Injection (AIR)
    e. Catalysts (TWC)
11. Assistance Programs that Ensure Equity in Access to Automotive Repairs
    a. California DMV Consumer Assistance Program (CAP)
        i. Repair Assistance
        ii. Vehicle Retirement Assistance

Course Lab Content

1. General Engine Diagnosis
    a. Cooling and Lubrication Systems
        i. Verify Proper Cooling System Operation
        ii. Diagnose Oil Consumption
    b. Basic Engine Tests
        i. Intake Manifold Vacuum/Pressure Testing
        ii. Engine Compression Testing
        iii. Cylinder Leakage Testing
        iv. Cylinder Power Balance Testing
2. Computerized Engine Controls
    a. Scan Tool Diagnostics
        i. Step-by-Step Diagnosis Using Vehicle Service Information
        ii. Testing Actuator Operation Using Bi-Directional Controls
        iii. Using OBD II System Monitors to Perform Diagnosis
    b. Mechanical Diagnosis
        i. Visual Inspection
        ii. Analysis of Exhaust Gases
3. The Ignition System
    a. Remove and Replace Spark Plugs
    b. Test Ignition System Sensors
        i. Analog CKP and/or CMP
        ii. Digital CKP and/or CMP
    c. Inspect and Test Ignition Control Modules
4. Fuel, Induction and Exhaust Systems
    a. Fuel Injection Testing
        i. Pressure and Volume Testing
        ii. Injector Electrical and Mechanical Testing
    b. Exhaust System Testing
        i. Visual Inspection
        ii. Back-Pressure Testing
    c. Induction System Testing
        i. Smoke Testing
        ii. Idle Quality Tests
        iii. Turbocharger and Supercharger Testing
5. Emission Control Systems

a. PCV System Testing
   i. Visual Inspection
   ii. Crankcase Pressure Test
b. Evaporative System Tests
   i. Smoke Testing
   ii. Component Actuator Tests
   iii. OBD II Monitor Testing
c. Exhaust Gas Recirculation Testing
   i. Flow Testing
   ii. Actuator Tests Using the Scan Tool
d. Secondary Air Injection Testing
   i. Actuator Tests Using the Scan Tool
   ii. Air Pressure and Volume Testing
e. Exhaust Catalyst System Testing
   i. Temperature Analysis
   ii. Analyzing Catalyst Efficiency with the Five-Gas Analyzer

6. California DMV CAP Program
   a. Determine Qualification for the Repair Assistance Program
   b. Determine Eligibility for the Vehicle Retirement Program

Methods of Instruction

Method

Film/video Viewing and Discussion

Integration

This course makes extensive use of accessible training videos covering a variety of engine management topics. The students will be encouraged to discuss the implications of the material presented in the accessible 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

Projects

Integration

Students will complete a research project concerning consumer eligibility for the State of California Department of Motor Vehicle's Consumer Assistance Program and its ability to provide equity of access to automotive repair services.

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 accepted industry standards. 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 by the published labor and time guides.

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 customer complaint.

Method

Research Projects

Integration

Students will be able to determine whether an engine management repair performed for a disadvantaged consumer qualifies for assistance under the guidelines of the California DMV Consumer Assistance Program; the student will posses the ability to document consumer eligibility on a work order. The quality of the recommendation will be judged according to its adherence to the CAP program guidelines.

Assignments

Assignment Type

Reading

In-class and/or outside of class

Outside of class

Formative or Summative

Formative

Assignment

Research how equity issues are addressed concerning access to automotive repair services by the State of California DMV's Consumer Assistance (CAP) program.

Assignment Type
Reading

In-class and/or outside of class
Outside of class

Formative or Summative
Formative

Assignment
Read the chapters in the textbook assigned by your instructor that identify the essential components of the engine management system and familiarize yourself with their basic theory of operation; this includes the ignition, fuel injection and emission control sub-systems of a modern computerized engine management control system.

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 described 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 Bureau of Automotive Repair (BAR) standards.

Assignment Type
Other

In-class and/or outside of class
Outside of class

Formative or Summative
Summative

Assignment
Prepare a 5 to 10 minute presentation about the components and the theory of operation of one of the sub-systems of an automotive engine management system. The presentation can be made in person, take the form of a PowerPoint presentation or you can make a short video presentation using the Canvas studio feature. The presentation must explain the sub-system in terms that a beginning automotive student would be able to understand. The evaluation of your performance of this assignment will be based on the accuracy of the information presented and the professionalism with which it is prepared.

Course Materials

Textbooks
Johanson, Chris. (2021) Auto Engine Performance and Drivability, 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.

The Department has made an extensive effort to overhaul its facilities in order to provide a safe and welcoming environment to all of its students. We have also worked to alter the tools and equipment that are used during our lab exercises so that les physical strength is required to perform the necessary tasks adequately; these initiatives are intended to attract a greater number of traditional and non-traditional students representing different genders, backgrounds and abilities.
In addition, this course provides the basic skills necessary for students to obtain work which will provide them with a substantial increase in income quickly; these skills can be acquired in just one semester. This is intended to address cultural issues which attach a stigma to obtaining an education rather than entering the workforce immediately.
This course also employs the extensive use of accessible training videos which cover various aspects of the course content. These accessible videos, along with the accessible online manufacturer training that the Department makes available to all students, are often presented by people of color--vehicle manufacturers and our textbook publishers are quite sensitive to the need that we have to encourage diversity, equity and inclusion. The presentation of these accessible videos and the available online training literally puts a member of a previously underrepresented group right at the head of the class.
Finally, every effort is made in this course to assure that every student has the best possible chance to be successful in it; the fact that they will be evaluated in a number of different ways which are designed to accommodate different abilities and learning styles is stressed throughout the course.

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

The Department employs the use of accessible video presentations presented by people representing different races and genders as we mentioned above. We also make online manufacturer training available to all of our students; this training has been previewed and evaluated by the Department to be both accessible and ensure that members of diverse racial and gender backgrounds are represented; it is our intention to provide every student with a welcoming and comfortable learning environment in this way.
In addition, the department utilizes a number of different types of instructional tools, including the aforementioned accessible videos, PowerPoint presentations, and actual demonstrations performed by the instructor in both the classroom and the laboratory setting; this combination is intended to accommodate students who possess different learning styles. Finally, the evaluation of the student's performance in the course is based on a diverse set of competency measurements ranging from online quizzes that generally allow students multiple attempts, to daily or weekly evaluation of student performance in hands-on laboratory exercises and a final performance evaluation wherever possible. A written final that is presented in the same style as the certification exams used by our industry is also administered, and the final grade for the course is based on a combination of all of these inputs; our intention is to be able to evaluate our student's abilities in the most equitable way possible while making accommodation for their ability to perform differently on a diverse group of evaluation methods.

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 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 department's 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.

Key: 397