Wayne County Community College District



COURSE SYLLABUS

AUT 209 Manual Drive Train and Axles II

CREDIT HOURS: 2.00

CONTACT HOURS: 45.00

COURSE DESCRIPTION:

This course is a continuation of AUT 126 and is designed to provide students with the necessary skills and understanding to diagnose, disassemble, and reassemble a manual transmission. Onvehicle inspection, diagnosis, and repair are performed by the student.

PREREQUISITIES: AUT 114, AUT 115, AUT 116, AUT 117, AUT 126.

EXPECTED COMPETENCIES:

Upon successful completion of this course, the student will:

Shop Safety

- Identify protective clothing and equipment and their proper use; proper shop behavior; principles of fire safety; and federal regulations concerning hazardous material and shop safety.
 Objective
 - o Describe how to select individual personal protective clothing and equipment.
 - Identify the dangers of improper behavior in the shop.
 - Identify the importance of proper grooming and hygiene.
 - o Identify the classes of fires and the types of fire extinguishers.
 - Identify the use of a fire blanket.
 - o Identify general fire emergency procedures.
 - o Identify the Occupational Safety and Health Administration (OSHA) regulations.
 - o Identify the Environmental Protection Agency (EPA) regulations.
 - Demonstrate the following:
 - A. Identify the safe use of chemicals
 - B. Identify the safe use of hand tools
 - C. Identify the safe use of power tools
 - D. Identify the safe use of protective clothing and equipment
 - E. Identify the safe use of fire protection equipment
 - F. Identify the safe use of shop equipment Follow Environmental Protection G. Agency
 - (EPA) and Occupational Safety and Health Act (OSHA) regulations

Shop Operation

- H. Communicate with customers and write repair orders
- I. Estimate time and cost for a job and order parts
- J. Obtain appropriate repair information from service manuals
- K. Practice clean and orderly work habits (vehicle, tools, and work area)

Components and Careers

- L. Identify basic function and operation of vehicle mechanical components
- M. Identify automotive technology career opportunities and the duties of a technician



Drive Axle Diagnosis and Repair: Ring and Pinion Gears and Differential Case Assembly

- Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction. P-1 Objective
 - o Identify the procedures for identifying the customer's concern.
 - Identify terms and definitions associated with basic principles of automotive transmissions.
 - o Identify the basic principles by which an automotive transmission system functions.
 - Identify terms and definitions associated with basic principles of automotive transmissions.
 - o Identify the basic principles by which an automotive drive train functions.
- Diagnose noise and vibration concerns; determine necessary action P-2 Objective
 - o Wear PPE while performing the procedures on this job sheet.
 - Research applicable vehicle service information such as vehicle service history, VIN, certification labels, and calibration decals.
 - Performance tests the differential assembly.
 - Using service information, locate a procedure to inspect the differential. Include all necessary specifications. Make sure the procedure is appropriate for the make and model of the vehicle.
- Diagnose fluid leakage concerns; determine necessary action P-1 Objective
 - Wear PPE while performing the procedures on this job sheet.
 - Research applicable vehicle service information such as vehicle service history, VIN, certification labels, and calibration decals.
 - Performance tests the differential assembly.
 - Using service information, locate a procedure to inspect the differential. Include all necessary specifications. Make sure the procedure is appropriate for the make and model of the vehicle.
- Inspect and replace companion flange and pinion seal; measure companion flange runout P-2

Objective

- Wear PPE while performing the procedures on this job sheet.
- Research applicable vehicle service information such as vehicle service history, VIN, certification labels, and calibration decals.
- Using service information, locate a procedure for servicing the differential. Include replacing the axle bearing, changing the pinion seal, and replacing the ring and pinion gear set. Include all torque specifications and adjustment specifications. Make sure the procedure is appropriate for the make and model of the vehicle.
- Using service information, locate a procedure for removing the differential. Make sure the procedure is appropriate for the make and model of the vehicle.
- Using service information, locate a procedure for reinstalling the differential. Include the specifications and procedures for fill-in the lubricant. Make sure the procedure is appropriate for the make and model of the vehicle.
- o Rotate drive shaft to confirm that the differential assembly and wheels work freely.
- Performance tests the differential.



Inspect ring gear and measure runout; determine necessary action P-2 Objective

- Wear PPE while performing the procedures on this job sheet.
- Research applicable vehicle service information such as vehicle service history, VIN, certification labels, and calibration decals.
- Using service information, locate a procedure for servicing the differential. Include replacing the axle bearing, changing the pinion seal, and replacing the ring and pinion gear set. Include all torque specifications and adjustment specifications. Make sure the procedure is appropriate for the make and model of the vehicle.
- Using service information, locate a procedure for removing the differential. Make sure the procedure is appropriate for the make and model of the vehicle.
- Using service information, locate a procedure for reinstalling the differential. Include the specifications and procedures for fill-in the lubricant. Make sure the procedure is appropriate for the make and model of the vehicle.
- Rotate drive shaft to confirm that the differential assembly and wheels work freely.
- Performance tests the differential.

Remove, inspect, and reinstall drive pinion and ring gear, spacers, sleeves, and bearings P-2

Objective

- Wear PPE while performing the procedures on this job sheet.
- Research applicable vehicle service information such as vehicle service history, VIN, certification labels, and calibration decals.
- Using service information, locate a procedure for servicing the differential. Include replacing the axle bearing, changing the pinion seal, and replacing the ring and pinion gear set. Include all torque specifications and adjustment specifications. Make sure the procedure is appropriate for the make and model of the vehicle.
- Using service information, locate a procedure for removing the differential. Make sure the procedure is appropriate for the make and model of the vehicle.
- Using service information, locate a procedure for reinstalling the differential. Include the specifications and procedures for fill-in the lubricant. Make sure the procedure is appropriate for the make and model of the vehicle.
- o Rotate drive shaft to confirm that the differential assembly and wheels work freely.
- Performance tests the differential.

Measure and adjust drive pinion depth P-2 *Objective*

- Wear PPE while performing the procedures on this job sheet.
- Research applicable vehicle service information such as vehicle service history, VIN, certification labels, and calibration decals.
- Using service information, locate a procedure for servicing the differential. Include replacing the axle bearing, changing the pinion seal, and replacing the ring and pinion gear set. Include all torque specifications and adjustment specifications. Make sure the procedure is appropriate for the make and model of the vehicle.
- Using service information, locate a procedure for removing the differential. Make sure the procedure is appropriate for the make and model of the vehicle.
- Using service information, locate a procedure for reinstalling the differential. Include the specifications and procedures for fill-in the lubricant. Make sure the procedure is appropriate for the make and model of the vehicle.
- o Rotate drive shaft to confirm that the differential assembly and wheels work freely.
- Performance tests the differential.



• Measure and adjust drive pinion bearing preload P-2 *Objective*

- Wear PPE while performing the procedures on this job sheet.
- Research applicable vehicle service information such as vehicle service history, VIN, certification labels, and calibration decals.
- Using service information, locate a procedure for servicing the differential. Include replacing the axle bearing, changing the pinion seal, and replacing the ring and pinion gear set. Include all torque specifications and adjustment specifications. Make sure the procedure is appropriate for the make and model of the vehicle.
- Using service information, locate a procedure for removing the differential. Make sure the procedure is appropriate for the make and model of the vehicle.
- Using service information, locate a procedure for reinstalling the differential. Include the specifications and procedures for fill-in the lubricant. Make sure the procedure is appropriate for the make and model of the vehicle.
- o Rotate drive shaft to confirm that the differential assembly and wheels work freely.
- Performance test the differential.
- Measure and adjust side bearing preload and ring and pinion gear total backlash and backlash variation on a differential carrier assembly (threaded cup or shim types) P-2 *Objective*
 - Wear PPE while performing the procedures on this job sheet.
 - Research applicable vehicle service information such as vehicle service history, VIN, certification labels, and calibration decals.
 - Using service information, locate a procedure for servicing the differential. Include replacing the axle bearing, changing the pinion seal, and replacing the ring and pinion gear set. Include all torque specifications and adjustment specifications. Make sure the procedure is appropriate for the make and model of the vehicle.
 - Using service information, locate a procedure for removing the differential. Make sure the procedure is appropriate for the make and model of the vehicle.
 - Using service information, locate a procedure for reinstalling the differential. Include the specifications and procedures for fill-in the lubricant. Make sure the procedure is appropriate for the make and model of the vehicle.
 - o Rotate drive shaft to confirm that the differential assembly and wheels work freely.
 - Performance test the differential.

Check ring and pinion tooth contact patterns; perform necessary action P-1 Objective

- Wear PPE while performing the procedures on this job sheet.
- Research applicable vehicle service information such as vehicle service history, VIN, certification labels, and calibration decals.
- Using service information, locate a procedure for servicing the differential. Include replacing the axle bearing, changing the pinion seal, and replacing the ring and pinion gear set. Include all torque specifications and adjustment specifications. Make sure the procedure is appropriate for the make and model of the vehicle.
- Using service information, locate a procedure for removing the differential. Make sure the procedure is appropriate for the make and model of the vehicle.
- Using service information, locate a procedure for reinstalling the differential. Include the specifications and procedures for fill-in the lubricant. Make sure the procedure is appropriate for the make and model of the vehicle.
- o Rotate drive shaft to confirm that the differential assembly and wheels work freely.
- Performance test the differential.



- Disassemble, inspect, measure, and adjust or replace differential pinion gears (spiders), shaft, side gears, side bearings, thrust washers, and case P-2 *Objective*
 - Wear PPE while performing the procedures on this job sheet.
 - Research applicable vehicle service information such as vehicle service history, VIN, certification labels, and calibration decals.
 - Using service information, locate a procedure for servicing the differential. Include replacing the axle bearing, changing the pinion seal, and replacing the ring and pinion gear set. Include all torque specifications and adjustment specifications. Make sure the procedure is appropriate for the make and model of the vehicle.
 - Using service information, locate a procedure for removing the differential. Make sure the procedure is appropriate for the make and model of the vehicle.
 - Using service information, locate a procedure for reinstalling the differential. Include the specifications and procedures for filling the lubricant. Make sure the procedure is appropriate for the make and model of the vehicle.
 - Rotate drive shaft to confirm that the differential assembly and wheels work freely.
 Performance test the differential.
- Reassemble and reinstall differential case assembly; measure run-out; determine necessary action P-2

Objective

- Wear PPE while performing the procedures on this job sheet.
- Research applicable vehicle service information such as vehicle service history, VIN, certification labels, and calibration decals.
- Using service information, locate a procedure for servicing the differential. Include replacing the axle bearing, changing the pinion seal, and replacing the ring and pinion gear set. Include all torque specifications and adjustment specifications. Make sure the procedure is appropriate for the make and model of the vehicle.
- Using service information, locate a procedure for removing the differential. Make sure the procedure is appropriate for the make and model of the vehicle.
- Using service information, locate a procedure for reinstalling the differential. Include the specifications and procedures for fill-in the lubricant. Make sure the procedure is appropriate for the make and model of the vehicle.
- Rotate drive shaft to confirm that the differential assembly and wheels work freely.
- Performance test the differential.

Drive Axle Diagnosis and Repair: Limited-Slip Differential

- Diagnose noise, slippage, and chatter concerns; determine necessary action P-3 Objective
 - Wear PPE while performing the procedures on this job sheet.
 - Research applicable vehicle service information such as vehicle service history, VIN, certification labels, and calibration decals.
 - Using service information, locate a procedure to performance test a limited-slip differential. Include all necessary specifications. Make sure the procedure is appropriate for the make and model of the vehicle.
 - Using service information, locate a procedure to measure rotating torque. Include all necessary specifications. Make sure the procedure is appropriate for the make and model of the vehicle.
 - Using service information, locate a procedure to service the limited-slip differential assembly. Be sure to include all necessary specifications. Make sure the procedure is appropriate for the make and model of the vehicle.



• Clean and inspect differential housing, refill with correct lubricant and/or additive. P-2 *Objective*

- Wear PPE while performing the procedures on this job sheet.
- Research applicable vehicle service information such as vehicle service history, VIN, certification labels, and calibration decals.
- Using service information, locate a procedure to performance test a limited-slip differential. Include all necessary specifications. Make sure the procedure is appropriate for the make and model of the vehicle.
- Using service information, locate a procedure to measure rotating torque. Include all necessary specifications. Make sure the procedure is appropriate for the make and model of the vehicle.
- Using service information, locate a procedure to service the limited-slip differential assembly. Be sure to include all necessary specifications. Make sure the procedure is appropriate for the make and model of the vehicle.

Inspect and reinstall limited slip differential components P-3 Objective

- Wear PPE while performing the procedures on this job sheet.
- Research applicable vehicle service information such as vehicle service history, VIN, certification labels, and calibration decals.
- Using service information, locate a procedure to performance test a limited-slip differential. Include all necessary specifications. Make sure the procedure is appropriate for the make and model of the vehicle.
- Using service information, locate a procedure to measure rotating torque. Include all necessary specifications. Make sure the procedure is appropriate for the make and model of the vehicle.
- Using service information, locate a procedure to service the limited-slip differential assembly. Be sure to include all necessary specifications. Make sure the procedure is appropriate for the make and model of the vehicle.

Measure rotating torque; determine necessary action P-3 Objective

- Wear PPE while performing the procedures on this job sheet.
- Research applicable vehicle service information such as vehicle service history, VIN, certification labels, and calibration decals.
- Using service information, locate a procedure to performance test a limited-slip differential. Include all necessary specifications. Make sure the procedure is appropriate for the make and model of the vehicle.
- Using service information, locate a procedure to measure rotating torque. Include all necessary specifications. Make sure the procedure is appropriate for the make and model of the vehicle.
- Using service information, locate a procedure to service the limited-slip differential assembly. Be sure to include all necessary specifications. Make sure the procedure is appropriate for the make and model of the vehicle.



Drive Axle Diagnosis and Repair: Drive Axle Shaft

- Diagnose drive axle shafts, bearings, and seals for noise, vibration, and fluid leakage concerns; determine necessary action P-2 Objective
 - Wear PPE while performing the procedures on this job sheet.
 - Research applicable vehicle service information such as vehicle service history, VIN, certification labels, and calibration decals.
 - Using service information, locate a procedure for diagnosing drive axle noise, vibration and fluid leaks. Include all necessary specifications. Make sure the procedure is appropriate for the make and model of the vehicle.
 - Use proper lifting equipment to raise vehicle
 - Connect the exhaust ventilation equipment.
 - Perform a vehicle road test.
 - Inspect the axles for fluid leakage.
 - Grasp the axle flange. Move it up, down, and side to side.
 - Put transmission in neutral and rotate the axles.
 - o Shut off the engine and disconnect the exhaust ventilation equipment.
 - Use a dial indicator to measure axle flange runout and end play.
 - Using service information, locate a procedure for inspecting and replacing the drive axle shaft wheel stud. Include all necessary specification. Make sure the procedure is appropriate for the make and model of the vehicle

Inspect and replace drive axle shaft wheel studs P-1 Objective

- Wear PPE while performing the procedures on this job sheet.
- Research applicable vehicle service information such as vehicle service history, VIN, certification labels, and calibration decals.
- Using service information, locate a procedure for diagnosing drive axle noise, vibration and fluid leaks. Include all necessary specifications. Make sure the procedure is appropriate for the make and model of the vehicle.
- Use proper lifting equipment to raise vehicle
- Connect the exhaust ventilation equipment.
- Perform a vehicle road test.
- Inspect the axles for fluid leakage.
- \circ $\,$ Grasp the axle flange. Move it up, down, and side to side.
- Put transmission in neutral and rotate the axles.
- o Shut off the engine and disconnect the exhaust ventilation equipment.
- Use a dial indicator to measure axle flange runout and end play.
- Using service information, locate a procedure for inspecting and replacing the drive axle shaft wheel stud. Include all necessary specification. Make sure the procedure is appropriate for the make and model of the vehicle



Remove and replace drive axle shafts P-1 Objective

- o Wear PPE while performing the procedures on this job sheet.
- Research applicable vehicle service information such as vehicle service history, VIN, certification labels, and calibration decals.
- Using service information, locate a procedure for removing the axle shaft. Include all necessary specifications. Make sure the procedure is appropriate for the make and model of the vehicle.
- Using service information, locate a procedure for removing the axle bearings and seals. Include all necessary specifications. Make sure the procedure is appropriate for the make and model of the vehicle.
- Using service information, locate a procedure for installing the axle bearings and seals. Include all necessary specifications. Make sure the procedure is appropriate for the make and model of the vehicle.
- Inspect and replace drive axle shaft seals, bearings, and retainers P-2 Objective
 - o Wear PPE while performing the procedures on this job sheet.
 - Research applicable vehicle service information such as vehicle service history, VIN, certification labels, and calibration decals.
 - Using service information, locate a procedure for removing the axle shaft. Include all necessary specifications. Make sure the procedure is appropriate for the make and model of the vehicle.
 - Using service information, locate a procedure for removing the axle bearings and seals. Include all necessary specifications. Make sure the procedure is appropriate for the make and model of the vehicle.
 - Using service information, locate a procedure for installing the axle bearings and seals. Include all necessary specifications. Make sure the procedure is appropriate for the make and model of the vehicle.
- Measure drive axle flange runout and shaft end play; determine necessary action P-2 Objective
 - Wear PPE while performing the procedures on this job sheet.
 - Research applicable vehicle service information such as vehicle service history, VIN, certification labels, and calibration decals.
 - Using service information, locate a procedure for removing the axle shaft. Include all necessary specifications. Make sure the procedure is appropriate for the make and model of the vehicle.
 - Using service information, locate a procedure for removing the axle bearings and seals. Include all necessary specifications. Make sure the procedure is appropriate for the make and model of the vehicle.
 - Using service information, locate a procedure for installing the axle bearings and seals. Include all necessary specifications. Make sure the procedure is appropriate for the make and model of the vehicle.



Four-Wheel-Drive/All-Wheel Drive Component Diagnosis and Repair

 Diagnose noise, vibration, and unusual steering concerns; determine necessary action P-3

Objective

- Wear PPE while performing the procedures on this job sheet.
- Research applicable vehicle service information such as vehicle service history, VIN, certification labels, and calibration decals.
- Inspect the four-wheel/all-wheel drive components.
- Performance test a vehicle equipped with a four-wheel/all-wheel drive transfer case.
- Inspect, adjust, and repair shifting controls (mechanical, electrical, and vacuum), bushings, mounts, levers, and brackets P-3 Objective
 - Wear PPE while performing the procedures on this job sheet.
 - Research applicable vehicle service information such as vehicle service history, VIN, certification labels, and calibration decals.
 - Use proper lifting equipment to raise the vehicle.
 - Using service information, locate a procedure for inspecting mechanical transfer case shift components. Make sure the procedure is appropriate for the make and model of the vehicle.
 - Using service information, locate a procedure for adjusting mechanical transfer case shift components. Make sure the procedure is appropriate for the make and model of the vehicle
 - Using service information, locate a procedure for repairing mechanical transfer case shift components. Make sure the procedure is appropriate for the make and model of the vehicle.
 - Performance test the vehicle
 - Using service information, locate a procedure for inspecting and testing the electrical transfer case shift components using a DMM. Make sure the procedure is appropriate for the make and model of the vehicle
 - Using service information, locate a procedure for adjusting the electrical transfer case shift components using a DMM. Make sure the procedure is appropriate for the make and model of the vehicle
 - Using service information, locate a procedure for repairing the electrical transfer case shift components using a DMM. Make sure the procedure is appropriate for the make and model of the vehicle
 - Performance test the vehicle.
 - Using service information, locate a procedure for inspecting the vacuum transfer case shift components. Make sure the procedure is appropriate for the make and model of the vehicle
 - Using service information, locate a procedure for adjusting the vacuum transfer case shift components. Make sure the procedure is appropriate for the make and model of the vehicle
 - Using service information, locate a procedure for repairing the vacuum transfer case shift components. Make sure the procedure is appropriate for the make and model of the vehicle
 - Performance test the vehicle.



• Remove and reinstall transfer case P-3 *Objective*

- o Wear PPE while performing the procedures on this job sheet.
- Research applicable vehicle service information such as vehicle service history, VIN, certification labels, and calibration decals.
- Use proper lifting equipment to raise the vehicle.
- Using service information, locate a procedure for removing the transfer case. Make sure the procedure is appropriate for the make and model of the vehicle.
- Using service information, locate a procedure for disassembling the transfer case. Make sure the procedure is appropriate for the make and model of the vehicle.
- Inspect the transfer case for leakage.
- Drain fluid from the transfer case.
- o Clean the transfer case components and case with a safety solvent and blow dryer.
- Using service information, locate a procedure for determining and recording critical dimensions or clearances relating to the transfer case components. Make sure the procedure is appropriate for the make and model of the vehicle.
- Inspect all transfer case components for damage.
- Using service information, locate a procedure for reassembling the transfer case. Make sure the procedure is appropriate for the make and model of the vehicle.
- Using service information, locate a procedure for reinstalling the transfer case. Make sure the procedure is appropriate for the make and model of the vehicle.
- Performance test the vehicle.

Disassemble, service, and reassemble transfer case and components P-3 Objective

- Wear PPE while performing the procedures on this job sheet.
- Research applicable vehicle service information such as vehicle service history, VIN, certification labels, and calibration decals.
- Use proper lifting equipment to raise the vehicle.
- Using service information, locate a procedure for removing the transfer case. Make sure the procedure is appropriate for the make and model of the vehicle.
- Using service information, locate a procedure for disassembling the transfer case. Make sure the procedure is appropriate for the make and model of the vehicle.
- Inspect the transfer case for leakage.
- Drain fluid from the transfer case.
- o Clean the transfer case components and case with a safety solvent and blow dryer.
- Using service information, locate a procedure for determining and recording critical dimensions or clearances relating to the transfer case components. Make sure the procedure is appropriate for the make and model of the vehicle.
- o Inspect all transfer case components for damage.
- Using service information, locate a procedure for reassembling the transfer case. Make sure the procedure is appropriate for the make and model of the vehicle.
- Using service information, locate a procedure for reinstalling the transfer case. Make sure the procedure is appropriate for the make and model of the vehicle.
- Performance test the vehicle.



Inspect front-wheel bearings and locking hubs; perform necessary action P-3 Objective

- Wear PPE while performing the procedures on this job sheet.
- Research applicable vehicle service information such as vehicle service history, VIN, certification labels, and calibration decals.
- Inspect the hubs and front-wheel bearings and locking hubs.
- Use proper lifting equipment to raise the vehicle.
- Using service information, locate a procedure for disassembling the hubs and wheel bearings. Make sure the procedure is appropriate for the make and model of the vehicle.
- Using service information, locate a procedure for servicing the hubs and wheel bearings. Include cleaning and inspecting of the components. Make sure the procedure is appropriate for the make and model of the vehicle.
- Using service information, locate a procedure for packing the wheel bearings. Make sure the procedure is appropriate for the make and model of the vehicle.
- Using service information, locate a procedure for reassembling the hubs and wheel bearings. Include critical dimensions and clearances. Make sure the procedure is appropriate for the make and model of the vehicle.
- Spin each wheel and manually lock and unlock the hubs to make sure no parts are binding.
- Road test the vehicle.

• Check drive assembly seals and vents; check lube level P-3 *Objective*

- Wear PPE while performing the procedures on this job sheet.
- Research applicable vehicle service information such as vehicle service history, VIN, certification labels, and calibration decals.
- Perform a visual inspection of the seals.
- Using service information, locate a procedure for repairing seals. Make sure the procedure is appropriate for the make and model of the vehicle.
- Perform a visual inspection of the vent system.
- Using service information, locate a procedure for checking fluid levels and filling to the correct level. Make sure the procedure is appropriate for the make and model of the vehicle.

Diagnose test, adjust, and replace electrical/electronic components of four-wheeldrive systems P-3

Objective

- Wear PPE while performing the procedures on this job sheet.
- Research applicable vehicle service information such as vehicle service history, VIN, certification labels, and calibration decals.
- Inspect the electrical/electronic components.
- Using service information, locate a procedure for checking and troubleshooting diagnostic trouble coeds (DTC). Include using a DMM to isolate the defective component. Make sure the procedure is appropriate for the make and model of the vehicle.
- Using service information, locate a procedure for diagnosing defective components based on symptoms. Make sure the procedure is appropriate for the make and model of the vehicle.
- Complete a vehicle road test.



 Identify concerns related to variations in tire circumference and/or final drive ratios. P-3

ASSESSMENT METHODS:

Student performance may be assessed by examination, quizzes, case studies, oral conversation, group discussion, oral presentations. The instructor reserves the option to employ one or more of these assessment methods during the course.

GRADING SCALE:

90%-100% = A 80%-89.9%= B 70%-79.9%= C 60%-69.9%= D <60% = E