AUME-771: AUTOMOTIVE BRAKE SYSTEMS

Effective Term
Fall 2024

BOT Approval Date
12/14/2023

Discipline
AUME - Automotive/Transportation Tech
Course Number
771

Course Title
Automotive Brake Systems

Short Title
Auto Brake Systems

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 the theory of operation, diagnosis and repair of automotive brake systems. The experience gained in this course prepares the student for entry-level employment as an automotive brake technician and assists in preparation for the ASE A5 Brake Systems Specialist Certification Exam.

Attach Supporting Documents
ASE PROGRAM STANDARDS BRAKE.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.

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. Document repairs on a work order and provide cost estimates for necessary repairs according to State of California Bureau of Automotive Repair (BAR) regulations.
2. Inspect and assess the condition of automotive brake systems.
3. Develop the most efficacious method of performing a brake system repair.
4. Compare and contrast the operating characteristics of different types of brake systems.

5. Validate the effectiveness of a brake system repair.

6. Investigate the contributions of African-American inventors such as Richard B. Spikes to advances in Automotive Braking System Technology.

7. Estimate the total cost of any necessary brake service and repair procedures.

Learning Outcome Information

Course Learning Outcomes

Learning Outcome
1. The student will demonstrate the ability to prepare a repair order that provides an estimated cost of repairs, revised cost of repairs, and a final invoice according to the State of California Bureau of Automotive Repair Regulations.
2. The student will demonstrate the ability to identify the component parts and interpret the principles of operation of automotive disc and drum brake systems, including the Anti-lock brake, Traction Control, and Electronic Stability Control systems.
3. The student will demonstrate the ability to formulate proper procedures required to successfully verify, pinpoint, and repair brake system failures.
4. The student will practice common automotive service safety and hazardous pollution prevention procedures.

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

A. S/P2 Certifications
1. Automotive Service Safety Certification
2. Automotive Service Hazardous Pollution Prevention Certification
3. Automotive Lift Institute's "Lifting It Right" Certification
4. "Ethics and You in the Automotive Industry" Certification

B. Automotive Database Navigation
1. ALLDATA Navigation Exercise
2. Mitchell ProDemand Navigation Exercise

C. Repair Order Preparation
1. Telling a Story on a Repair Order
    a. "Writing It Right" Bureau of Automotive Repair Regulations
    b. The Three "Cs"
        1. Customer Complaint

2. Cause of the Complaint
3. Correction of the Complaint

D. Contributions Made by Members of Underrepresented Groups to Automotive Technology
1. Richard B. Spikes
a. Invention of the Dual-Circuit Brake Primary Cylinder
2. George Washington Carver
a. Development of Synthetic Rubber
i. Effect on Tire Adhesion and Effectiveness
ii. Overall Effect on the Preservation of the Automotive Industry During WWI

E. General Brake Repair
1. Brake System Components and Performance Standards
2. Retrieving and Interpreting Diagnostic Trouble Codes (DTC's)
3. The Importance of Torque and How to Achieve it Properly

F. Brake Hydraulic System
1. Pascal's Law and Brake Hydraulics
2. Brake Fluid Types and Serviceability
3. Hydraulic System Components
4. The Brake Balance System
a. Proportioning Valves
b. Metering Valves
c. Pressure Differential Valves
d. Combination Valves
e. Electronic or Dynamic Brake Proportioning

G. Drum Brake Systems
1. Types of Drum Brake Systems
a. Servo-Type Drum Brakes
b. Non-Servo Type Drum Brakes
2. Brake Drum Precision Measurement and Machining
3. The Drum Brake Overhaul--An Overview

H. Disc Brake Systems
1. Types of Disc Brake Systems
a. Floating Caliper Type
b. Fixed Caliper Type
2. Precision Measurement and Machining Techniques for Disc Brake Rotors
a. Off-Car Brake Lathes
b. On-Car Brake Lathes
3. The Disc Brake Overhaul--An Overview

I. Power Brake Assist Systems
1. Vacuum Power Assist Systems
2. Hydro-Boost Power Assist Systems
3. Electro-Hydraulic Power Assist Systems
4. Electro-Mechanical Power Assist Systems

J. Related Systems
1. Parking Brake System Types and Components
2. Wheel Bearing Types and Components
3. Brake Lamp and Warning Light Systems
a. Components
b. Diagnostic Techniques

K. Electronic Braking Systems
1. Anti-Lock Brakes (ABS)
a. Components
b. System Operation

2. Electronic Traction Control Systems
3. Electronic Stability Control Systems
4. Regenerative Braking Systems
    a. Service Precautions and Technician Safety Warnings
    b. Fundamental Operating Principles

Course Lab Content

1. Prepare the Work Order
    a. Collect Customer and Vehicle Information
    b. Assure Compliance with State BAR Regulations
    c. Utilize the Three "Cs"
        i. Determine the Customer Complaint
        ii. Locate the Cause of the Complaint
        iii. Formulate the Correction for the Complaint
    d. Assess the Customer's Ability to Manage Repair Costs
        i. Assess the Extent of Repairs Necessary to Assure Safe Vehicle Operation
        ii. Counsel Customers Who Represent Disadvantaged Populations in Order to Assure that They are Better Able to Manage Repair Expenses
2. General Brake System Repair
    a. Physically Identify Individual Brake Components on an Actual Vehicle
    b. Recover, Read and Interpret Diagnostic Trouble Codes (DTCs) With a Scan Tool
    c. Practice Proper Techniques Used to Torque Lug Nuts and Bolts
        i. On Drum Brake Systems
        ii. On Disc Brake Systems
3. Brake Hydraulic System Diagnosis and Repair
    a. Perform Brake Hydraulic System Diagnosis Using Pascal's Law of Hydraulics
        i. Perform Pressure Measurements and Determine Specifications Related to Dual-Circuit Brake Systems Inspired by the Work of Richard B. Spikes
    b. Perform Primary Cylinder Service
        i. Perform Bench Bleeding
        ii. Replace Brake Primary Cylinder
    c. Brake Hydraulic Line Inspection and Testing
        i. Pressure and Force Gauge Tests
        ii. Brake Line and Flexible Brake Hose Inspection and Diagnosis
    d. Brake System Fluid Exchange
        i. Perform Gravity Bleed
        ii. Perform Manual Bleed
        iii. Perform Vacuum Bleed
        iv. Perform Pressure Bleed
        v. Perform Surge Bleed
4. Drum Brake System Repair
    a. Drum Brake Inspection and Maintenance
        i. Perform Brake Drum Micrometer Measurement
        ii. Perform Brake Lining Thickness Measurement
        iii. Perform Lining Wear uniformity Inspection
5. Drum Brake System Overhaul
    a. Perform Brake Shoe Replacement
    b. Replace Brake Hydraulic Wheel Cylinders
    c. Replace Brake Self Adjuster Units
        i. Perform Drum Brake Pre-Adjustment Routine
    d. Machine Brake Drums
        i. Perform Drum Brake Rough Cut
        ii. Perform Drum Brake Finish Cut
        iii. Properly Sand and Clean Machined Drums
6. Disc Brake System Service

a. Disc Brake Inspection and Measurement
   i. Lateral Runout Inspection
   ii. Perform Thickness Variation Measurement
   iii. Determine Overall Thickness and Serviceability
b. Disc Brake Overhaul
   i. Rebuild Brake Calipers
   ii. Renew Caliper Brackets and Slides
c. Machine Disc Brake Rotors
   i. On-Car Machining
   ii. Off-Car Machining
      1. Pro-Cut Rotor Matching Certification

7. Power Brake Assist Service
   a. Test Vacuum Power Brake Unit Performance
      i. Perform Vacuum Source Supply Test
      ii. Test the Power Brake Vacuum Checking Valve
      iii. Use a Smoke-Detector to Locate Vacuum Booster Leaks
   b. Test Hydro-Boost Brake Boosters
      i. Test the Booster Supply Pump Pressure
      ii. Test for Booster Accumulator Leak-Down
   c. Electro-Hydraulic Brake Booster Tests
      i. Scan Tool Test for Electro-Hydraulic Boosters
      ii. Test the Leak-Down Rate of the Booster Accumulator
   d. Electro-Mechanical Booster Tests
      i. Test the Operation of the Electro-Mechanical Booster with a Scan Tool
      ii. Perform Electro-Mechanical Booster Garage Adaptions
8. Brake Related System Testing
   a. Service Wheel Bearings
      i. Repack Tapered Wheel Bearings
         1. Perform Bearing Preload Adjustments
      ii. Service Sealed Hub/Bearing Assemblies
         1. Remove and Replace
         2. Perform Pre-Load and Torque Adjustments
   b. Inspection of the Parking Brake System
      i. Test Warning Lamp Operation
      ii. Perform Cable Adjustments
      iii. Verify Proper Cable Operation and Release
   c. Test Brake Light and Warning System Operation
      i. Test and Adjust the Brake Pedal Position Sensor
      ii. Verify Center-High-Mounted Stop Light Operation
9. Electronic Brake System Service and Repair
   a. Identify the Anti-Lock System Components on an Actual Vehicle
      i. Hydraulic Modulator Assembly Identification and Inspection
      ii. Locate the Control Module
      iii. Identify Wheel Speed Sensor Types
         1. Analog Sensors
         2. Digital or Active Sensors
      iv. Test the Operation of the Anti-Lock Brake System with a Scan Tool
      v. Test the Operation of the Anti-Lock Components with a Digital Multi-Meter or a Lab Scope
   b. Describe the Operating Principles of the Regenerative Braking System

Methods of Instruction

Method

Lecture

Integration

Classroom lecture and discussion along with power-point presentations on the design and theory of operation of automotive brake systems are intended to enhance student understanding of the subject matter. Special emphasis will be placed upon the

contributions made to Automotive Technology by African-American inventors such as Richard B. Spikes, whose innovations inspired the modern dual-circuit brake hydraulic system. Accessible video presentations portraying current brake service techniques will be integrated into the lecture content.

Method

Observation and Demonstration

Integration

The instructor will demonstrate the techniques required to complete the assigned ASEEF task sheets in the lab setting. Demonstration will include in-class practice in performing operations such as light machine work, during which coaching and feedback on student performance will be given by the instructor.

Method

Reading

Integration

Chapter readings from the required textbook will be assigned each week. The textbook chapters cover the areas of brake system operation and repair techniques specified by the ASE Education Foundation, such as the proper operation of the brake hydraulic system.
Students will be required to complete the review questions and ASE style quiz questions from the end of each assigned chapter. Their relevance to the ASE A5 Brake Technician Specialist Certification Exam will be noted.

Method

Role Playing/Simulation

Integration

Students will prepare a repair order according to the standards prescribed by the State of California Bureau of Automotive Repair describing the customer complaint, cause of the complaint and correction for the complaint on a bugged vehicle.

Methods of Evaluation

Method

Exams/Tests

Integration

A mid-term and a written final exam will be administered during the course of the semester. These tests or exams are intended to evaluate student comprehension of the materials covered in the textbook readings and during the lecture and lab sessions. The test or exam questions mimic the form of an ASE-style certification exam question. Evaluation will be based on adherence to industry standards as prescribed by the ASE Education Foundation, which is the Department's third-party accreditation body.

Method

Final Performance

Integration

A hands-on final exam may be given to evaluate the individual student's ability to perform a brake system inspection which will include an assessment of applicable electronic brake control systems. The student will be evaluated on their ability to detect brake system faults, work professionalism, and completeness of documentation.

Method

Group Projects

Integration

Students will work in small groups of four or five and assigned a simulated repair situation on a bugged vehicle. One of the students should conduct research on the problem from the repair information, another member of the group should complete the repair order, another the diagnosis of the fault, and the remaining members of the group will complete the repair. The project is intended to evaluate the ability of students to perform as part of a team, and the evaluation will be based on the quality and extent of the individual student's contribution to the team effort.

Method

Quizzes

Integration

Quizzes will be given throughout the semester to assess the student's understanding of the materials presented in their reading assignments and the lecture periods. Evaluation will be made according to the accuracy of the student responses.

Method

Role-playing/Simulation

Integration

All students will demonstrate the ability to provide a written estimate and a completed repair order which will be prepared according to the standards prescribed in the State of California Bureau of Automotive Repair(BAR) "Write it Right" manual. Evaluation will be based on conformity to the official regulations.

Method

Simulation

Integration

Students will participate in individual or small group simulations of brake system inspection, diagnosis and/or repair. Evaluation will be based upon instructor observation of the level of skill achieved, work professionalism, completeness of documentation and observance of safety procedures.

Method

Research Projects

Integration

Students will be asked to prepare a short two-to-three page paper outlining the origin of the inventions that made braking systems on modern vehicles safer, such as the dual-circuit brake hydraulic system inspired by Richard B. Spikes and the advent of modern electronic braking systems such as Anti-Lock Brakes, Traction and Stability Control Systems.

Assignments

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

Reading

In-class and/or outside of class

Outside of class

Formative or Summative

Formative

Assignment

Read a textbook chapter designed to advance your knowledge about the function of the components of automotive mechanical and electronic brake sub-systems such as the anti-lock brake, electronic traction control, and vehicle stability control systems. Be prepared to complete a quiz about the material in order to verify completion of the assignment and provide you with feedback about your level of understanding of the material presented.

Assignment Type

Other

In-class and/or outside of class

In-class
Outside of class

Formative or Summative

Summative

Assignment

Prepare a presentation about the components and the theory of operation of one of the sub-systems of an automotive brake mechanical, hydraulic or electronic system. The presentation can be made in person, take the form of a visual point-by-point presentation or you can make a short video presentation.. 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.

Assignment Type

Writing

In-class and/or outside of class

Outside of class

Formative or Summative

Formative

Assignment

Prepare a short paper discussing the contributions of people of color to Automotive Technology; for example, write a paper discussing the contributions of Richard B. Spikes, whose inventions inspired the dual-circuit brake hydraulic system, which has saved countless lives throughout the years. The paper needs to focus on the ways in which the contribution made the brake system safer and more efficient.

Course Materials

Textbooks

Johanson, Chris and Stockel, Martin T. (2021) Auto Brakes, 5th edition. Goodheart and Willcox. ISBN:978-1-64564-076-9
Pickerill, K (2019). Today's Technician: Automotive Brake Systems 7th Cengage. ISBN: 9781337564526

Other Resources

Mitchell Pro-Demand web-based repair manual Alldata on-line service information databases.
State of California Bureau of Automotive Repair's "Writing It Right" Repair Order Preparation Guide (Online) Revised February 2021.

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.

Diversity and inclusion has been infused into this course by placing an emphasis on the overall design of the modern braking system, which was inspired by innovations that were introduced by Richard B. Spikes, who was an African-American mechanic and inventor who received a number of different patents for inventions that altered the course of automotive technological progress despite the fact that he possessed very little in the way of formal training in engineering.
In particular, Mr. Spikes laid the groundwork for the modern dual-circuit brake primary cylinder, which provides a reserve of braking action in the event that there is a failure in the main brake system. This innovation, which was popularized in the early 1960s and required on all vehicles by law after 1966, has saved countless lives and has largely dictated the overall design characteristics of the majority of the components that compose the modern automotive brake system.

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

The assignments for this course can be divided into three major classifications: (1) The reading assignments and the quizzes associated with them, (2) the actual lab work that students perform in our shop area, and, (3) the exams and final performance evaluations that act as summative assessments of how much the students have learned from their reading assignments and how that knowledge was applied to their lab work.
Thus, the student's final grade is determined by a combination of their displayed ability in three different areas; the design of this assessment schema is intentional, since it allows students with diverse learning styles and who possess different backgrounds and abilities the best possibility of success that can reasonably be achieved. The assignments favor neither the "bookworm" or the "visual learner"; they favor the person who can perform the tasks prescribed by the ASE Education Foundation, which is our third-party accrediting body.
The content of the course emphasizes the overall design of the braking system, which is largely the product of the innovations introduced by Mr. Spikes, as we have already mentioned above. The next section of the course outline details how the students will perform their lab work; because the number of workstations is necessarily limited, students are generally encouraged to perform their lab tasks in groups of three or four students working together; every effort is made to encourage the diversity of the composition of these groups.
Finally, because a large portion of the material related to this course is actually presented in the lab setting, it is important to note that the Automotive Department has devoted a great deal of time, effort and funding designed to transform the facility into a more welcoming environment for all, make it safer and more accessible, and provide tools and equipment that increase leverage and ease of use. Our primary purpose in doing this is to encourage the participation of non-traditional students in our program, and we have already experienced some modest success in achieving this goal.

Interactions

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

Students are grouped into teams of three or four students so they can accomplish their lab tasks together; the Department staff makes every effort to assure that these groups have as diverse a composition as possible. While some freedom to migrate from one group to another is allowed during the first four to six weeks of the semester, the group will have taken on some sense of permanency and will have learned to cooperate with one another as a cohesive team by the time the end of the term. For example, one member of the group will prepare the repair order describing the progress of a specific task, while another may be responsible for retrieving

any vehicle service information that might be necessary to perform it; meanwhile, other members of the group will lift the vehicle and remove the wheels in order to prepare it for repair, while yet another member of the group will obtain the tools and equipment necessary to perform the work. These responsibilities will rotate during the course of the semester to encourage the proficiency of each of the members of the group to perform all of the aspects of the tasks 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 mechanical and electronic braking systems.; the advent of Advanced Driver Assist Systems such as Active Braking and Active Cruise Control, both of which operate the braking system autonomously, has necessitated the need to include instruction using specialized automotive trainer units, which require extensive coaching on the part of the instructor of the course. The actual, physical demonstration of diagnostic and repair procedures on an bugged vehicle is also utilized; during the diagnosis of these vehicles, the instructor acts as a guide to lead to encourage the student to formulate the most efficient possible methods of making an accurate diagnosis and a safe repair according to the standards of our industry. Finally, the instructor is always present in the lab area to provide timely feedback to the students about their overall job performance and its effect on the safety of the public, which is obviously particularly important as a part of this course.

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 specifically configured mechanical or electronic brake system and asked to label 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 the specialized brake system trainer units we maintain. That experiment will allow the students to practice and to improve their skills in diagnosing and repairing customer brake complaints. 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).

Students are introduced to an important concept that is universal to the diagnosis and repair of virtually any automotive subsystem, but one that is particularly important to apply to brake system repair. An eight-step process that is generally accepted as the industry standard for performing diagnosis and repair on modern vehicles is stressed. 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; this has become particularly important in the context of the electronic braking systems that have been introduced into service during the past 30-40 years. Finally the problem will be repaired and the quality of the repair will be verified by road testing the vehicle. 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: 394