



## Articulation Agreement

between

College of Applied Technologies

and

Institution: \_\_\_\_\_ Titusville HS \_\_\_\_\_

Address: \_\_\_\_\_ 150 Terrier Trail South \_\_\_\_\_

\_\_\_\_\_ Titusville, FL 32780 \_\_\_\_\_

Phone: \_\_\_\_\_ 321-264-3100 \_\_\_\_\_

The University of Northwestern Ohio believes that many high schools and career centers have extensive course work in technical areas that give students a solid foundation for college study. Students who have these technical skills may be granted college credit for their proficiencies.

A partnership agreement between the university and the high schools and career centers is appropriate to recognize and reward those graduates who have acquired the skills for proficiency credit in specific introductory classes. The university will grant advanced placement to high school graduates who fulfill course requirements agreed to in this document.

The advantages to advanced placement:

- There will be no expense to the student
- It will reduce the total tuition expense, book fees, and housing costs for your college program
- It will reduce the time necessary for completion of the program.

The decision on advanced placement will be determined by the following University of Northwestern Ohio authorized personnel: Provost / Vice President for Academic Affairs and the College Registrar.

The total number of credits to be awarded to a student may vary and will be decided on an individual basis. Awarded credit will be reflected on the students' transcript after completion of the first term.

**To take advantage of this agreement, the student should:**

- Contact the Admission Office at the University of Northwestern Ohio for a formal admissions application to the university (419)998-3120.
- Pick up the Articulation Application from myself or your high school counselor. You can also call the University to have the application form mailed or e-mailed to you at (419) 998-8889.
- The form should be taken to the high school where it should be completed and approved by the student's instructor and administrator. The student will also be required to sign the form stating the he or she has had the necessary training and has met the attached learning outcomes.

- After it is approved by the student's instructor and counselor, and signed by the student, the school's chief administrator should sign the form and mail it to the Shawanna Roob at the University of Northwestern Ohio, along with documentation of NATEF accreditation found on the web at [natef.org](http://natef.org).

After the materials are reviewed by University personnel, the student will be notified if advanced credit has been awarded. Awarded credit will be reflected on the students' transcript after completion of the first term.

## **COURSES AND CREDITS FOR ADVANCED PLACEMENT**

### **AU126 Suspension and Steering (6 credits)**

- Student must have 2 years of high school in an automotive or diesel training program, with a grade of "B" or higher each year, and the school must have NATEF, AST or higher accreditation.
- Schools with NATEF, MLR level of accreditation or schools that are not NATEF accredited, will have the opportunity to articulate with UNOH if the attached list of learning outcomes for AU 126, Steering and Suspension are met.

### **AU127 Hydraulic Brake Systems (6 credits)**

- Student must have 2 years of high school in an automotive or diesel training program, with a grade of "B" or higher each year, and the school must have NATEF, AST or higher accreditation.
- Schools with NATEF, MLR level of accreditation or schools that are not NATEF accredited, will have the opportunity to articulate with UNOH if the attached lists of learning outcomes for AU 127, Hydraulic Brake Systems are met.

## **CATALOG DESCRIPTIONS OF COURSES LISTED**

### **AU126 SUSPENSION AND STEERING**

The fundamentals of the chassis, including basic and power steering systems, variable effort power steering systems, suspension systems both basic and computer controlled, geometric centerline alignment, thrust line alignment and total four-wheel alignment provide the focus of this course. Proper procedures in diagnosis of components along with basic frame and body measuring for correct locations are covered. Also covered is the diagnosis of vehicle vibrations and tire pressure monitor systems. Lab work includes steering and suspension repair, tire balancing and alignment on computerized alignment equipment, and computerized wheel balancing, utilizing training aids and live vehicles.

### **AU127 HYDRAULIC BRAKE SYSTEMS**

The fundamental principles of hydraulics pertaining to the automotive and medium duty truck brake systems are presented. Students will study the theory of operation and advanced study of component principles. Students will use standard skills to diagnose and repair hydraulic systems, drum and disc brake systems, power assist units and anti-lock brake systems. Lab work includes demonstration, on-car practice to provide a working knowledge of diagnosis and repair of the hydraulic systems, drum and disc brake systems, power assist units and associated systems. Included will be coverage of wheel bearings, parking brakes, related electrical circuits and use of on-car brake lathes.

- \* NATEF, AST or higher accredited programs must attach a copy of their accreditation to process this agreement. NATEF Maintenance & Light Repair and non-NATEF programs see the next page.
- \* All Articulation Agreements will be revaluated every five years, to assure all students are getting, and have the necessary information to have credit granted to them.
- \* All schools desiring to articulate classes with the University of Northwestern Ohio must be NATEF, AST or higher accredited, or meet the learning outcomes @ for each class that articulation is desired. If your institution's accreditation has temporarily lapsed due to NATEF's inability to evaluate in a timely fashion, please attach documentation that an evaluation will be conducted.
- \* If an educational deficiency pattern is detected with a specific high school or career center, said school will have the opportunity to work with UNOH to remedy the concern.

@ [www.unoh.edu/files/admissions/articulation/cot-articulation-agreement.pdf](http://www.unoh.edu/files/admissions/articulation/cot-articulation-agreement.pdf)

**NATEF Maintenance & Light Repair and non-NATEF programs, initial the learning outcomes your program meets:**

**Automotive:**

AU126 Suspension & Steering       AU127 Hydraulic Brake Systems

**Diesel:**

AU126 Suspension & Steering       AU127 Hydraulic Brake Systems

We, the undersigned representatives of the cooperating university and high school/career centers, agree that a student completing career and technical education training in select automotive or diesel technology may be eligible for advanced placement credit. Guidelines for acceptance of the credit are covered in this document.

\_\_\_\_\_  
**University of Northwestern Ohio**  
**Institution**

\_\_\_\_\_  
**Titusville HS**  
**Institution**

\_\_\_\_\_  
**Vice President for Academic**  
**Affairs Provost**

\_\_\_\_\_  
**Janice Scholz**  
**Superintendent/Director**

\_\_\_\_\_  
**Date**

\_\_\_\_\_  
**11/7/18**  
**Date**

**Return agreement to:**

The University of Northwestern Ohio  
 Attention: Admissions  
 Shawna Roob, Educational Relations Representative  
 1441 N. Cable Rd., Lima, OH 45805

*University of Northwestern Ohio, 1441 N. Cable Rd., Lima, OH 45805  
 Office Phone: 419-998-8889 Fax: 419-998-3139*

## UNOH Learning Outcomes AU-126

Learning outcomes do not apply to NATEF AST or Master accredited schools.

Students are required to meet the following learning outcomes to receive articulation credit for AU-126, Steering and Suspension at the University of Northwestern Ohio.

### **General: Suspension and Steering Systems**

1. Research applicable vehicle and service information, vehicle service history, service precautions, and technical service bulletins.
2. Identify and interpret suspension and steering system concerns; determine necessary action.

### **Steering Systems Diagnosis and Repair**

1. Disable and enable supplemental restraint system (SRS).
2. Inspect rack and pinion steering gear inner tie rod ends (sockets) and bellows boots; replace as needed.
3. Determine proper power steering fluid type; inspect fluid level and condition.
4. Flush, fill, and bleed power steering system.
5. Inspect for power steering fluid leakage; determine necessary action.
6. Remove, inspect, replace, and adjust power steering pump drive belt.
7. Inspect and replace power steering hoses and fittings.
8. Inspect and replace pitman arm, relay (center link/intermediate) rod, idler arm and mountings, and steering linkage damper.
9. Inspect, replace, and adjust tie rod ends (sockets), tie rod sleeves, and clamps.
10. Identify hybrid vehicle power steering system electrical circuits and safety precautions.
11. Inspect electric power-assisted steering.

### **Suspension Systems Diagnosis and Repair**

1. Diagnose short and long arm suspension system noises, body sway, and uneven ride height concerns; determine necessary action.
2. Diagnose strut suspension system noises, body sway, and uneven ride height concerns; determine necessary action.
3. Inspect, remove and install upper and lower control arms, bushings, shafts, and rebound bumpers.
4. Inspect, remove and install strut rods and bushings.
5. Inspect, remove and install upper and/or lower ball joints (with or without wear indicators).
6. Inspect, remove and install torsion bars and mounts
7. Inspect, remove and install front stabilizer bar (sway bar) bushings, brackets, and links.
8. Inspect, remove and install strut cartridge or assembly, strut coil spring, insulators (silencers), and upper strut bearing mount.
9. Inspect, remove and install track bar, strut rods/radius arms, and related mounts and bushings.
10. Inspect rear suspension system leaf spring(s), bushings, center pins/bolts, and mounts.

### **Related Suspension and Steering Service**

1. Inspect, remove, and replace shock absorbers; inspect mounts and bushings.
2. Describe the function of the power steering pressure switch.

### **Wheel Alignment Diagnosis, Adjustment, and Repair**

1. Perform pre-alignment inspection and measure vehicle ride height; perform necessary action.
2. Prepare vehicle for wheel alignment on alignment machine; perform four-wheel alignment by checking and adjusting front and rear wheel caster, camber and toe as required; center steering wheel.
3. Check toe-out-on-turns (turning radius); determine necessary action.
4. Check SAI (steering axis inclination) and included angle; determine necessary action.
5. Check rear wheel thrust angle; determine necessary action.

6. Check for front wheel setback; determine necessary action.

### **Wheels and Tires Diagnosis and Repair**

1. Inspect tire condition; identify tire wear patterns; check for correct tire size and application (load and speed ratings) and adjust air pressure; determine necessary action.
2. Diagnose wheel/tire vibration, shimmy, and noise; determine necessary action.
3. Rotate tires according to manufacturer's recommendations.
4. Dismount, inspect, and remount tire on wheel; balance wheel and tire assembly (static and dynamic).
5. Dismount, inspect, and remount tire on wheel equipped with tire pressure monitoring system sensor.
6. Inspect tire and wheel assembly for air loss; perform necessary action.
7. Repair tire using internal patch.
8. Identify and test tire pressure monitoring system (indirect and direct) for operation; calibrate system; verify operation of instrument panel lamps.
9. Demonstrate knowledge of steps required to remove and replace sensors in a tire pressure monitoring system.

### UNOH Learning Outcomes AU-127

Learning outcomes do not apply to NATEF AST or Master accredited schools.

Students are required to meet the following learning outcomes to receive articulation credit for AU-127, Hydraulic Brake Systems at the University of Northwestern Ohio.

#### **General: Brake Systems Diagnosis**

1. Research applicable vehicle and service information, vehicle service history, service precautions, and technical service bulletins.
2. Describe procedure for performing a road test to check brake system operation; including an anti-lock brake system (ABS).
3. Install wheel and torque lug nuts.

#### **Hydraulic System Diagnosis and Repair**

1. Diagnose pressure concerns in the brake system using hydraulic principles (Pascal's Law).
2. Measure brake pedal height, travel, and free play (as applicable); determine necessary action.
3. Check master cylinder for internal/external leaks and proper operation; determine necessary action.
4. Remove, bench bleed, and reinstall master cylinder.
5. Inspect brake lines, flexible hoses, and fittings for leaks, dents, kinks, rust, cracks, bulging, and wear; check for loose fittings and supports; determine necessary action.
6. Fabricate brake lines using proper material and flaring procedures (double flare and ISO types).
7. Select, handle, store, and fill brake fluids to proper level.
8. Identify components of brake warning light system.
9. Bleed and/or flush brake system.
10. Test brake fluid for contamination.

### **Drum Brake Diagnosis and Repair**

1. Remove, clean, inspect, and measure brake drum diameter; determine necessary action.
2. Refinish brake drum and measure final drum diameter; compare with specifications.
3. Remove, clean, and inspect brake shoes, springs, pins, clips, levers, adjusters/self-adjusters, other related brake hardware, and backing support plates; lubricate and reassemble.
4. Inspect wheel cylinders for leaks and proper operation; remove and replace as needed.
5. Pre-adjust brake shoes and parking brake; install brake drums or drum/hub assemblies and wheel bearings; perform final checks and adjustments.

### **Disc Brake Diagnosis and Repair**

1. Diagnose poor stopping, noise, vibration, pulling, grabbing, dragging, or pulsation concerns; determine necessary action.
2. Remove and clean caliper assembly; inspect for leaks and damage/wear to caliper housing; determine necessary action.
3. Clean and inspect caliper mounting and slides/pins for proper operation, wear, and damage; determine necessary action.
4. Remove, inspect, and replace pads and retaining hardware; determine necessary action.
5. Lubricate and reinstall caliper, pads, and related hardware; seat pads and inspect for leaks.
6. Clean and inspect rotor; measure rotor thickness, thickness variation, and lateral run out; determine necessary action.
7. Remove and reinstall rotor.
8. Refinish rotor on vehicle; measure final rotor thickness and compare with specifications.
9. Refinish rotor off vehicle; measure final rotor thickness and compare with specifications.
10. Retract and re-adjust caliper piston on an integrated parking brake system.
11. Check brake pad wear indicator; determine necessary action.
12. Describe importance of operating vehicle to burnish/break-in replacement brake pads according to manufacturer's recommendations.



**Power-Assist Units Diagnosis and Repair**

1. Check brake pedal travel with, and without, engine running to verify proper power booster operation.
2. Check vacuum supply (manifold or auxiliary pump) to vacuum-type power booster.
3. Inspect vacuum-type power booster unit for leaks; inspect the check-valve for proper operation; determine necessary action.

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

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

**Electronic Brake, Traction and Stability Control Systems Diagnosis and Repair**

1. Identify and inspect electronic brake control system components; determine necessary action.
2. Diagnose poor stopping, wheel lock-up, abnormal pedal feel, unwanted application, and noise concerns associated with the electronic brake control system; determine necessary action.
3. Diagnose electronic brake control system electronic control(s) and components by retrieving diagnostic trouble codes, and/or using recommended test equipment; determine necessary action.
4. Bleed the electronic brake control system hydraulic circuits.
5. Test, diagnose, and service electronic brake control system speed sensors (digital and analog), toothed ring (tone wheel), and circuits using a graphing multimeter (GMM)/digital storage oscilloscope (DSO) (includes output signal, resistance, shorts to voltage/ground, and frequency data).
6. Diagnose electronic brake control system braking concerns caused by vehicle modifications (tire size, curb height, final drive ratio, etc.).



## Articulation Agreement

between

College of Applied Technologies

and

**Institution:**    \_\_\_ Satellite HS \_\_\_\_\_

**Address:**       \_\_\_ 300 Scorpion Court \_\_\_\_\_

                      \_\_\_ Satellite Beach FL 32937 \_\_\_\_\_

**Phone:**         \_\_\_ 321-779-2000 \_\_\_\_\_

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## **CATALOG DESCRIPTIONS OF COURSES LISTED**

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**NATEF Maintenance & Light Repair and non-NATEF programs, initial the learning outcomes your program meets:**

**Automotive:**

AU126 Suspension & Steering     AU127 Hydraulic Brake Systems

**Diesel:**

AU126 Suspension & Steering     AU127 Hydraulic Brake Systems

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**Institution**

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**Institution**

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**Vice President for Academic**  
**Affairs Provost**

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 Janice Scholz \_\_\_\_\_  
**Superintendent/Director**

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 11/7/18 \_\_\_\_\_  
**Date**

**Return agreement to:**

The University of Northwestern Ohio  
 Attention: Admissions  
 Shawna Roob, Educational Relations Representative  
 1441 N. Cable Rd., Lima, OH 45805

*University of Northwestern Ohio, 1441 N. Cable Rd., Lima, OH 45805  
 Office Phone: 419-998-8889 Fax: 419-998-3139*

## UNOH Learning Outcomes AU-126

Learning outcomes do not apply to NATEF AST or Master accredited schools.

Students are required to meet the following learning outcomes to receive articulation credit for AU-126, Steering and Suspension at the University of Northwestern Ohio.

### **General: Suspension and Steering Systems**

1. Research applicable vehicle and service information, vehicle service history, service precautions, and technical service bulletins.
2. Identify and interpret suspension and steering system concerns; determine necessary action.

### **Steering Systems Diagnosis and Repair**

1. Disable and enable supplemental restraint system (SRS).
2. Inspect rack and pinion steering gear inner tie rod ends (sockets) and bellows boots; replace as needed.
3. Determine proper power steering fluid type; inspect fluid level and condition.
4. Flush, fill, and bleed power steering system.
5. Inspect for power steering fluid leakage; determine necessary action.
6. Remove, inspect, replace, and adjust power steering pump drive belt.
7. Inspect and replace power steering hoses and fittings.
8. Inspect and replace pitman arm, relay (center link/intermediate) rod, idler arm and mountings, and steering linkage damper.
9. Inspect, replace, and adjust tie rod ends (sockets), tie rod sleeves, and clamps.
10. Identify hybrid vehicle power steering system electrical circuits and safety precautions.
11. Inspect electric power-assisted steering.

### **Suspension Systems Diagnosis and Repair**

1. Diagnose short and long arm suspension system noises, body sway, and uneven ride height concerns; determine necessary action.
2. Diagnose strut suspension system noises, body sway, and uneven ride height concerns; determine necessary action.
3. Inspect, remove and install upper and lower control arms, bushings, shafts, and rebound bumpers.
4. Inspect, remove and install strut rods and bushings.
5. Inspect, remove and install upper and/or lower ball joints (with or without wear indicators).
6. Inspect, remove and install torsion bars and mounts
7. Inspect, remove and install front stabilizer bar (sway bar) bushings, brackets, and links.
8. Inspect, remove and install strut cartridge or assembly, strut coil spring, insulators (silencers), and upper strut bearing mount.
9. Inspect, remove and install track bar, strut rods/radius arms, and related mounts and bushings.
10. Inspect rear suspension system leaf spring(s), bushings, center pins/bolts, and mounts.

### **Related Suspension and Steering Service**

1. Inspect, remove, and replace shock absorbers; inspect mounts and bushings.
2. Describe the function of the power steering pressure switch.

### **Wheel Alignment Diagnosis, Adjustment, and Repair**

1. Perform pre-alignment inspection and measure vehicle ride height; perform necessary action.
2. Prepare vehicle for wheel alignment on alignment machine; perform four-wheel alignment by checking and adjusting front and rear wheel caster, camber and toe as required; center steering wheel.
3. Check toe-out-on-turns (turning radius); determine necessary action.
4. Check SAI (steering axis inclination) and included angle; determine necessary action.
5. Check rear wheel thrust angle; determine necessary action.

6. Check for front wheel setback; determine necessary action.

### **Wheels and Tires Diagnosis and Repair**

1. Inspect tire condition; identify tire wear patterns; check for correct tire size and application (load and speed ratings) and adjust air pressure; determine necessary action.
2. Diagnose wheel/tire vibration, shimmy, and noise; determine necessary action.
3. Rotate tires according to manufacturer's recommendations.
4. Dismount, inspect, and remount tire on wheel; balance wheel and tire assembly (static and dynamic).
5. Dismount, inspect, and remount tire on wheel equipped with tire pressure monitoring system sensor.
6. Inspect tire and wheel assembly for air loss; perform necessary action.
7. Repair tire using internal patch.
8. Identify and test tire pressure monitoring system (indirect and direct) for operation; calibrate system; verify operation of instrument panel lamps.
9. Demonstrate knowledge of steps required to remove and replace sensors in a tire pressure monitoring system.

### UNOH Learning Outcomes AU-127

Learning outcomes do not apply to NATEF AST or Master accredited schools.

Students are required to meet the following learning outcomes to receive articulation credit for AU-127, Hydraulic Brake Systems at the University of Northwestern Ohio.

#### **General: Brake Systems Diagnosis**

1. Research applicable vehicle and service information, vehicle service history, service precautions, and technical service bulletins.
2. Describe procedure for performing a road test to check brake system operation; including an anti-lock brake system (ABS).
3. Install wheel and torque lug nuts.

#### **Hydraulic System Diagnosis and Repair**

1. Diagnose pressure concerns in the brake system using hydraulic principles (Pascal's Law).
2. Measure brake pedal height, travel, and free play (as applicable); determine necessary action.
3. Check master cylinder for internal/external leaks and proper operation; determine necessary action.
4. Remove, bench bleed, and reinstall master cylinder.
5. Inspect brake lines, flexible hoses, and fittings for leaks, dents, kinks, rust, cracks, bulging, and wear; check for loose fittings and supports; determine necessary action.
6. Fabricate brake lines using proper material and flaring procedures (double flare and ISO types).
7. Select, handle, store, and fill brake fluids to proper level.
8. Identify components of brake warning light system.
9. Bleed and/or flush brake system.
10. Test brake fluid for contamination.



### **Drum Brake Diagnosis and Repair**

1. Remove, clean, inspect, and measure brake drum diameter; determine necessary action.
2. Refinish brake drum and measure final drum diameter; compare with specifications.
3. Remove, clean, and inspect brake shoes, springs, pins, clips, levers, adjusters/self-adjusters, other related brake hardware, and backing support plates; lubricate and reassemble.
4. Inspect wheel cylinders for leaks and proper operation; remove and replace as needed.
5. Pre-adjust brake shoes and parking brake; install brake drums or drum/hub assemblies and wheel bearings; perform final checks and adjustments.

### **Disc Brake Diagnosis and Repair**

1. Diagnose poor stopping, noise, vibration, pulling, grabbing, dragging, or pulsation concerns; determine necessary action.
2. Remove and clean caliper assembly; inspect for leaks and damage/wear to caliper housing; determine necessary action.
3. Clean and inspect caliper mounting and slides/pins for proper operation, wear, and damage; determine necessary action.
4. Remove, inspect, and replace pads and retaining hardware; determine necessary action.
5. Lubricate and reinstall caliper, pads, and related hardware; seat pads and inspect for leaks.
6. Clean and inspect rotor; measure rotor thickness, thickness variation, and lateral run out; determine necessary action.
7. Remove and reinstall rotor.
8. Refinish rotor on vehicle; measure final rotor thickness and compare with specifications.
9. Refinish rotor off vehicle; measure final rotor thickness and compare with specifications.
10. Retract and re-adjust caliper piston on an integrated parking brake system.
11. Check brake pad wear indicator; determine necessary action.
12. Describe importance of operating vehicle to burnish/break-in replacement brake pads according to manufacturer's recommendations.

### **Power-Assist Units Diagnosis and Repair**

1. Check brake pedal travel with, and without, engine running to verify proper power booster operation.
2. Check vacuum supply (manifold or auxiliary pump) to vacuum-type power booster.
3. Inspect vacuum-type power booster unit for leaks; inspect the check-valve for proper operation; determine necessary action.

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

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

### **Electronic Brake, Traction and Stability Control Systems Diagnosis and Repair**

1. Identify and inspect electronic brake control system components; determine necessary action.
2. Diagnose poor stopping, wheel lock-up, abnormal pedal feel, unwanted application, and noise concerns associated with the electronic brake control system; determine necessary action.
3. Diagnose electronic brake control system electronic control(s) and components by retrieving diagnostic trouble codes, and/or using recommended test equipment; determine necessary action.
4. Bleed the electronic brake control system hydraulic circuits.
5. Test, diagnose, and service electronic brake control system speed sensors (digital and analog), toothed ring (tone wheel), and circuits using a graphing multimeter (GMM)/digital storage oscilloscope (DSO) (includes output signal, resistance, shorts to voltage/ground, and frequency data).
6. Diagnose electronic brake control system braking concerns caused by vehicle modifications (tire size, curb height, final drive ratio, etc.).

## Articulation Agreement

between

College of Applied Technologies

and

**Institution:** \_\_\_\_\_ Rockledge HS \_\_\_\_\_

**Address:** \_\_\_\_\_ 220 Raider Road \_\_\_\_\_

\_\_\_\_\_ Rockledge FL 32955 \_\_\_\_\_

**Phone:** \_\_\_\_\_ 321-636-3711 \_\_\_\_\_

The University of Northwestern Ohio believes that many high schools and career centers have extensive course work in technical areas that give students a solid foundation for college study. Students who have these technical skills may be granted college credit for their proficiencies.

A partnership agreement between the university and the high schools and career centers is appropriate to recognize and reward those graduates who have acquired the skills for proficiency credit in specific introductory classes. The university will grant advanced placement to high school graduates who fulfill course requirements agreed to in this document.

The advantages to advanced placement:

- There will be no expense to the student
- It will reduce the total tuition expense, book fees, and housing costs for your college program
- It will reduce the time necessary for completion of the program.

The decision on advanced placement will be determined by the following University of Northwestern Ohio authorized personnel: Provost / Vice President for Academic Affairs and the College Registrar.

The total number of credits to be awarded to a student may vary and will be decided on an individual basis. Awarded credit will be reflected on the students' transcript after completion of the first term.

**To take advantage of this agreement, the student should:**

- Contact the Admission Office at the University of Northwestern Ohio for a formal admissions application to the university (419)998-3120.
- Pick up the Articulation Application from myself or your high school counselor. You can also call the University to have the application form mailed or e-mailed to you at (419) 998-8889.
- The form should be taken to the high school where it should be completed and approved by the student's instructor and administrator. The student will also be required to sign the form stating the he or she has had the necessary training and has met the attached learning outcomes.

- After it is approved by the student's instructor and counselor, and signed by the student, the school's chief administrator should sign the form and mail it to the Shawwna Roob at the University of Northwestern Ohio, along with documentation of NATEF accreditation found on the web at [natef.org](http://natef.org).

After the materials are reviewed by University personnel, the student will be notified if advanced credit has been awarded. Awarded credit will be reflected on the students' transcript after completion of the first term.

## **COURSES AND CREDITS FOR ADVANCED PLACEMENT**

### **AU126 Suspension and Steering (6 credits)**

- Student must have 2 years of high school in an automotive or diesel training program, with a grade of "B" or higher each year, and the school must have NATEF, AST or higher accreditation.
- Schools with NATEF, MLR level of accreditation or schools that are not NATEF accredited, will have the opportunity to articulate with UNOH if the attached list of learning outcomes for AU 126, Steering and Suspension are met.

### **AU127 Hydraulic Brake Systems (6 credits)**

- Student must have 2 years of high school in an automotive or diesel training program, with a grade of "B" or higher each year, and the school must have NATEF, AST or higher accreditation.
- Schools with NATEF, MLR level of accreditation or schools that are not NATEF accredited, will have the opportunity to articulate with UNOH if the attached lists of learning outcomes for AU 127, Hydraulic Brake Systems are met.

## **CATALOG DESCRIPTIONS OF COURSES LISTED**

### **AU126 SUSPENSION AND STEERING**

The fundamentals of the chassis, including basic and power steering systems, variable effort power steering systems, suspension systems both basic and computer controlled, geometric centerline alignment, thrust line alignment and total four-wheel alignment provide the focus of this course. Proper procedures in diagnosis of components along with basic frame and body measuring for correct locations are covered. Also covered is the diagnosis of vehicle vibrations and tire pressure monitor systems. Lab work includes steering and suspension repair, tire balancing and alignment on computerized alignment equipment, and computerized wheel balancing, utilizing training aids and live vehicles.

### **AU127 HYDRAULIC BRAKE SYSTEMS**

The fundamental principles of hydraulics pertaining to the automotive and medium duty truck brake systems are presented. Students will study the theory of operation and advanced study of component principles. Students will use standard skills to diagnose and repair hydraulic systems, drum and disc brake systems, power assist units and anti-lock brake systems. Lab work includes demonstration, on-car practice to provide a working knowledge of diagnosis and repair of the hydraulic systems, drum and disc brake systems, power assist units and associated systems. Included will be coverage of wheel bearings, parking brakes, related electrical circuits and use of on-car brake lathes.

- \* NATEF, AST or higher accredited programs must attach a copy of their accreditation to process this agreement. NATEF Maintenance & Light Repair and non-NATEF programs see the next page.
- \* All Articulation Agreements will be revaluated every five years, to assure all students are getting, and have the necessary information to have credit granted to them.
- \* All schools desiring to articulate classes with the University of Northwestern Ohio must be NATEF, AST or higher accredited, or meet the learning outcomes @ for each class that articulation is desired. If your institution's accreditation has temporarily lapsed due to NATEF's inability to evaluate in a timely fashion, please attach documentation that an evaluation will be conducted.
- \* If an educational deficiency pattern is detected with a specific high school or career center, said school will have the opportunity to work with UNOH to remedy the concern.

@ [www.unoh.edu/files/admissions/articulation/cot-articulation-agreement.pdf](http://www.unoh.edu/files/admissions/articulation/cot-articulation-agreement.pdf)

**NATEF Maintenance & Light Repair and non-NATEF programs, initial the learning outcomes your program meets:**

**Automotive:**

AU126 Suspension & Steering       AU127 Hydraulic Brake Systems

**Diesel:**

AU126 Suspension & Steering       AU127 Hydraulic Brake Systems

We, the undersigned representatives of the cooperating university and high school/career centers, agree that a student completing career and technical education training in select automotive or diesel technology may be eligible for advanced placement credit. Guidelines for acceptance of the credit are covered in this document.

\_\_\_\_\_  
**University of Northwestern Ohio**  
**Institution**

\_\_\_\_\_  
**Rockledge HS**  
**Institution**

\_\_\_\_\_  
**Vice President for Academic**  
**Affairs Provost**

\_\_\_\_\_  
**Janice Scholz**  
**Superintendent/Director**

\_\_\_\_\_  
**Date**

\_\_\_\_\_  
**11/7/18**  
**Date**

**Return agreement to:**

The University of Northwestern Ohio  
 Attention: Admissions  
 Shawna Roob, Educational Relations Representative  
 1441 N. Cable Rd., Lima, OH 45805

*University of Northwestern Ohio, 1441 N. Cable Rd., Lima, OH 45805  
 Office Phone: 419-998-8889 Fax: 419-998-3139*

## UNOH Learning Outcomes AU-126

Learning outcomes do not apply to NATEF AST or Master accredited schools.

Students are required to meet the following learning outcomes to receive articulation credit for AU-126, Steering and Suspension at the University of Northwestern Ohio.

### **General: Suspension and Steering Systems**

1. Research applicable vehicle and service information, vehicle service history, service precautions, and technical service bulletins.
2. Identify and interpret suspension and steering system concerns; determine necessary action.

### **Steering Systems Diagnosis and Repair**

1. Disable and enable supplemental restraint system (SRS).
2. Inspect rack and pinion steering gear inner tie rod ends (sockets) and bellows boots; replace as needed.
3. Determine proper power steering fluid type; inspect fluid level and condition.
4. Flush, fill, and bleed power steering system.
5. Inspect for power steering fluid leakage; determine necessary action.
6. Remove, inspect, replace, and adjust power steering pump drive belt.
7. Inspect and replace power steering hoses and fittings.
8. Inspect and replace pitman arm, relay (center link/intermediate) rod, idler arm and mountings, and steering linkage damper.
9. Inspect, replace, and adjust tie rod ends (sockets), tie rod sleeves, and clamps.
10. Identify hybrid vehicle power steering system electrical circuits and safety precautions.
11. Inspect electric power-assisted steering.

### **Suspension Systems Diagnosis and Repair**

1. Diagnose short and long arm suspension system noises, body sway, and uneven ride height concerns; determine necessary action.
2. Diagnose strut suspension system noises, body sway, and uneven ride height concerns; determine necessary action.
3. Inspect, remove and install upper and lower control arms, bushings, shafts, and rebound bumpers.
4. Inspect, remove and install strut rods and bushings.
5. Inspect, remove and install upper and/or lower ball joints (with or without wear indicators).
6. Inspect, remove and install torsion bars and mounts
7. Inspect, remove and install front stabilizer bar (sway bar) bushings, brackets, and links.
8. Inspect, remove and install strut cartridge or assembly, strut coil spring, insulators (silencers), and upper strut bearing mount.
9. Inspect, remove and install track bar, strut rods/radius arms, and related mounts and bushings.
10. Inspect rear suspension system leaf spring(s), bushings, center pins/bolts, and mounts.

### **Related Suspension and Steering Service**

1. Inspect, remove, and replace shock absorbers; inspect mounts and bushings.
2. Describe the function of the power steering pressure switch.

### **Wheel Alignment Diagnosis, Adjustment, and Repair**

1. Perform pre-alignment inspection and measure vehicle ride height; perform necessary action.
2. Prepare vehicle for wheel alignment on alignment machine; perform four-wheel alignment by checking and adjusting front and rear wheel caster, camber and toe as required; center steering wheel.
3. Check toe-out-on-turns (turning radius); determine necessary action.
4. Check SAI (steering axis inclination) and included angle; determine necessary action.
5. Check rear wheel thrust angle; determine necessary action.

6. Check for front wheel setback; determine necessary action.

### **Wheels and Tires Diagnosis and Repair**

1. Inspect tire condition; identify tire wear patterns; check for correct tire size and application (load and speed ratings) and adjust air pressure; determine necessary action.
2. Diagnose wheel/tire vibration, shimmy, and noise; determine necessary action.
3. Rotate tires according to manufacturer's recommendations.
4. Dismount, inspect, and remount tire on wheel; balance wheel and tire assembly (static and dynamic).
5. Dismount, inspect, and remount tire on wheel equipped with tire pressure monitoring system sensor.
6. Inspect tire and wheel assembly for air loss; perform necessary action.
7. Repair tire using internal patch.
8. Identify and test tire pressure monitoring system (indirect and direct) for operation; calibrate system; verify operation of instrument panel lamps.
9. Demonstrate knowledge of steps required to remove and replace sensors in a tire pressure monitoring system.



### UNOH Learning Outcomes AU-127

Learning outcomes do not apply to NATEF AST or Master accredited schools.

Students are required to meet the following learning outcomes to receive articulation credit for AU-127, Hydraulic Brake Systems at the University of Northwestern Ohio.

#### **General: Brake Systems Diagnosis**

1. Research applicable vehicle and service information, vehicle service history, service precautions, and technical service bulletins.
2. Describe procedure for performing a road test to check brake system operation; including an anti-lock brake system (ABS).
3. Install wheel and torque lug nuts.

#### **Hydraulic System Diagnosis and Repair**

1. Diagnose pressure concerns in the brake system using hydraulic principles (Pascal's Law).
2. Measure brake pedal height, travel, and free play (as applicable); determine necessary action.
3. Check master cylinder for internal/external leaks and proper operation; determine necessary action.
4. Remove, bench bleed, and reinstall master cylinder.
5. Inspect brake lines, flexible hoses, and fittings for leaks, dents, kinks, rust, cracks, bulging, and wear; check for loose fittings and supports; determine necessary action.
6. Fabricate brake lines using proper material and flaring procedures (double flare and ISO types).
7. Select, handle, store, and fill brake fluids to proper level.
8. Identify components of brake warning light system.
9. Bleed and/or flush brake system.
10. Test brake fluid for contamination.

### **Drum Brake Diagnosis and Repair**

1. Remove, clean, inspect, and measure brake drum diameter; determine necessary action.
2. Refinish brake drum and measure final drum diameter; compare with specifications.
3. Remove, clean, and inspect brake shoes, springs, pins, clips, levers, adjusters/self-adjusters, other related brake hardware, and backing support plates; lubricate and reassemble.
4. Inspect wheel cylinders for leaks and proper operation; remove and replace as needed.
5. Pre-adjust brake shoes and parking brake; install brake drums or drum/hub assemblies and wheel bearings; perform final checks and adjustments.

### **Disc Brake Diagnosis and Repair**

1. Diagnose poor stopping, noise, vibration, pulling, grabbing, dragging, or pulsation concerns; determine necessary action.
2. Remove and clean caliper assembly; inspect for leaks and damage/wear to caliper housing; determine necessary action.
3. Clean and inspect caliper mounting and slides/pins for proper operation, wear, and damage; determine necessary action.
4. Remove, inspect, and replace pads and retaining hardware; determine necessary action.
5. Lubricate and reinstall caliper, pads, and related hardware; seat pads and inspect for leaks.
6. Clean and inspect rotor; measure rotor thickness, thickness variation, and lateral run out; determine necessary action.
7. Remove and reinstall rotor.
8. Refinish rotor on vehicle; measure final rotor thickness and compare with specifications.
9. Refinish rotor off vehicle; measure final rotor thickness and compare with specifications.
10. Retract and re-adjust caliper piston on an integrated parking brake system.
11. Check brake pad wear indicator; determine necessary action.
12. Describe importance of operating vehicle to burnish/break-in replacement brake pads according to manufacturer's recommendations.

**Power-Assist Units Diagnosis and Repair**

1. Check brake pedal travel with, and without, engine running to verify proper power booster operation.
2. Check vacuum supply (manifold or auxiliary pump) to vacuum-type power booster.
3. Inspect vacuum-type power booster unit for leaks; inspect the check-valve for proper operation; determine necessary action.

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

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

**Electronic Brake, Traction and Stability Control Systems Diagnosis and Repair**

1. Identify and inspect electronic brake control system components; determine necessary action.
2. Diagnose poor stopping, wheel lock-up, abnormal pedal feel, unwanted application, and noise concerns associated with the electronic brake control system; determine necessary action.
3. Diagnose electronic brake control system electronic control(s) and components by retrieving diagnostic trouble codes, and/or using recommended test equipment; determine necessary action.
4. Bleed the electronic brake control system hydraulic circuits.
5. Test, diagnose, and service electronic brake control system speed sensors (digital and analog), toothed ring (tone wheel), and circuits using a graphing multimeter (GMM)/digital storage oscilloscope (DSO) (includes output signal, resistance, shorts to voltage/ground, and frequency data).
6. Diagnose electronic brake control system braking concerns caused by vehicle modifications (tire size, curb height, final drive ratio, etc.).



## Articulation Agreement

between

College of Applied Technologies

and

**Institution:** \_\_\_\_\_ Heritage HS \_\_\_\_\_

**Address:** \_\_\_\_\_ 2351 Malabar Rd NW \_\_\_\_\_

\_\_\_\_\_ Palm Bay FL 32907 \_\_\_\_\_

**Phone:** \_\_\_\_\_ 321-722-4178 \_\_\_\_\_

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## **COURSES AND CREDITS FOR ADVANCED PLACEMENT**

### **AU126 Suspension and Steering (6 credits)**

- Student must have 2 years of high school in an automotive or diesel training program, with a grade of "B" or higher each year, and the school must have NATEF, AST or higher accreditation.
- Schools with NATEF, MLR level of accreditation or schools that are not NATEF accredited, will have the opportunity to articulate with UNOH if the attached list of learning outcomes for AU 126, Steering and Suspension are met.

### **AU127 Hydraulic Brake Systems (6 credits)**

- Student must have 2 years of high school in an automotive or diesel training program, with a grade of "B" or higher each year, and the school must have NATEF, AST or higher accreditation.
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## **CATALOG DESCRIPTIONS OF COURSES LISTED**

### **AU126 SUSPENSION AND STEERING**

The fundamentals of the chassis, including basic and power steering systems, variable effort power steering systems, suspension systems both basic and computer controlled, geometric centerline alignment, thrust line alignment and total four-wheel alignment provide the focus of this course. Proper procedures in diagnosis of components along with basic frame and body measuring for correct locations are covered. Also covered is the diagnosis of vehicle vibrations and tire pressure monitor systems. Lab work includes steering and suspension repair, tire balancing and alignment on computerized alignment equipment, and computerized wheel balancing, utilizing training aids and live vehicles.

### **AU127 HYDRAULIC BRAKE SYSTEMS**

The fundamental principles of hydraulics pertaining to the automotive and medium duty truck brake systems are presented. Students will study the theory of operation and advanced study of component principles. Students will use standard skills to diagnose and repair hydraulic systems, drum and disc brake systems, power assist units and anti-lock brake systems. Lab work includes demonstration, on-car practice to provide a working knowledge of diagnosis and repair of the hydraulic systems, drum and disc brake systems, power assist units and associated systems. Included will be coverage of wheel bearings, parking brakes, related electrical circuits and use of on-car brake lathes.

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**NATEF Maintenance & Light Repair and non-NATEF programs, initial the learning outcomes your program meets:**

**Automotive:**

AU126 Suspension & Steering       AU127 Hydraulic Brake Systems

**Diesel:**

AU126 Suspension & Steering       AU127 Hydraulic Brake Systems

We, the undersigned representatives of the cooperating university and high school/career centers, agree that a student completing career and technical education training in select automotive or diesel technology may be eligible for advanced placement credit. Guidelines for acceptance of the credit are covered in this document.

\_\_\_\_\_  
**University of Northwestern Ohio**  
**Institution**

\_\_\_\_\_  
 Heritage HS  
**Institution**

\_\_\_\_\_  
**Vice President for Academic**  
**Affairs Provost**

\_\_\_\_\_  
 Janice Scholz  
**Superintendent/Director**

\_\_\_\_\_  
**Date**

\_\_\_\_\_  
 11/7/18  
**Date**

**Return agreement to:**

The University of Northwestern Ohio  
 Attention: Admissions  
 Shawna Roob, Educational Relations Representative  
 1441 N. Cable Rd., Lima, OH 45805

*University of Northwestern Ohio, 1441 N. Cable Rd., Lima, OH 45805  
 Office Phone: 419-998-8889 Fax: 419-998-3139*

## UNOH Learning Outcomes AU-126

Learning outcomes do not apply to NATEF AST or Master accredited schools.

Students are required to meet the following learning outcomes to receive articulation credit for AU-126, Steering and Suspension at the University of Northwestern Ohio.

### **General: Suspension and Steering Systems**

1. Research applicable vehicle and service information, vehicle service history, service precautions, and technical service bulletins.
2. Identify and interpret suspension and steering system concerns; determine necessary action.

### **Steering Systems Diagnosis and Repair**

1. Disable and enable supplemental restraint system (SRS).
2. Inspect rack and pinion steering gear inner tie rod ends (sockets) and bellows boots; replace as needed.
3. Determine proper power steering fluid type; inspect fluid level and condition.
4. Flush, fill, and bleed power steering system.
5. Inspect for power steering fluid leakage; determine necessary action.
6. Remove, inspect, replace, and adjust power steering pump drive belt.
7. Inspect and replace power steering hoses and fittings.
8. Inspect and replace pitman arm, relay (center link/intermediate) rod, idler arm and mountings, and steering linkage damper.
9. Inspect, replace, and adjust tie rod ends (sockets), tie rod sleeves, and clamps.
10. Identify hybrid vehicle power steering system electrical circuits and safety precautions.
11. Inspect electric power-assisted steering.

### **Suspension Systems Diagnosis and Repair**

1. Diagnose short and long arm suspension system noises, body sway, and uneven ride height concerns; determine necessary action.
2. Diagnose strut suspension system noises, body sway, and uneven ride height concerns; determine necessary action.
3. Inspect, remove and install upper and lower control arms, bushings, shafts, and rebound bumpers.
4. Inspect, remove and install strut rods and bushings.
5. Inspect, remove and install upper and/or lower ball joints (with or without wear indicators).
6. Inspect, remove and install torsion bars and mounts
7. Inspect, remove and install front stabilizer bar (sway bar) bushings, brackets, and links.
8. Inspect, remove and install strut cartridge or assembly, strut coil spring, insulators (silencers), and upper strut bearing mount.
9. Inspect, remove and install track bar, strut rods/radius arms, and related mounts and bushings.
10. Inspect rear suspension system leaf spring(s), bushings, center pins/bolts, and mounts.

### **Related Suspension and Steering Service**

1. Inspect, remove, and replace shock absorbers; inspect mounts and bushings.
2. Describe the function of the power steering pressure switch.

### **Wheel Alignment Diagnosis, Adjustment, and Repair**

1. Perform pre-alignment inspection and measure vehicle ride height; perform necessary action.
2. Prepare vehicle for wheel alignment on alignment machine; perform four-wheel alignment by checking and adjusting front and rear wheel caster, camber and toe as required; center steering wheel.
3. Check toe-out-on-turns (turning radius); determine necessary action.
4. Check SAI (steering axis inclination) and included angle; determine necessary action.
5. Check rear wheel thrust angle; determine necessary action.



6. Check for front wheel setback; determine necessary action.

### **Wheels and Tires Diagnosis and Repair**

1. Inspect tire condition; identify tire wear patterns; check for correct tire size and application (load and speed ratings) and adjust air pressure; determine necessary action.
2. Diagnose wheel/tire vibration, shimmy, and noise; determine necessary action.
3. Rotate tires according to manufacturer's recommendations.
4. Dismount, inspect, and remount tire on wheel; balance wheel and tire assembly (static and dynamic).
5. Dismount, inspect, and remount tire on wheel equipped with tire pressure monitoring system sensor.
6. Inspect tire and wheel assembly for air loss; perform necessary action.
7. Repair tire using internal patch.
8. Identify and test tire pressure monitoring system (indirect and direct) for operation; calibrate system; verify operation of instrument panel lamps.
9. Demonstrate knowledge of steps required to remove and replace sensors in a tire pressure monitoring system.

### UNOH Learning Outcomes AU-127

Learning outcomes do not apply to NATEF AST or Master accredited schools.

Students are required to meet the following learning outcomes to receive articulation credit for AU-127, Hydraulic Brake Systems at the University of Northwestern Ohio.

#### **General: Brake Systems Diagnosis**

1. Research applicable vehicle and service information, vehicle service history, service precautions, and technical service bulletins.
2. Describe procedure for performing a road test to check brake system operation; including an anti-lock brake system (ABS).
3. Install wheel and torque lug nuts.

#### **Hydraulic System Diagnosis and Repair**

1. Diagnose pressure concerns in the brake system using hydraulic principles (Pascal's Law).
2. Measure brake pedal height, travel, and free play (as applicable); determine necessary action.
3. Check master cylinder for internal/external leaks and proper operation; determine necessary action.
4. Remove, bench bleed, and reinstall master cylinder.
5. Inspect brake lines, flexible hoses, and fittings for leaks, dents, kinks, rust, cracks, bulging, and wear; check for loose fittings and supports; determine necessary action.
6. Fabricate brake lines using proper material and flaring procedures (double flare and ISO types).
7. Select, handle, store, and fill brake fluids to proper level.
8. Identify components of brake warning light system.
9. Bleed and/or flush brake system.
10. Test brake fluid for contamination.

### **Drum Brake Diagnosis and Repair**

1. Remove, clean, inspect, and measure brake drum diameter; determine necessary action.
2. Refinish brake drum and measure final drum diameter; compare with specifications.
3. Remove, clean, and inspect brake shoes, springs, pins, clips, levers, adjusters/self-adjusters, other related brake hardware, and backing support plates; lubricate and reassemble.
4. Inspect wheel cylinders for leaks and proper operation; remove and replace as needed.
5. Pre-adjust brake shoes and parking brake; install brake drums or drum/hub assemblies and wheel bearings; perform final checks and adjustments.

### **Disc Brake Diagnosis and Repair**

1. Diagnose poor stopping, noise, vibration, pulling, grabbing, dragging, or pulsation concerns; determine necessary action.
2. Remove and clean caliper assembly; inspect for leaks and damage/wear to caliper housing; determine necessary action.
3. Clean and inspect caliper mounting and slides/pins for proper operation, wear, and damage; determine necessary action.
4. Remove, inspect, and replace pads and retaining hardware; determine necessary action.
5. Lubricate and reinstall caliper, pads, and related hardware; seat pads and inspect for leaks.
6. Clean and inspect rotor; measure rotor thickness, thickness variation, and lateral run out; determine necessary action.
7. Remove and reinstall rotor.
8. Refinish rotor on vehicle; measure final rotor thickness and compare with specifications.
9. Refinish rotor off vehicle; measure final rotor thickness and compare with specifications.
10. Retract and re-adjust caliper piston on an integrated parking brake system.
11. Check brake pad wear indicator; determine necessary action.
12. Describe importance of operating vehicle to burnish/break-in replacement brake pads according to manufacturer's recommendations.

### **Power-Assist Units Diagnosis and Repair**

1. Check brake pedal travel with, and without, engine running to verify proper power booster operation.
2. Check vacuum supply (manifold or auxiliary pump) to vacuum-type power booster.
3. Inspect vacuum-type power booster unit for leaks; inspect the check-valve for proper operation; determine necessary action.

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

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

### **Electronic Brake, Traction and Stability Control Systems Diagnosis and Repair**

1. Identify and inspect electronic brake control system components; determine necessary action.
2. Diagnose poor stopping, wheel lock-up, abnormal pedal feel, unwanted application, and noise concerns associated with the electronic brake control system; determine necessary action.
3. Diagnose electronic brake control system electronic control(s) and components by retrieving diagnostic trouble codes, and/or using recommended test equipment; determine necessary action.
4. Bleed the electronic brake control system hydraulic circuits.
5. Test, diagnose, and service electronic brake control system speed sensors (digital and analog), toothed ring (tone wheel), and circuits using a graphing multimeter (GMM)/digital storage oscilloscope (DSO) (includes output signal, resistance, shorts to voltage/ground, and frequency data).
6. Diagnose electronic brake control system braking concerns caused by vehicle modifications (tire size, curb height, final drive ratio, etc.).



## Articulation Agreement

between

College of Applied Technologies

and

Institution: \_\_\_\_\_ Merritt Island HS \_\_\_\_\_

Address: \_\_\_\_\_ 100 East Mustang Way \_\_\_\_\_

\_\_\_\_\_ Merritt Island, FL 32953 \_\_\_\_\_

Phone: \_\_\_\_\_ 321-454-1000 \_\_\_\_\_

The University of Northwestern Ohio believes that many high schools and career centers have extensive course work in technical areas that give students a solid foundation for college study. Students who have these technical skills may be granted college credit for their proficiencies.

A partnership agreement between the university and the high schools and career centers is appropriate to recognize and reward those graduates who have acquired the skills for proficiency credit in specific introductory classes. The university will grant advanced placement to high school graduates who fulfill course requirements agreed to in this document.

The advantages to advanced placement:

- There will be no expense to the student
- It will reduce the total tuition expense, book fees, and housing costs for your college program
- It will reduce the time necessary for completion of the program.

The decision on advanced placement will be determined by the following University of Northwestern Ohio authorized personnel: Provost / Vice President for Academic Affairs and the College Registrar.

The total number of credits to be awarded to a student may vary and will be decided on an individual basis. Awarded credit will be reflected on the students' transcript after completion of the first term.

**To take advantage of this agreement, the student should:**

- Contact the Admission Office at the University of Northwestern Ohio for a formal admissions application to the university (419)998-3120.
- Pick up the Articulation Application from myself or your high school counselor. You can also call the University to have the application form mailed or e-mailed to you at (419) 998-8889.
- The form should be taken to the high school where it should be completed and approved by the student's instructor and administrator. The student will also be required to sign the form stating the he or she has had the necessary training and has met the attached learning outcomes.

- After it is approved by the student's instructor and counselor, and signed by the student, the school's chief administrator should sign the form and mail it to the Shawwna Roob at the University of Northwestern Ohio, along with documentation of NATEF accreditation found on the web at [natef.org](http://natef.org).

After the materials are reviewed by University personnel, the student will be notified if advanced credit has been awarded. Awarded credit will be reflected on the students' transcript after completion of the first term.

## **COURSES AND CREDITS FOR ADVANCED PLACEMENT**

### **AU126 Suspension and Steering (6 credits)**

- Student must have 2 years of high school in an automotive or diesel training program, with a grade of "B" or higher each year, and the school must have NATEF, AST or higher accreditation.
- Schools with NATEF, MLR level of accreditation or schools that are not NATEF accredited, will have the opportunity to articulate with UNOH if the attached list of learning outcomes for AU 126, Steering and Suspension are met.

### **AU127 Hydraulic Brake Systems (6 credits)**

- Student must have 2 years of high school in an automotive or diesel training program, with a grade of "B" or higher each year, and the school must have NATEF, AST or higher accreditation.
- Schools with NATEF, MLR level of accreditation or schools that are not NATEF accredited, will have the opportunity to articulate with UNOH if the attached lists of learning outcomes for AU 127, Hydraulic Brake Systems are met.

## **CATALOG DESCRIPTIONS OF COURSES LISTED**

### **AU126 SUSPENSION AND STEERING**

The fundamentals of the chassis, including basic and power steering systems, variable effort power steering systems, suspension systems both basic and computer controlled, geometric centerline alignment, thrust line alignment and total four-wheel alignment provide the focus of this course. Proper procedures in diagnosis of components along with basic frame and body measuring for correct locations are covered. Also covered is the diagnosis of vehicle vibrations and tire pressure monitor systems. Lab work includes steering and suspension repair, tire balancing and alignment on computerized alignment equipment, and computerized wheel balancing, utilizing training aids and live vehicles.

### **AU127 HYDRAULIC BRAKE SYSTEMS**

The fundamental principles of hydraulics pertaining to the automotive and medium duty truck brake systems are presented. Students will study the theory of operation and advanced study of component principles. Students will use standard skills to diagnose and repair hydraulic systems, drum and disc brake systems, power assist units and anti-lock brake systems. Lab work includes demonstration, on-car practice to provide a working knowledge of diagnosis and repair of the hydraulic systems, drum and disc brake systems, power assist units and associated systems. Included will be coverage of wheel bearings, parking brakes, related electrical circuits and use of on-car brake lathes.

- \* NATEF, AST or higher accredited programs must attach a copy of their accreditation to process this agreement. NATEF Maintenance & Light Repair and non-NATEF programs see the next page.
- \* All Articulation Agreements will be revaluated every five years, to assure all students are getting, and have the necessary information to have credit granted to them.
- \* All schools desiring to articulate classes with the University of Northwestern Ohio must be NATEF, AST or higher accredited, or meet the learning outcomes @ for each class that articulation is desired. If your institution's accreditation has temporarily lapsed due to NATEF's inability to evaluate in a timely fashion, please attach documentation that an evaluation will be conducted.
- \* If an educational deficiency pattern is detected with a specific high school or career center, said school will have the opportunity to work with UNOH to remedy the concern.

@ [www.unoh.edu/files/admissions/articulation/cot-articulation-agreement.pdf](http://www.unoh.edu/files/admissions/articulation/cot-articulation-agreement.pdf)

**NATEF Maintenance & Light Repair and non-NATEF programs, initial the learning outcomes your program meets:**

**Automotive:**

AU126 Suspension & Steering       AU127 Hydraulic Brake Systems

**Diesel:**

AU126 Suspension & Steering       AU127 Hydraulic Brake Systems

We, the undersigned representatives of the cooperating university and high school/career centers, agree that a student completing career and technical education training in select automotive or diesel technology may be eligible for advanced placement credit. Guidelines for acceptance of the credit are covered in this document.

\_\_\_\_\_  
**University of Northwestern Ohio**  
**Institution**

\_\_\_\_\_  
**Merritt Island HS**  
**Institution**

\_\_\_\_\_  
**Vice President for Academic**  
**Affairs Provost**

\_\_\_\_\_  
**Janice Scholz**  
**Superintendent/Director**

\_\_\_\_\_  
**Date**

\_\_\_\_\_  
**11/7/18**  
**Date**

**Return agreement to:**

The University of Northwestern Ohio  
 Attention: Admissions  
 Shawna Roob, Educational Relations Representative  
 1441 N. Cable Rd., Lima, OH 45805

*University of Northwestern Ohio, 1441 N. Cable Rd., Lima, OH 45805  
 Office Phone: 419-998-8889 Fax: 419-998-3139*

## UNOH Learning Outcomes AU-126

Learning outcomes do not apply to NATEF AST or Master accredited schools.

Students are required to meet the following learning outcomes to receive articulation credit for AU-126, Steering and Suspension at the University of Northwestern Ohio.

### **General: Suspension and Steering Systems**

1. Research applicable vehicle and service information, vehicle service history, service precautions, and technical service bulletins.
2. Identify and interpret suspension and steering system concerns; determine necessary action.

### **Steering Systems Diagnosis and Repair**

1. Disable and enable supplemental restraint system (SRS).
2. Inspect rack and pinion steering gear inner tie rod ends (sockets) and bellows boots; replace as needed.
3. Determine proper power steering fluid type; inspect fluid level and condition.
4. Flush, fill, and bleed power steering system.
5. Inspect for power steering fluid leakage; determine necessary action.
6. Remove, inspect, replace, and adjust power steering pump drive belt.
7. Inspect and replace power steering hoses and fittings.
8. Inspect and replace pitman arm, relay (center link/intermediate) rod, idler arm and mountings, and steering linkage damper.
9. Inspect, replace, and adjust tie rod ends (sockets), tie rod sleeves, and clamps.
10. Identify hybrid vehicle power steering system electrical circuits and safety precautions.
11. Inspect electric power-assisted steering.



### **Suspension Systems Diagnosis and Repair**

1. Diagnose short and long arm suspension system noises, body sway, and uneven ride height concerns; determine necessary action.
2. Diagnose strut suspension system noises, body sway, and uneven ride height concerns; determine necessary action.
3. Inspect, remove and install upper and lower control arms, bushings, shafts, and rebound bumpers.
4. Inspect, remove and install strut rods and bushings.
5. Inspect, remove and install upper and/or lower ball joints (with or without wear indicators).
6. Inspect, remove and install torsion bars and mounts
7. Inspect, remove and install front stabilizer bar (sway bar) bushings, brackets, and links.
8. Inspect, remove and install strut cartridge or assembly, strut coil spring, insulators (silencers), and upper strut bearing mount.
9. Inspect, remove and install track bar, strut rods/radius arms, and related mounts and bushings.
10. Inspect rear suspension system leaf spring(s), bushings, center pins/bolts, and mounts.

### **Related Suspension and Steering Service**

1. Inspect, remove, and replace shock absorbers; inspect mounts and bushings.
2. Describe the function of the power steering pressure switch.

### **Wheel Alignment Diagnosis, Adjustment, and Repair**

1. Perform pre-alignment inspection and measure vehicle ride height; perform necessary action.
2. Prepare vehicle for wheel alignment on alignment machine; perform four-wheel alignment by checking and adjusting front and rear wheel caster, camber and toe as required; center steering wheel.
3. Check toe-out-on-turns (turning radius); determine necessary action.
4. Check SAI (steering axis inclination) and included angle; determine necessary action.
5. Check rear wheel thrust angle; determine necessary action.

6. Check for front wheel setback; determine necessary action.

### **Wheels and Tires Diagnosis and Repair**

1. Inspect tire condition; identify tire wear patterns; check for correct tire size and application (load and speed ratings) and adjust air pressure; determine necessary action.
2. Diagnose wheel/tire vibration, shimmy, and noise; determine necessary action.
3. Rotate tires according to manufacturer's recommendations.
4. Dismount, inspect, and remount tire on wheel; balance wheel and tire assembly (static and dynamic).
5. Dismount, inspect, and remount tire on wheel equipped with tire pressure monitoring system sensor.
6. Inspect tire and wheel assembly for air loss; perform necessary action.
7. Repair tire using internal patch.
8. Identify and test tire pressure monitoring system (indirect and direct) for operation; calibrate system; verify operation of instrument panel lamps.
9. Demonstrate knowledge of steps required to remove and replace sensors in a tire pressure monitoring system.

**UNOH Learning Outcomes AU-127**

**Learning outcomes do not apply to NATEF AST or Master accredited schools.**

**Students are required to meet the following learning outcomes to receive articulation credit for AU-127, Hydraulic Brake Systems at the University of Northwestern Ohio.**

**General: Brake Systems Diagnosis**

1. Research applicable vehicle and service information, vehicle service history, service precautions, and technical service bulletins.
2. Describe procedure for performing a road test to check brake system operation; including an anti-lock brake system (ABS).
3. Install wheel and torque lug nuts.

**Hydraulic System Diagnosis and Repair**

1. Diagnose pressure concerns in the brake system using hydraulic principles (Pascal's Law).
2. Measure brake pedal height, travel, and free play (as applicable); determine necessary action.
3. Check master cylinder for internal/external leaks and proper operation; determine necessary action.
4. Remove, bench bleed, and reinstall master cylinder.
5. Inspect brake lines, flexible hoses, and fittings for leaks, dents, kinks, rust, cracks, bulging, and wear; check for loose fittings and supports; determine necessary action.
6. Fabricate brake lines using proper material and flaring procedures (double flare and ISO types).
7. Select, handle, store, and fill brake fluids to proper level.
8. Identify components of brake warning light system.
9. Bleed and/or flush brake system.
10. Test brake fluid for contamination.

### **Drum Brake Diagnosis and Repair**

1. Remove, clean, inspect, and measure brake drum diameter; determine necessary action.
2. Refinish brake drum and measure final drum diameter; compare with specifications.
3. Remove, clean, and inspect brake shoes, springs, pins, clips, levers, adjusters/self-adjusters, other related brake hardware, and backing support plates; lubricate and reassemble.
4. Inspect wheel cylinders for leaks and proper operation; remove and replace as needed.
5. Pre-adjust brake shoes and parking brake; install brake drums or drum/hub assemblies and wheel bearings; perform final checks and adjustments.

### **Disc Brake Diagnosis and Repair**

1. Diagnose poor stopping, noise, vibration, pulling, grabbing, dragging, or pulsation concerns; determine necessary action.
2. Remove and clean caliper assembly; inspect for leaks and damage/wear to caliper housing; determine necessary action.
3. Clean and inspect caliper mounting and slides/pins for proper operation, wear, and damage; determine necessary action.
4. Remove, inspect, and replace pads and retaining hardware; determine necessary action.
5. Lubricate and reinstall caliper, pads, and related hardware; seat pads and inspect for leaks.
6. Clean and inspect rotor; measure rotor thickness, thickness variation, and lateral run out; determine necessary action.
7. Remove and reinstall rotor.
8. Refinish rotor on vehicle; measure final rotor thickness and compare with specifications.
9. Refinish rotor off vehicle; measure final rotor thickness and compare with specifications.
10. Retract and re-adjust caliper piston on an integrated parking brake system.
11. Check brake pad wear indicator; determine necessary action.
12. Describe importance of operating vehicle to burnish/break-in replacement brake pads according to manufacturer's recommendations.

**Power-Assist Units Diagnosis and Repair**

1. Check brake pedal travel with, and without, engine running to verify proper power booster operation.
2. Check vacuum supply (manifold or auxiliary pump) to vacuum-type power booster.
3. Inspect vacuum-type power booster unit for leaks; inspect the check-valve for proper operation; determine necessary action.

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

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

**Electronic Brake, Traction and Stability Control Systems Diagnosis and Repair**

1. Identify and inspect electronic brake control system components; determine necessary action.
2. Diagnose poor stopping, wheel lock-up, abnormal pedal feel, unwanted application, and noise concerns associated with the electronic brake control system; determine necessary action.
3. Diagnose electronic brake control system electronic control(s) and components by retrieving diagnostic trouble codes, and/or using recommended test equipment; determine necessary action.
4. Bleed the electronic brake control system hydraulic circuits.
5. Test, diagnose, and service electronic brake control system speed sensors (digital and analog), toothed ring (tone wheel), and circuits using a graphing multimeter (GMM)/digital storage oscilloscope (DSO) (includes output signal, resistance, shorts to voltage/ground, and frequency data).
6. Diagnose electronic brake control system braking concerns caused by vehicle modifications (tire size, curb height, final drive ratio, etc.).



## Articulation Agreement

between

College of Applied Technologies

and

**Institution:** \_\_\_\_\_ Eau Gallie HS \_\_\_\_\_

**Address:** \_\_\_\_\_ 1400 Commodore BLVD \_\_\_\_\_

\_\_\_\_\_ Melbourne FL 32935 \_\_\_\_\_

**Phone:** \_\_\_\_\_ 321-242-6400 \_\_\_\_\_

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## **COURSES AND CREDITS FOR ADVANCED PLACEMENT**

### **AU126 Suspension and Steering (6 credits)**

- Student must have 2 years of high school in an automotive or diesel training program, with a grade of "B" or higher each year, and the school must have NATEF, AST or higher accreditation.
- Schools with NATEF, MLR level of accreditation or schools that are not NATEF accredited, will have the opportunity to articulate with UNOH if the attached list of learning outcomes for AU 126, Steering and Suspension are met.

### **AU127 Hydraulic Brake Systems (6 credits)**

- Student must have 2 years of high school in an automotive or diesel training program, with a grade of "B" or higher each year, and the school must have NATEF, AST or higher accreditation.
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## **CATALOG DESCRIPTIONS OF COURSES LISTED**

### **AU126 SUSPENSION AND STEERING**

The fundamentals of the chassis, including basic and power steering systems, variable effort power steering systems, suspension systems both basic and computer controlled, geometric centerline alignment, thrust line alignment and total four-wheel alignment provide the focus of this course. Proper procedures in diagnosis of components along with basic frame and body measuring for correct locations are covered. Also covered is the diagnosis of vehicle vibrations and tire pressure monitor systems. Lab work includes steering and suspension repair, tire balancing and alignment on computerized alignment equipment, and computerized wheel balancing, utilizing training aids and live vehicles.

### **AU127 HYDRAULIC BRAKE SYSTEMS**

The fundamental principles of hydraulics pertaining to the automotive and medium duty truck brake systems are presented. Students will study the theory of operation and advanced study of component principles. Students will use standard skills to diagnose and repair hydraulic systems, drum and disc brake systems, power assist units and anti-lock brake systems. Lab work includes demonstration, on-car practice to provide a working knowledge of diagnosis and repair of the hydraulic systems, drum and disc brake systems, power assist units and associated systems. Included will be coverage of wheel bearings, parking brakes, related electrical circuits and use of on-car brake lathes.

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**NATEF Maintenance & Light Repair and non-NATEF programs, initial the learning outcomes your program meets:**

**Automotive:**

AU126 Suspension & Steering       AU127 Hydraulic Brake Systems

**Diesel:**

AU126 Suspension & Steering       AU127 Hydraulic Brake Systems

We, the undersigned representatives of the cooperating university and high school/career centers, agree that a student completing career and technical education training in select automotive or diesel technology may be eligible for advanced placement credit. Guidelines for acceptance of the credit are covered in this document.

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**University of Northwestern Ohio**  
**Institution**

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 Eau Gallie HS  
**Institution**

\_\_\_\_\_  
**Vice President for Academic**  
**Affairs Provost**

\_\_\_\_\_  
 Janice Scholz  
**Superintendent/Director**

\_\_\_\_\_  
**Date**

\_\_\_\_\_  
 11/7/18  
**Date**

**Return agreement to:**

The University of Northwestern Ohio  
 Attention: Admissions  
 Shawna Roob, Educational Relations Representative  
 1441 N. Cable Rd., Lima, OH 45805

*University of Northwestern Ohio, 1441 N. Cable Rd., Lima, OH 45805  
 Office Phone: 419-998-8889 Fax: 419-998-3139*



## UNOH Learning Outcomes AU-126

Learning outcomes do not apply to NATEF AST or Master accredited schools.

Students are required to meet the following learning outcomes to receive articulation credit for AU-126, Steering and Suspension at the University of Northwestern Ohio.

### **General: Suspension and Steering Systems**

1. Research applicable vehicle and service information, vehicle service history, service precautions, and technical service bulletins.
2. Identify and interpret suspension and steering system concerns; determine necessary action.

### **Steering Systems Diagnosis and Repair**

1. Disable and enable supplemental restraint system (SRS).
2. Inspect rack and pinion steering gear inner tie rod ends (sockets) and bellows boots; replace as needed.
3. Determine proper power steering fluid type; inspect fluid level and condition.
4. Flush, fill, and bleed power steering system.
5. Inspect for power steering fluid leakage; determine necessary action.
6. Remove, inspect, replace, and adjust power steering pump drive belt.
7. Inspect and replace power steering hoses and fittings.
8. Inspect and replace pitman arm, relay (center link/intermediate) rod, idler arm and mountings, and steering linkage damper.
9. Inspect, replace, and adjust tie rod ends (sockets), tie rod sleeves, and clamps.
10. Identify hybrid vehicle power steering system electrical circuits and safety precautions.
11. Inspect electric power-assisted steering.

### **Suspension Systems Diagnosis and Repair**

1. Diagnose short and long arm suspension system noises, body sway, and uneven ride height concerns; determine necessary action.
2. Diagnose strut suspension system noises, body sway, and uneven ride height concerns; determine necessary action.
3. Inspect, remove and install upper and lower control arms, bushings, shafts, and rebound bumpers.
4. Inspect, remove and install strut rods and bushings.
5. Inspect, remove and install upper and/or lower ball joints (with or without wear indicators).
6. Inspect, remove and install torsion bars and mounts
7. Inspect, remove and install front stabilizer bar (sway bar) bushings, brackets, and links.
8. Inspect, remove and install strut cartridge or assembly, strut coil spring, insulators (silencers), and upper strut bearing mount.
9. Inspect, remove and install track bar, strut rods/radius arms, and related mounts and bushings.
10. Inspect rear suspension system leaf spring(s), bushings, center pins/bolts, and mounts.

### **Related Suspension and Steering Service**

1. Inspect, remove, and replace shock absorbers; inspect mounts and bushings.
2. Describe the function of the power steering pressure switch.

### **Wheel Alignment Diagnosis, Adjustment, and Repair**

1. Perform pre-alignment inspection and measure vehicle ride height; perform necessary action.
2. Prepare vehicle for wheel alignment on alignment machine; perform four-wheel alignment by checking and adjusting front and rear wheel caster, camber and toe as required; center steering wheel.
3. Check toe-out-on-turns (turning radius); determine necessary action.
4. Check SAI (steering axis inclination) and included angle; determine necessary action.
5. Check rear wheel thrust angle; determine necessary action.

6. Check for front wheel setback; determine necessary action.

### **Wheels and Tires Diagnosis and Repair**

1. Inspect tire condition; identify tire wear patterns; check for correct tire size and application (load and speed ratings) and adjust air pressure; determine necessary action.
2. Diagnose wheel/tire vibration, shimmy, and noise; determine necessary action.
3. Rotate tires according to manufacturer's recommendations.
4. Dismount, inspect, and remount tire on wheel; balance wheel and tire assembly (static and dynamic).
5. Dismount, inspect, and remount tire on wheel equipped with tire pressure monitoring system sensor.
6. Inspect tire and wheel assembly for air loss; perform necessary action.
7. Repair tire using internal patch.
8. Identify and test tire pressure monitoring system (indirect and direct) for operation; calibrate system; verify operation of instrument panel lamps.
9. Demonstrate knowledge of steps required to remove and replace sensors in a tire pressure monitoring system.

### UNOH Learning Outcomes AU-127

Learning outcomes do not apply to NATEF AST or Master accredited schools.

Students are required to meet the following learning outcomes to receive articulation credit for AU-127, Hydraulic Brake Systems at the University of Northwestern Ohio.

#### **General: Brake Systems Diagnosis**

1. Research applicable vehicle and service information, vehicle service history, service precautions, and technical service bulletins.
2. Describe procedure for performing a road test to check brake system operation; including an anti-lock brake system (ABS).
3. Install wheel and torque lug nuts.

#### **Hydraulic System Diagnosis and Repair**

1. Diagnose pressure concerns in the brake system using hydraulic principles (Pascal's Law).
2. Measure brake pedal height, travel, and free play (as applicable); determine necessary action.
3. Check master cylinder for internal/external leaks and proper operation; determine necessary action.
4. Remove, bench bleed, and reinstall master cylinder.
5. Inspect brake lines, flexible hoses, and fittings for leaks, dents, kinks, rust, cracks, bulging, and wear; check for loose fittings and supports; determine necessary action.
6. Fabricate brake lines using proper material and flaring procedures (double flare and ISO types).
7. Select, handle, store, and fill brake fluids to proper level.
8. Identify components of brake warning light system.
9. Bleed and/or flush brake system.
10. Test brake fluid for contamination.

### **Drum Brake Diagnosis and Repair**

1. Remove, clean, inspect, and measure brake drum diameter; determine necessary action.
2. Refinish brake drum and measure final drum diameter; compare with specifications.
3. Remove, clean, and inspect brake shoes, springs, pins, clips, levers, adjusters/self-adjusters, other related brake hardware, and backing support plates; lubricate and reassemble.
4. Inspect wheel cylinders for leaks and proper operation; remove and replace as needed.
5. Pre-adjust brake shoes and parking brake; install brake drums or drum/hub assemblies and wheel bearings; perform final checks and adjustments.

### **Disc Brake Diagnosis and Repair**

1. Diagnose poor stopping, noise, vibration, pulling, grabbing, dragging, or pulsation concerns; determine necessary action.
2. Remove and clean caliper assembly; inspect for leaks and damage/wear to caliper housing; determine necessary action.
3. Clean and inspect caliper mounting and slides/pins for proper operation, wear, and damage; determine necessary action.
4. Remove, inspect, and replace pads and retaining hardware; determine necessary action.
5. Lubricate and reinstall caliper, pads, and related hardware; seat pads and inspect for leaks.
6. Clean and inspect rotor; measure rotor thickness, thickness variation, and lateral run out; determine necessary action.
7. Remove and reinstall rotor.
8. Refinish rotor on vehicle; measure final rotor thickness and compare with specifications.
9. Refinish rotor off vehicle; measure final rotor thickness and compare with specifications.
10. Retract and re-adjust caliper piston on an integrated parking brake system.
11. Check brake pad wear indicator; determine necessary action.
12. Describe importance of operating vehicle to burnish/break-in replacement brake pads according to manufacturer's recommendations.

**Power-Assist Units Diagnosis and Repair**

1. Check brake pedal travel with, and without, engine running to verify proper power booster operation.
2. Check vacuum supply (manifold or auxiliary pump) to vacuum-type power booster.
3. Inspect vacuum-type power booster unit for leaks; inspect the check-valve for proper operation; determine necessary action.

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

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

**Electronic Brake, Traction and Stability Control Systems Diagnosis and Repair**

1. Identify and inspect electronic brake control system components; determine necessary action.
2. Diagnose poor stopping, wheel lock-up, abnormal pedal feel, unwanted application, and noise concerns associated with the electronic brake control system; determine necessary action.
3. Diagnose electronic brake control system electronic control(s) and components by retrieving diagnostic trouble codes, and/or using recommended test equipment; determine necessary action.
4. Bleed the electronic brake control system hydraulic circuits.
5. Test, diagnose, and service electronic brake control system speed sensors (digital and analog), toothed ring (tone wheel), and circuits using a graphing multimeter (GMM)/digital storage oscilloscope (DSO) (includes output signal, resistance, shorts to voltage/ground, and frequency data).
6. Diagnose electronic brake control system braking concerns caused by vehicle modifications (tire size, curb height, final drive ratio, etc.).