AUME-751: AUTOMOTIVE ENGINE THEORY AND REPAIR (UPPER END)

Effective Term
Fall 2026

BOT Approval Date
03/20/2025

Discipline
AUME - Automotive/Transportation Tech
Course Number
751

Course Title
Automotive Engine Theory and Repair (Upper End)

Short Title
Engine Theory & Repair-Upper

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

Units

Lecture Units
2.00

Lab Units
1.00

Total Units
3.00

Hours

Lecture Contact Hours
32-36
Out of Class Hours Lecture
64-72

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

Total Contact Hours
80 - 90

Total Out of Class Hours
64 - 72

Total Student Learning Hours
144 - 162

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 the theory of operation, disassembly, inspection, repair and reassembly of the cylinder heads and timing components, usually referred to as the upper end, of a modern internal combustion engine.

Requisites

Prerequisite(s)

Prerequisite(s) (must be taken before)
AUME-750 (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.

Codes

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

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

Repeatability Code
No

Grading Option
Letter grade OR P/NP

Minimum Qualifications

Minimum Qualifications	And/Or
Automotive Technology	End

Learning Objectives

Learning Objectives

Learning Objective
1. Develop safe work habits in the shop setting that conform to industry standards.
2. Exhibit the ability to identify the specialized tools commonly used in the automotive repair industry to disassemble, examine, repair and reassemble the engine cylinder head assembly.
3. Dissect the upper end of an internal combustion engine, evaluate the condition of the internal components of the cylinder head, valve and timing components and compare the condition of those components to factory specifications.
4. Exhibit the ability to use precision measuring and test equipment to determine the serviceability of the cylinder head assembly by examining the cylinder head for flatness and cracking.
5. Examine the component parts of the engine cooling system and evaluate their condition.
6. Evaluate the condition of the components related to the engine's timing system, including those components related to variable valve timing systems.
7. Analyze the operation of the engine's ignition system, intake and exhaust system components, including the turbocharger, supercharger and charge air cooler.

8. Discover the advantages of the career paths that this course makes available to women and special population students such as dislocated workers.

Learning Outcome Information

Course Learning Outcomes

Learning Outcome
1. The student will demonstrate compliance with personal and environmental safety practices used in the diagnosis, repair and maintenance of automotive engines.
2. The student will identify the components used on the lower end of modern automotive internal combustion engines and discuss the theory of operation for those components.
3. The student will demonstrate the ability to verify, diagnose and repair faults related to the upper end components of a modern automotive internal combustion engine.
4. Students will exhibit the ability to discuss the advantages of the career paths that this course makes available to women and members of other special populations.

Content

Course Lecture Content

1. Cylinder Head Service
    a. Identify cylinder head and valve train components and configurations.
    b. Cylinder Head Removal and Inspection Techniques
    c. Gaskets and Seals
        i. Safe methods for Gasket Removal
        ii. Gasket and Seal Installation Techniques
            1. Torque Sequences and Procedures
                a. Torque-to-Yield Bolts
                b. Torque Angles
    d. Cleaning and Inspection Techniques
        i. Hot Tanks vs. Cold Tanks
        ii. Inspecting for Cracks--Magna-Fluxing
    e. Gasket Surface Areas Inspection
        i. Warpage
        ii. Surface Finishes Required by Vehicle Manufacturers
2. Valve Train Service
    a. Valve Train Types and Configurations
        i. Pushrod Operated Overhead Valve
        ii. Overhead Camshaft Designs
            1. Single Camshaft
            2. Double Camshaft
            3. Variable Valve Timing Systems
                a. Lift Variation Systems
                b. Duration Variation Systems
        iii. Valve Adjustment Techniques
            1. Manual Valve Adjustment
            2. Hydraulic Valve Adjustment
        iv. Variable Displacement Cylinder Heads
            1. Valve Lifter Based Systems
            2. Fulcrum Based Systems
3. Camshaft Design
    a. Wear Inspection Techniques
    b. Warpage and Twisting Inspection Techniques
4. Induction System Design
    a. Normally Aspirated Engines
    b. Forced Induction Engines

i. Turbocharging
ii. Supercharging
iii. Variable Runner Manifolds
iv. Cylinder Deactivation Systems

5. Careers in the Automotive Industry
   a. Career Paths
   b. ASE Certification
   c. Employment Opportunities
      i. Improved Opportunities for Women
         1. Changes in the Industry Make the Work More Physically Accessible
         2. Increased Demand for Female Technicians and Service Advisors
         3. Success in the Industry is Now More Dependent on Intelligence Rather Than Physical Strength
      ii. Time Requirements
      iii. Opportunities to Earn While Learning
         1. Apprenticeships
         2. Employer Provided Training Opportunities

Course Lab Content

1. Cylinder Head Service
   a. Remove Cylinder Head; Inspect Gasket Condition.
   b. Install Cylinder Head
   c. Install Cylinder Head Gasket; Tighten According to Manufacturer's Specification and Procedure.
   d. Clean and Inspect
      i. Cylinder Head Cracks
      ii. Check Gasket Surface Areas
         1. Warpage
         2. Surface Finish
         3. Check Passage Condition.
2. Valve Train Service
   a. Inspect Valve Actuating Mechanisms
      i. Wear
      ii. Binding
      iii. Blocked Oil Passages
   b. Valve Service
      i. Seat and Face Surface Renewal
      ii. Valve Guide Inspection and Servicing
      iii. Check Valve Spring Standing Height
      iv. Adjust Valves
      v. Install Locks and Keepers
         1. In-Vehicle Service
         2. Out-of-Vehicle Service
   c. Timing System Service
      i. Inspect and/or Replace Camshaft and Drive Belt/Chain
         1. Drive Gear Wear and Backlash
         2. End play
         3. Sprocket and Chain Wear
         4. Camshaft Reluctor Ring/Tone-Wheel,
         5. Inspect Valve Timing Components
         6. Verify Correct Camshaft Timing.
         7. Inspect Camshaft Bearing Surfaces
            a. Wear
            b. Out-of-Round
            c. Alignment
3. Induction System Service
   a. Normally Aspirated Engines
      i. Check Variable Runner Manifold Actuator Operation
      ii. Inspect Manifold

1. Cracks
2. Warpage

b. Forced Induction Engines
   i. Turbocharging
      1. Pressure Testing
      2. Wastegate Operation Inspection
      3. Test Variable Geometry Turbocharger Actuators
         a. Perform Electrical/Electronic Testing
         b. Decarbonize Actuators and Vanes
      4. Supercharging
      5. Bearing Inspection
      6. Inspect Accessory Belt Drive System
      7. Check Supercharger Oil Level/Oil Delivery System

4. Employment Opportunity Research
   a. Visit Automotive Repair Facility
   b. Job Shadowing
   c. Conduct Technician Interview

Methods of Instruction

Method

Discussion

Integration

Class discussions, led by the instructor, will introduce students to the component parts of the intake, cylinder head and exhaust systems of the modern internal combustion automobile engine.

Method

Lab Activities

Integration

Students will be required to perform lab assignments focused on the disassembly, inspection, repair and assembly of the engine cylinder head and timing components.

Method

Observation and Demonstration

Integration

The instructor will demonstrate the performance of diagnostic and repair techniques used to diagnose problems with the intake, exhaust, turbocharger, supercharger and charge air cooler systems.

Method

Reading

Integration

Readings will be assigned from the sections of the required textbook(s) which concern themselves with the operation and repair of the engine upper end.

Method

Role Playing/Simulation

Integration
Students will be required to perform the diagnostic and repair tasks related to the intake, cylinder head and exhaust systems.

Method
Visiting Lecturers

Integration
Visiting lecturers from the engine reconditioning industry will discuss the modern techniques used to disassemble, inspect and repair the cylinder head and timing components of the modern automobile engine.

Method
Papers and Reports

Integration
Students will research the ways in which engine components have been made lighter over the course of the past 20 years and describe how this change has made the process of engine repair more accessible to individuals who may not be able to exert a great deal of upper body strength.

Methods of Evaluation

Method
Simulation

Integration
Students will be asked to perform a diagnostic procedure on a bugged vehicle. Evaluation of the student's ability to make an accurate diagnosis of such a problem on that vehicle in the amount of time prescribed by industry standard labor and time guides.

Method
Class Performance

Integration
Students will be asked to perform various tasks related to the diagnosis, service and repair of the engine top or upper end. These tasks are based on the list assigned for this portion of the course by the ASE Education Foundation (ASEEF) which is the Automotive Department's external accrediting body. Student ability and work professionalism will be evaluated according to the conformity of the student's performance to commonly accepted industry practices.

Method
Exams/Tests

Integration
At least two exams will be given to students during the course of the semester in order to test the student's knowledge of engine upper end components, their operating principles and the diagnostic and repair techniques commonly used on these components.

Method
Papers

Integration
Students will be given writing assignments covering information presented during the classroom lecture and or lab discussions. The subject of this paper must go beyond the scope of the material covered in class and may cover automotive subjects the students find

interesting, such as the steps required to add a turbocharger to a vehicle that did not originally come equipped with one. Evaluation will be made according to the accuracy and originality of the material presented by the student.

Method
Quizzes

Integration
Students will be asked to complete the review and ASE style questions at the end of each assigned textbook chapter. Evaluation will be made according to the accuracy of the student responses.

Method
Research Projects

Integration
Research project(s) covering the engine upper end may be assigned according to the instructor's discretion. These assignments may be submitted electronically, on paper or presented orally. Evaluation will be made according to the accuracy and originality of the material presented by the student.

Method
Research Projects

Integration
Students will be asked to interview a working technician about the job prospects for students representing special populations and the time that it takes to go from being a beginning student to possessing the ability to earn a living wage. Evaluation will be made according to the completeness and accuracy of the research.

Assignments

Assignment Type
Reading

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

Formative or Summative
Formative

Assignment
Read and analyze the appropriate textbook chapter that covers the subject of forced induction systems. Upon completion of the assigned reading, write a one to two-page paper that discusses the similarities and differences between turbocharging and supercharging and the relative advantages and disadvantages of each type of system. Your paper will be evaluated according to your comprehension of the material and your ability to present a convincing argument in favor of one type of forced induction system as opposed to the other.

Assignment Type
Writing

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

Formative or Summative
Formative

Assignment
Prepare a repair order based on a mock customer interview. The repair order will document a technical fault on a bugged vehicle. The repair order will be prepared using the form of the "3Cs"; Customer complaint, cause of the complaint, and correction of the complaint.

Assignment Type
Other

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

Formative or Summative
Formative

Assignment
Conduct an interview with a working automotive technician, shop foreman or service manager about the opportunities available to members of special populations in the automotive service industry and the amount of time it will require in order to be able to earn a living wage.

Assignment Type
Other

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

Formative or Summative
Summative

Assignment
Perform a precision measurement or inspection of a cylinder head or valve train component and assess its serviceability.

Course Materials

Textbooks
Duffy, James. (2021) Auto Engine Repair 7th Edition Goodheart and Willcox ISBN: 978-1-64564-070-7
Gilles, T (2019). Automotive Engines: Diagnosis, Repair and Rebuilding 8th Cengage. ISBN: 9781337567480

Class Size Information

Class Size
24

Class Size Category
J - Specialty lab

Diversity and Inclusion

Course Design and Materials: Course will incorporate diverse perspectives, authors, and examples that reflect a variety of cultures, identities, and lived experiences. Instructional materials will be reviewed regularly to ensure representation, inclusivity, and alignment with equity-minded practices across disciplines.

Inclusive Learning Environment: Instructors will establish classroom norms and policies that promote respect, civil discourse, and belonging in both online and face-to-face classes. Clear expectations for communication and engagement will support a learning space where all students feel valued and heard.

Accessible Instruction: Course content will be delivered using accessible design. Materials will follow accessibility guidelines within the CMS, including captioned media, readable document formats, and multiple means of engagement to support diverse learning.

Equitable Teaching Practices: Instructors will use transparent and grading criteria, varied assessment methods, and timely feedback to promote fairness and student success. Opportunities for revision, reflection, and multiple demonstrations of learning may be incorporated when appropriate to the discipline.

Culturally Responsive Pedagogies: Instructional strategies will encourage critical thinking about diverse perspectives and systems of power relevant to the course content. Faculty will foster opportunities for students to connect course material to real-world contexts.

Ongoing Reflection and Improvement: Faculty will engage in continuous professional development related to IDEAA principles and reflect on course practices using metacognition to identify opportunities for increased equity, inclusion, and accessibility.

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

The area of the SJC Auto Shop in which this class is held has been extensively modified in order to provide a safer and more welcoming environment to all of its students. In addition, every effort has been made to update the tools and equipment that are used during the lab exercises for this course so that less 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, with a particular focus on our students representing special populations.

Special emphasis has been placed on the presentation of the career opportunities available to women who complete this type of training. Approximately 10% of all automotive technicians are of African-American descent; while that does mean that they are underrepresented as a group, the most serious shortcoming that the automotive repair industry faces is the disparity in the percentage of females who participate. Only about 4% of all service technicians are women. This course is the second of a two-part series; in the first part of the series, the emphasis was placed upon the career opportunities available to women and special populations. In this course, the emphasis will be placed on the brevity of the career paths possession of the skills imparted in these two courses.

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.

Student lab assignments have been altered in a number of different ways in order to accommodate individuals with differing levels of physical strength and agility; for example, new tools have been purchase which increase the amount of leverage provided by the tool itself. In addition, students perform their lab exercises in teams of four people; every effort is made to diversify these teams as much as possible and encourage teamwork so that the students are best able to support one another's efforts.

Evaluations are made on the basis of student performance on quizzes, exams, the ability to physically identify components and verbally discuss their function, and evaluation of actual performance of the lab exercises, including a final performance evaluation of a student's ability to perform a precision measurement of various components of the cylinder block. This combination of written, oral, visual and performance evaluations are intended to provide as equitable an opportunity as possible so that students who possess a variety of different learning styles can be accommodated fairly.

While the Automotive Department has been making progress in attracting more women to take advantage of its training opportunities, we are still facing a considerable shortfall. As a result, this course makes a particular effort to increase awareness of the many job opportunities available to women and others who are familiar with the components and understand the functions of the internal combustion engine. Students are able to acquire a sufficient number of skills in just two semesters to enable them to obtain employment as Automotive Specialty Technicians. This provides individuals who may be struggling financially to advance to earning a living wage very quickly, which appeals especially to single parents, displaced homemakers, and other individuals whose cultural background dictates that they should be working rather than studying.

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. Engine repair involves a great deal of what is referred to in the industry as heavy-duty work, and this is performed ideally by multiple technicians, in this case student technicians, working together as a team to get the required tasks accomplished. The responsibilities required by the course 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 mechanical, cooling and lubrication 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.

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 an internal combustion engine (ICE) and are then asked to label those components on a worksheet. After this is completed successfully, the theory of operation of various ICE designs 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 or on an engine mock-up. 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).

Student-to-self interaction will take place in this course during the process of diagnosing a mechanical problem in an internal combustion engine. Students will perform various operations, including making precision measurements and checking the integrity of metal parts by magna-fluxing them; their mission in this course is to match a defect to a customer complaint. Students are then encouraged to look for the root cause of the issue. For example, an engine may have a spoiled machined surface that causes an undesirable engine noise or oil pressure problem; the surface or cylinder head may need to be replaced, of course, but the student will also be asked to determine why that machined surface failed. Bearing failure can have a number of different causes, and it will be up to the student, under the supervision of the instructor, to perform some detective work until the correct root cause is located. The hunt for the root cause of the problem will provide more than adequate student-to self, or metacognitive, interaction.

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