

ILLINOIS VALLEY COMMUNITY COLLEGE



COURSE OUTLINE

DIVISION: Workforce Development

COURSE: ATO 2200 – Brake Systems

Date: Spring 2014

Credit Hours: 5

Prerequisite(s): None

Delivery Method: **Lecture** **2 Contact Hours** (1 contact = 1 credit hour)
 Seminar **0 Contact Hours** (1 contact = 1 credit hour)
 Lab **6 Contact Hours** (2 contact = 1 credit hour)
 Clinical **0 Contact Hours** (3 contact = 1 credit hour)
 Online
 Blended

Offered: **Fall** **Spring** **Summer**

IAI Equivalent –**Only for Transfer Courses**-go to <http://www.itransfer.org>.

CATALOG DESCRIPTION:

This course of study is for the design and operation of automotive brake systems used on cars and light trucks. It will focus on the theory of operation for disc and drum brake designs, hydraulics, master cylinder and power assist units, valves, and anti-lock brakes. The service of these systems will be practiced during lab sessions.

GENERAL EDUCATION GOALS ADDRESSED

[See the last page of this form for more information.]

Upon completion of the course, the student will be able:

[Choose those goals that apply to this course.]

- To apply analytical and problem solving skills to personal, social and professional issues and situations.
- To communicate orally and in writing, socially and interpersonally.
- To develop an awareness of the contributions made to civilization by the diverse cultures of the world.
- To understand and use contemporary technology effectively and to understand its impact on the individual and society.
- To work and study effectively both individually and in collaboration with others.
- To understand what it means to act ethically and responsibly as an individual in one's career and as a member of society.
- To develop and maintain a healthy lifestyle physically, mentally, and spiritually.
- To appreciate the ongoing values of learning, self-improvement, and career planning.

EXPECTED LEARNING OUTCOMES AND RELATED COMPETENCIES:

[Outcomes related to course specific goals.]

Upon completion of the course, the student will be able to:

- V. Brake Tasks (NATEF)
 - A. General Brake System Diagnosis
 - V.A.1. Identify and interpret brake system concern; determine necessary action.
 - V.A.2. Research applicable vehicle and service information, such as brake system operation, vehicle service history, service precautions, and technical service bulletins.
 - V.A.3. Locate and interpret vehicle and major component identification numbers (VIN, vehicle certification labels, calibration decals).
 - B. Hydraulic System Diagnosis and Repair
 - V.B.1. Diagnose pressure concerns in the brake system using hydraulic principles (Pascal's Law).
 - V.B.2. Measure brake pedal height; determine necessary action.
 - V.B.3. Check master cylinder for internal and external leaks and proper operation; determine necessary action.
 - V.B.4. Remove, bench bleed, and reinstall master cylinder.
 - V.B.5. Diagnose poor stopping, pulling, or dragging concerns caused by malfunctions in the hydraulic system; determine necessary action.
 - V.B.6. Inspect brake lines, flexible hoses, and fittings for leaks, dents, kinks, rust, cracks, bulging or wear; tighten loose fittings and supports; determine necessary action.
 - V.B.7. Fabricate and/or install brake lines (double flare or ISO types); replace hoses, fittings, and supports as needed.
 - V.B.8. Select, handle, store and install brake fluids to proper level.
 - V.B.9. Inspect, test, and replace metering (hold off), proportioning (balance), pressure differential, and combination valves.

- V.B.10. Inspect, test, replace, and adjust height (load) sensing type proportioning valve.
- V.B.11. Inspect, test, and replace components of brake warning light system.
- V.B.12. Bleed (manual, pressure, vacuum, or surge) brake system.
- V.B.13. Flush hydraulic system.
- C. Drum Brake Diagnosis and Repair
 - V.C.1. Diagnose poor stopping, noise, pulling, grabbing, dragging, or pedal pulsation problems; determine necessary action.
 - V.C.2. Remove, clean (using proper safety procedures), inspect, and measure brake drums; service or replace as needed.
 - V.C.3. Refinish brake drum.
 - V.C.4. Remove, clean, and inspect brake shoes, springs, pins, clips, levers, adjusters/self adjusters, other related brake hardware, and backing support plates; lubricate and reassemble.
 - V.C.5. Remove, inspect, and install wheel cylinders.
 - V.C.6. Pre-adjust brake shoes and parking brake before installing brake drums or drum/hub assemblies and wheel bearings.
 - V.C.7. Install wheel, torque lug nuts, and make final checks and adjustments.
- D. Disc Brake Diagnosis and Repair
 - V.D.1. Diagnose poor stopping, noise, pulling, grabbing, dragging, or pedal pulsation concerns; determine necessary action.
 - V.D.2. Remove caliper assembly from mountings; clean and inspect for leaks and damage to caliper housing; determine necessary action.
 - V.D.3. Clean and inspect caliper mounting and slides for wear and damage; determine necessary action.
 - V.D.4. Remove, clean, and inspect pads and retaining hardware; determine necessary action.
 - V.D.5. Disassemble, and clean caliper assembly; inspect parts for wear, rust, scoring, and damage; replace seal, boot, and damaged or worn parts.
 - V.D.6. Reassemble, lubricate and reinstall caliper, pads, and related hardware; seat pads and inspect for leaks.
 - V.D.7. Clean, inspect and measure rotor with a dial indicator and a micrometer; follow manufacturer=s recommendations in determining need to machine or replace.
 - V.D.8. Remove and install rotor.
 - V.D.9. Refinish rotor according to manufacturer’s recommendations.
 - V.D.10. Adjust calipers with integrated parking brakes.
 - V.D.11. Install wheel, torque lug nuts, and make final checks and adjustments.
- E. Power Assist Units Diagnosis and Repair
 - V.E.1. Test pedal free travel with and without engine running; check power assist operation.
 - V.E.2. Check vacuum supply (manifold or auxiliary pump) to vacuum type power booster.
 - V.E.3. Inspect the vacuum type power booster unit for vacuum leaks; inspect the check valve for proper operation; determine necessary action.
 - V.E.4. Inspect and test hydro-boost system and accumulator for leaks and proper operation; determine necessary action.

F. Miscellaneous (Wheel Bearings, Parking Brakes, Electrical, Etc.) Diagnosis and Repair

- V.F.1. Diagnose wheel bearing noises, wheel shimmy and vibration concerns; determine necessary action.
- V.F.2. Remove, clean, inspect, repack, and install wheel bearings and replace seals; install hub and adjust wheel bearings.
- V.F.3. Check parking brake cables and components for wear, rusting, binding and corrosion; clean, lubricate and replace as needed.
- V.F.4. Check parking brake operation; determine necessary action.
- V.F.5. Check operation of parking brake indicator light system.
- V.F.6. Check operation of brake stop light system; determine necessary action.
- V.F.7. Replace wheel bearing and race.
- V.F.8. Inspect and replace wheel studs.
- V.F.9. Remove and reinstall sealed wheel bearing assembly.

G. Anti-lock Brake and Traction Control Systems

- V.G.1. Identify and inspect anti-lock brake system (ABS) components; determine necessary action.
- V.G.2. Diagnose poor stopping, wheel lock-up, pedal feel or pulsation, and noise concerns caused by the anti-lock brake system (ABS); determine necessary action.
- V.G.3. Diagnose anti-lock brake system (ABS) electronic control(s) and components using self-diagnosis and/or recommended test equipment; determine necessary action.
- V.G.4. Depressurize high pressure components of the anti-lock brake system (ABS).
- V.G.5. Bleed the anti-lock brake system's (ABS) front and rear hydraulic circuits.
- V.G.6. Remove and install anti-lock brake system (ABS) electrical/electronic and hydraulic components.
- V.G.7. Test, diagnose and service ABS speed sensors, toothed ring (tone wheel), and circuits using a graphing multi-meter (DMM)/digital storage oscilloscope (DSO) (includes output signal, resistance, shorts to voltage/ground, and frequency data).
- V.G.8. Diagnose anti-lock brake system (ABS) braking concerns caused by vehicle modifications (tire size, curb height, final drive ratio, etc.).
- V.G.9. Identify traction control system components.

COURSE TOPICS AND CONTENT REQUIREMENTS:

- I. Safety
 - A. Brake Safety Regulations
 - B. Asbestos Health Hazards
 - C. Material Safety Data Sheets
 - D. Hazardous Waste Disposal
 - E. Personal Safety
 - F. Hoist Safety
 - G. Air Bag Safety
 - H. Tool Safety
 - I. Floor Jacks and Safety Stands

- II. Brake Tools and Equipment
 - A. Fasteners
 - B. Measuring Systems
 - a. Metric and English
 - b. Disc and Drum Specification Manual and Brake Bleeding Sequence Guide
 - C. Brake Tools
 - a. Disc Brake Micrometer
 - b. Drum Brake Digital Measuring Tool
 - c. Torque Wrenches
 - d. Common Brake Service Tools
 - e. Dial Indicator
 - D. Brake Bleeding Equipment
 - E. Brake Cleaning Equipment
- III. Brake Fluid
 - A. Characteristics and Characteristics
 - B. Types
 - C. Electronic Tester
 - D. Service
 - E. Bleeding Brakes
 - a. Conventional
 - b. ABS
 - F. Using A Scanner to Bleed Brakes
- IV. Master Cylinders
 - A. Dual-Piston Construction and Operation
 - B. Front-to-Rear and Diagonally Split Systems
 - C. Fast-Fill and Quick Take-up Master Cylinders
 - D. Central-Valve Master Cylinder
 - E. Free Pedal Inspection
 - F. Bench Bleeding Procedure
 - G. Remove and Replace Procedure
 - H. Checking Teves High Pressure ABS Fluid Level
 - I. Final System Bleeding
- V. Hydraulic Lines, Valves, and Switches
 - A. Brake Lines
 - a. Steel
 - b. Rubber
 - c. Proper Service
 - B. Brake Fittings
 - a. Banjo and Other Designs
 - C. Flare Fittings
 - a. ISO Flare
 - b. SAE Flare
 - D. Brake System Valves
 - a. Metering Valve
 - b. Proportioning Valve
 - c. Height-Sensing Proportioning Valve
 - d. Pressure Differential Valve
 - e. Combination Valve

- E. Brake Pad Indicators
- F. Master Cylinder Fluid Level Switch
- G. Stoplamp Switch Service and Adjustment
- H. Brake Bleeding
 - a. Manual, Vacuum, Gravity, and Pressure
- I. Wheel Brake Bleeding Sequence
- J. Recentering the Pressure Differential Valve
- K. Using Flare Wrenches for Brake Lines and Bleeder Screws
- L. Brake Switch Adjustment
- VII. Power Brake Service
 - A. Design and Operation
 - B. Types of Vacuum Boosters
 - C. Reaction-Disc Booster
 - D. Tandem Boosters
 - E. Hydro-Boost Design
 - F. Power Master Operation
 - G. Vacuum Booster Testing
 - H. Pedal Height Adjustment
 - I. Pushrod Gauge Adjustment
 - J. Vacuum Pump
- VIII. Disc Brakes
 - A. Design and Operation
 - B. Construction
 - C. Fixed and Floating Rotors
 - D. Solid and Vented Rotors
 - E. Friction Materials for Disc and Drum Brakes
 - F. Friction Material Selection
 - a. Coefficient of Friction
 - b. Edge Coding
 - G. Brake Pad Wear Indicators
 - H. Caliper Design and Operation
 - a. Steel and Phenolic Pistons
 - b. Low-Drag Calipers
 - I. Fixed, Floating, and Sliding Calipers
 - J. Rear Wheel Disc Brakes
 - a. Design and Service
 - b. Parking Brake Design
 - K. Proper Inspection Procedures
 - L. Loaded versus Unloaded Calipers
 - M. Brake Pad Replacement
 - N. Anti-Rattle Clips
 - O. Caliper Overhaul
 - P. Brake Rotor Service
 - a. Measurements – Minimum and Discard Thickness
 - b. Parellelism and Rotor Run-out
 - Q. On and Off Brake Lathe Operation and Procedures
 - R. Proper Torque Procedures for Calipers and Wheels
- IX. Drum Brake Service
 - A. Design and Operation

- B. Servo and Self-Engerizing Action
- C. Self-Adjustment Designs and Service
- D. Fade Resistance
- E. Construction
- F. Brake Drum Design and Service
- G. Backing Plate
- H. Wheel Cylinders
 - a. Overhaul and Replacement
 - b. Residual pressure
- I. Hold-Down Springs Types and Replacement
- J. Self-Adjusters
 - a. Manual and Automatic
- K. Leading/Trailing Design
- L. Parking Brake Adjustment
- M. Brake Drum Machining and Service
- N. Final Brake Adjustment
- O. Brake Drum Common Failures
- X. Parking Brakes
 - A. Design and Operation
 - B. Warning Lamps
 - C. Adjustments
 - D. Cable Replacement
 - E. Rear Disc Parking Brake Design and Service
 - a. Special tools
 - F. Automatic Vacuum Release System
- XI. Antilock Brake System
 - A. Design and Operation -- One, Three, or Four Channel Systems
 - B. System Components
 - C. Hold, Release, and Build Modes
 - D. Network Sharing
 - E. Inputs
 - F. Outputs
 - G. Wheel Speed Sensors Design, Operation, Troubleshooting, and Known Good Oscilloscope Patterns
 - H. Brake Switch
 - I. Solenoid Valve Design, Operation, and Troubleshooting
 - J. Relays
 - K. Warning Lamps Operation and Troubleshooting
 - L. Rear Wheel Anti-Lock Brake Design and Service
 - M. Traction Control System
 - a. Six Different Ways to Control Wheel Spin
 - N. Data Link Connector, Scan Tool Usage and Code Retrival
 - O. Pinpoint Charts for Codes
 - P. Depressurizing the System if Needed for Service
 - Q. Hard and Soft Codes
 - R. Voltage Drop Testing Procedures and Specifications
 - S. Clearing ABS Codes
- XII. Tire, Wheel, and Bearing Service
 - A. Tire and Wheel Inspection

- B. Proper Tire Inflation
- C. Tire Placard
- D. ABS and the Need for the Same Tire Size on Each Wheel
- E. Tire Effects on Braking
- F. Tire Inflation Monitoring Operation
 - a. Inspection
- G. Wheel Bearing Design and Operation
- H. Wheel Bearing Service, Repacking, and Proper Adjustments
 - a. Bearing Cup/Cone Replacement
- I. Wheel Alignment Effects on Braking
- J. Proper Tire Rotation
- K. Proper Wheel Lug Nut Torque Procedures
 - a. Torque Stick

INSTRUCTIONAL METHODS:

- 1. Lecture
- 2. Demonstrations
- 3. Practical (Lab)
- 4. Transparencies
- 5. Power Point
- 6. Alldata and Mitchell On-Demand
- 7. Internet
- 8. Class Discussion
- 9. Handouts
- 10. Quizzes and Tests

INSTRUCTIONAL MATERIALS:

- 1. Complete all lab objectives (NATEF Tasks)
- 2. Practical Application
- 3. Attendance
- 4. Work Habits
- 5. Attitude
- 6. Safety Practices
- 7. Student Notebook and Log Book
- 8. Ability to Work with Others
- 9. Written Exams and Quizzes
- 10. Class Participation

STUDENT REQUIREMENTS AND METHODS OF EVALUATION:

Owen, Clifton. Automotive Brake Systems. Delmar Publishing Co., 2004, 3rd Edition.
(2 Books) - Classroom Manual and Shop Manual.

OTHER REFERENCES

- 1. Alldata and Mitchell On-Demand, DVD Information System
(Both Labs, Office, and Classroom)
- 2. 1974-2006 Disc and Drum Brake Specifications – Carquest, (Auto Office)
- 3. Automotive Brake Systems – Prentice Hall (Auto Office)
- 4. Domestic Automotive Brakes -- Target Training (Auto Office)

Course Competency/Assessment Methods Matrix

ATO 2200 – Brake Systems		Assessment Options																															
For each competency/outcome place an “X” below the method of assessment to be used.	Assessment of Student Learning	Article Review	Case Studies	Group Projects	Lab Work	Oral Presentations	Pre-Post Tests	Quizzes	Written Exams	Artifact Self Reflection of Growth	Capstone Projects	Comprehensive Written Exit Exam	Course Embedded Questions	Multi-Media Projects	Observation	Writing Samples	Portfolio Evaluation	Real World Projects	Reflective Journals	Applied Application (skills) Test	Oral Exit Interviews	Accreditation Reviews/Reports	Advisory Council Feedback	Employer Surveys	Graduate Surveys	Internship/Practicum /Site Supervisor Evaluation	Licensing Exam	In Class Feedback	Simulation	Interview	Written Report	Assignment	
	Direct/ Indirect	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	I	I	I	I	D	D							
Assessment Measures – Are direct or indirect as indicated. List competencies/outcomes below.																																	
V.A.1. Brake Tasks - Identify and interpret brake system concern; determine necessary action.					X			X	X																								
V.A.2. Brake Tasks - Research applicable vehicle and service information, such as brake system operation, vehicle service history, service precautions, and technical service bulletins.					X			X	X																								
V.A.3. Brake Tasks - Locate and interpret vehicle and major component identification numbers (VIN, vehicle certification labels, calibration decals).					X			X	X																								
V.B.1. Brake Tasks - Diagnose pressure concerns in the brake system using hydraulic principles (Pascal’s Law).								X	X																								
V.B.2. Brake Tasks - Measure brake pedal height; determine necessary action.				X				X																									

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For each competency/outcome place an “X” below the method of assessment to be used.	Assessment of Student Learning	Article Review	Case Studies	Group Projects	Lab Work	Oral Presentations	Pre-Post Tests	Quizzes	Written Exams	Artifact Self Reflection of Growth	Capstone Projects	Comprehensive Written Exit Exam	Course Embedded Questions	Multi-Media Projects	Observation	Writing Samples	Portfolio Evaluation	Real World Projects	Reflective Journals	Applied Application (skills) Test	Oral Exit Interviews	Accreditation Reviews/Reports	Advisory Council Feedback	Employer Surveys	Graduate Surveys	Internship/Practicum /Site Supervisor Evaluation	Licensing Exam	In Class Feedback	Simulation	Interview	Written Report	Assignment	
	Direct/Indirect	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	I	I	I	I	D	D							
Assessment Measures – Are direct or indirect as indicated. List competencies/outcomes below.																																	
V.B.3. Brake Tasks - Check master cylinder for internal and external leaks and proper operation; determine necessary action.					X																												
V.B.4. Brake Tasks - Remove, bench bleed, and reinstall master cylinder.					X																												
V.B.5. Brake Tasks - Diagnose poor stopping, pulling, or dragging concerns caused by malfunctions in the hydraulic system; determine necessary action.					X																												
V.B.6. Brake Tasks - Inspect brake lines, flexible hoses, and fittings for leaks, dents, kinks, rust, cracks, bulging or wear; tighten loose fittings and supports; determine necessary action.					X																												
V.B.7. Brake Tasks - Fabricate and/or install brake lines (double flare or ISO types); replace hoses, fittings, and supports as needed.					X																												

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	Direct/Indirect	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	I	I	I	I	D	D							
Assessment Measures – Are direct or indirect as indicated. List competencies/outcomes below.																																	
V.B.8. Brake Tasks - Select, handle, store and install brake fluids to proper level.					X																												
V.B.9. Brake Tasks - Inspect, test, and replace metering (hold off), proportioning (balance), pressure differential, and combination valves.					X																												
V.B.10. Brake Tasks - Inspect, test, replace, and adjust height (load) sensing type proportioning valve.					X																												
V.B.11. Brake Tasks - Inspect, test, and replace components of brake warning light system.					X																												
V.B.12. Brake Tasks - Bleed (manual, pressure, vacuum, or surge) brake system.					X																												
V.B.13. Brake Tasks - Flush hydraulic system.					X																												

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	Direct/Indirect	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	I	I	I	I	D	D							
Assessment Measures – Are direct or indirect as indicated. List competencies/outcomes below.																																	
V.C.1. Brake Tasks - Diagnose poor stopping, noise, pulling, grabbing, dragging, or pedal pulsation problems; determine necessary action.					X																												
V.C.2. Brake Tasks - Remove, clean (using proper safety procedures), inspect, and measure brake drums; service or replace as needed.					X																												
V.C.3. Brake Tasks - Refinish brake drum.					X																												
V.C.4. Brake Tasks - Remove, clean, and inspect brake shoes, springs, pins, clips, levers, adjusters/self adjusters, other related brake hardware, and backing support plates; lubricate and reassemble.					X																												
V.C.5. Brake Tasks - Remove, inspect, and install wheel cylinders.					X																												

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For each competency/outcome place an “X” below the method of assessment to be used.	Assessment of Student Learning	Article Review	Case Studies	Group Projects	Lab Work	Oral Presentations	Pre-Post Tests	Quizzes	Written Exams	Artifact Self Reflection of Growth	Capstone Projects	Comprehensive Written Exit Exam	Course Embedded Questions	Multi-Media Projects	Observation	Writing Samples	Portfolio Evaluation	Real World Projects	Reflective Journals	Applied Application (skills) Test	Oral Exit Interviews	Accreditation Reviews/Reports	Advisory Council Feedback	Employer Surveys	Graduate Surveys	Internship/Practicum /Site Supervisor Evaluation	Licensing Exam	In Class Feedback	Simulation	Interview	Written Report	Assignment	
	Direct/Indirect	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	I	I	I	I	D	D							
Assessment Measures – Are direct or indirect as indicated. List competencies/outcomes below.																																	
V.C.6. Brake Tasks - Pre-adjust brake shoes and parking brake before installing brake drums or drum/hub assemblies and wheel bearings.					X																												
V.C.7. Brake Tasks - Install wheel, torque lug nuts, and make final checks and adjustments.					X																												
V.D.1. Diagnose poor stopping, noise, pulling, grabbing, dragging, or pedal pulsation concerns; determine necessary action.					X			X																									
V.D.2. Remove caliper assembly from mountings; clean and inspect for leaks and damage to caliper housing; determine necessary action.					X			X																									
V.D.3. Clean and inspect caliper mounting and slides for wear and damage; determine necessary action.				X				X																									

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For each competency/outcome place an “X” below the method of assessment to be used.	Assessment of Student Learning	Article Review	Case Studies	Group Projects	Lab Work	Oral Presentations	Pre-Post Tests	Quizzes	Written Exams	Artifact Self Reflection of Growth	Capstone Projects	Comprehensive Written Exit Exam	Course Embedded Questions	Multi-Media Projects	Observation	Writing Samples	Portfolio Evaluation	Real World Projects	Reflective Journals	Applied Application (skills) Test	Oral Exit Interviews	Accreditation Reviews/Reports	Advisory Council Feedback	Employer Surveys	Graduate Surveys	Internship/Practicum /Site Supervisor Evaluation	Licensing Exam	In Class Feedback	Simulation	Interview	Written Report	Assignment	
	Direct/Indirect	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	I	I	I	I	D	D							
Assessment Measures – Are direct or indirect as indicated. List competencies/outcomes below.																																	
V.D.4. Remove, clean, and inspect pads and retaining hardware; determine necessary action.					X			X	X																								
V.D.5. Disassemble, and clean caliper assembly; inspect parts for wear, rust, scoring, and damage; replace seal, boot, and damaged or worn parts.					X			X	X																								
V.D.6. Reassemble, lubricate and reinstall caliper, pads, and related hardware; seat pads and inspect for leaks.					X			X	X																								
V.D.7. Clean, inspect and measure rotor with a dial indicator and a micrometer; follow manufacturer=s recommendations in determining need to machine or replace.					X			X	X																								
V.D.8. Remove and install rotor.					X			X	X																								
V.D.9. Refinish rotor according to manufacturer’s recommendations.					X			X	X																								
V.D.10. Adjust calipers with integrated parking brakes.					X			X	X																								

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	Direct/Indirect	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	I	I	I	I	D	D								
Assessment Measures – Are direct or indirect as indicated. List competencies/outcomes below.																																			
V.D.11. Install wheel, torque lug nuts, and make final checks and adjustments.					X																														
V.E.1. Brake Tasks -Test pedal free travel with and without engine running; check power assist operation.					X																														
V.E.2 Brake Tasks - Check vacuum supply (manifold or auxiliary pump) to vacuum type power booster.					X																														
V.E.3. Brake Tasks -Inspect the vacuum type power booster unit for vacuum leaks; inspect the check valve for proper operation; determine necessary action.					X																														
V.E.4. Brake Tasks -Inspect and test hydro-boost system and accumulator for leaks and proper operation; determine necessary action.					X																														
V.F.1. Brake Tasks -Diagnose wheel bearing noises, wheel shimmy and vibration concerns; determine necessary action.					X																														

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For each competency/outcome place an “X” below the method of assessment to be used.	Assessment of Student Learning	Article Review	Case Studies	Group Projects	Lab Work	Oral Presentations	Pre-Post Tests	Quizzes	Written Exams	Artifact Self Reflection of Growth	Capstone Projects	Comprehensive Written Exit Exam	Course Embedded Questions	Multi-Media Projects	Observation	Writing Samples	Portfolio Evaluation	Real World Projects	Reflective Journals	Applied Application (skills) Test	Oral Exit Interviews	Accreditation Reviews/Reports	Advisory Council Feedback	Employer Surveys	Graduate Surveys	Internship/Practicum /Site Supervisor Evaluation	Licensing Exam	In Class Feedback	Simulation	Interview	Written Report	Assignment					
	Direct/Indirect	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	I	I	I	I	D	D											
Assessment Measures – Are direct or indirect as indicated. List competencies/outcomes below.																																					
V.F.2. Brake Tasks - Remove, clean, inspect, repack, and install wheel bearings and replace seals; install hub and adjust wheel bearings.					X																																
V.F.3. Brake Tasks -Check parking brake cables and components for wear, rusting, binding and corrosion; clean, lubricate and replace as needed.					X																																
V.F.4. Brake Tasks -Check parking brake operation; determine necessary action.					X																																
V.F.5. Brake Tasks - Check operation of parking brake indicator light system.					X																																
V.F.6. Brake Tasks -Check operation of brake stop light system; determine necessary action.					X																																
V.F.7. Brake Tasks -Replace wheel bearing and race.					X																																
V.F.8. Brake Tasks -Inspect and replace wheel studs.				X			X	X																													

ATO 2200 – Brake Systems		Assessment Options																																
For each competency/outcome place an “X” below the method of assessment to be used.	Assessment of Student Learning	Article Review	Case Studies	Group Projects	Lab Work	Oral Presentations	Pre-Post Tests	Quizzes	Written Exams	Artifact Self Reflection of Growth	Capstone Projects	Comprehensive Written Exit Exam	Course Embedded Questions	Multi-Media Projects	Observation	Writing Samples	Portfolio Evaluation	Real World Projects	Reflective Journals	Applied Application (skills) Test	Oral Exit Interviews	Accreditation Reviews/Reports	Advisory Council Feedback	Employer Surveys	Graduate Surveys	Internship/Practicum /Site Supervisor Evaluation	Licensing Exam	In Class Feedback	Simulation	Interview	Written Report	Assignment		
	Direct/Indirect	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	I	I	I	I	D	D								
Assessment Measures – Are direct or indirect as indicated. List competencies/outcomes below.																																		
V.F.9. Brake Tasks - Remove and reinstall sealed wheel bearing assembly.					X																													
V.G.1. Brake Tasks -Identify and inspect anti-lock brake system (ABS) components; determine necessary action.					X			X	X																									
V.G.2. Brake Tasks -Diagnose poor stopping, wheel lock-up, pedal feel or pulsation, and noise concerns caused by the anti-lock brake system (ABS); determine necessary action.					X			X	X																									
V.G.3. Brake Tasks - Diagnose anti-lock brake system (ABS) electronic control(s) and components using self-diagnosis and/or recommended test equipment; determine necessary action.					X			X	X																									
V.G.4. Brake Tasks -Depressurize high pressure components of the anti-lock brake system (ABS).					X																													
V.G.5. Brake Tasks -Bleed the anti-lock brake system’s (ABS) front and rear hydraulic circuits.					X																													

ATO 2200 – Brake Systems		Assessment Options																															
For each competency/outcome place an “X” below the method of assessment to be used.	Assessment of Student Learning	Article Review	Case Studies	Group Projects	Lab Work	Oral Presentations	Pre-Post Tests	Quizzes	Written Exams	Artifact Self Reflection of Growth	Capstone Projects	Comprehensive Written Exit Exam	Course Embedded Questions	Multi-Media Projects	Observation	Writing Samples	Portfolio Evaluation	Real World Projects	Reflective Journals	Applied Application (skills) Test	Oral Exit Interviews	Accreditation Reviews/Reports	Advisory Council Feedback	Employer Surveys	Graduate Surveys	Internship/Practicum /Site Supervisor Evaluation	Licensing Exam	In Class Feedback	Simulation	Interview	Written Report	Assignment	
	Direct/Indirect	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	I	I	I	I	D	D							
Assessment Measures – Are direct or indirect as indicated. List competencies/outcomes below.																																	
V.G.6. Brake Tasks -Remove and install anti-lock brake system (ABS) electrical/electronic and hydraulic components.					X																												
V.G.7. Brake Tasks - Test, diagnose and service ABS speed sensors, toothed ring (tone wheel), and circuits using a graphing multi-meter (DMM)/digital storage oscilloscope (DSO) (includes output signal, resistance, shorts to voltage/ground, and frequency data).					X			X	X																								
V.G.8. Brake Tasks -Diagnose anti-lock brake system (ABS) braking concerns caused by vehicle modifications (tire size, curb height, final drive ratio, etc.).					X			X	X																								
V.G.9. Brake Tasks -Identify traction control system components.					X			X	X																								