AUTO G150: MANUAL DRIVE TRAINS & AXLES

Item	Value
Curriculum Committee Approval Date	10/01/2024
Top Code	094800 - Automotive Technology
Units	4 Total Units
Hours	126 Total Hours (Lecture Hours 45; Lab Hours 81)
Total Outside of Class Hours	0
Course Credit Status	Credit: Degree Applicable (D)
Material Fee	No
Basic Skills	Not Basic Skills (N)
Repeatable	No
Open Entry/Open Exit	No
Grading Policy	Standard Letter (S), • Pass/No Pass (B)

Course Description

This course provides the students with theory, knowledge, and skills necessary to understand automotive manual drive trains and transaxles concepts. Instruction is given and lab experience provided in diagnosis, removal, disassembly, analysis and inspection, precision measurements, reassembly, and installation. Information presented is based on the Automotive Service Excellence (ASE) A-3 Manual Drive Train and Axles Tasks and Standards intended to prepare students for the ASE Certification Examination. Transfer Credit: CSU. C-ID: AUTO 130X. **C-ID:** AUTO 130X.

Course Level Student Learning Outcome(s)

1. Course Outcomes
2. Analyze manual transmissions, transaxles, and drivetrain related components for correct system operation.
3. Utilize diagnostic tools and equipment used for manual transmission, transaxles, drivetrain component and system repairs.
4. Utilize precision measurement tools to solve power flow concerns within manual transmission, transaxle, and drivetrain related components through systematic analysis.

Course Objectives

- 1. Demonstrate shop safety regarding working procedures, hazardous materials and waste handling.
- 2. Analyze manual drivetrain system-related wiring diagrams.
- 3. Perform systematic analysis on manual drivetrain systems using industry-accepted testing procedures, and diagnostic tools and equipment such as micrometers, depth gauges, dial indicators, and electronic scan tools as needed.
- 4. Use Service Information (SI) publications to obtain procedures and specifications for maintenance and repair of manual transmission and drive train systems.
- 5. Perform diagnosis, service and maintenance procedures in a timely manner to industry standards.
- 6. Identify component failures using analytical skills, processes, and industry-accepted procedures.
- 7. Apply industry-accepted processes and principles for system diagnostics and repairs.
- 8. Apply learned safety concepts when servicing HEV?s, identifying the location of high voltage service disconnect switches, warning devices, and following proper safeguards and correct set-up procedures.

Lecture Content

Safety Basic Auto Technology shop safety instruction and demonstration Instructor assigned Safety Certification General Drivetrain Concepts; Overview Drivetrain layout Rear-wheel drivetrain components Front-wheel drivetrain components Mounting and insulating methods General Drivetrain Diagnosis Applicable vehicle and service information Vehicle service history, service precautions, and Technical Service Bulletins (TSBs) Vehicle and major component identification numbers Vehicle Identification Number (VIN) Vehicle certification labels Calibration decals Fluid usage, level, and condition concerns Noise, vibration and harshness concerns Clutch Diagnosis and Repair Characteristics and theory of friction Clutch system components and operation Flywheel and ring gear Pressure plate assembly Clutch disc Release (throw-out) bearing Pilot bearing or bushing Clutch pedal linkage, cables, automatic adjuster mechanisms, brackets, bushing, pivots and springs Hydraulic system, slave and master cylinders, lines, and hoses Transmission/Transaxle Concepts Diagnosis and Repair Powerflow through the transmission/transaxle Gear reduction and overdrive theory Synchronizers Bearings Shift mechanisms Endplay or preload (shim or spacer selection procedure) on transmission/transaxle shafts Synchronizer hub, sleeve, keys (inserts), springs, and blocking rings Speedometer drive gear, driven gear, vehicle speed sensor (VSS), retainers Transaxle final drive pinion gears (spider), shaft, side gears, side bearings, thrust washers, and case assembly Lubrication devices (oil pump or slingers) External components Shift cover, forks, levers, grommets, shafts, sleeves, detent mechanism, interlocks, and springs Transmission/transaxle sensors and switches Transmission/transaxle case, extension housing, case mating surfaces, bores, bushings, and vents Shift linkages brackets, bushings, cables, pivots, and levers Powertrain mounts Gaskets, seals, and sealants Driveshaft and Half-Shafts, Universal and Constant-Velocity (CV) Joint Diagnosis and Repair CV joint noise and vibration concerns Universal joint (U-joint) noise and vibration concerns Front wheel drive (FWD), front wheel bearing Shafts, yokes, boots and CV joints Shaft, center support bearings Shaft balance, shaft runout, driveline angles Companion flange and pinion seal Drive Axle Diagnosis and Repair Drive shafts and U-joints Driveshaft construction, placement, and operation U-joints Differentials/final drives Construction, purpose, powerflow Gear reduction Differential action Four-wheel Drive/All-Wheel Drive Component Diagnosis and Repair System layout, construction Powerflow Four-wheel drive shift control Locking axles Transfer case construction and operation Electronic controls Operation, shift controls Electronic controls

Lab Content

General Drivetrain Diagnosis Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction Identify and interpret drivetrain concern; determine necessary action Research applicable vehicle and service information, such as drivetrain system operation, fluid type, vehicle service history, service precautions, and technical service bulletins Locate and interpret vehicle and major component identification numbers Diagnose fluid loss, level, and condition concerns; determine necessary action Drain and fill manual transmission/transaxle and

final drive unit Clutch Diagnosis and Repair Diagnose clutch noise, binding, slippage, pulsation, and chatter; determine necessary action Inspect clutch pedal linkage, cables, automatic adjuster mechanisms, brackets, bushings, pivots, and springs; perform necessary action Inspect hydraulic clutch slave and master cylinders, lines, and hoses; determine necessary action Inspect and replace clutch pressure plate assembly, clutch disc, release (throw-out) bearing, linkage, and pilot bearing/bushing (as applicable) Bleed clutch hydraulic system Inspect flywheel and ring gear for wear and cracks; determine necessary action Inspect engine block, core plugs, rear main engine oil seal, clutch (bell) housing, transmission/transaxle case mating surfaces, and alignment dowels; determine necessary action Measure flywheel runout and crankshaft endplay; determine necessary action Transmission/Transaxle Diagnosis and Repair Remove and reinstall transmission/transaxle Disassemble, clean, and reassemble transmission/transaxle components Inspect transmission/transaxle case, extension housing, case mating surfaces, bores, bushi ngs, and vents; perform necessary action Diagnose noise concerns using transmission/transaxle powerflow principles Diagnose hard shifting and jumping out of gear concerns determine necessary action Inspect, adjust, and reinstall shift linkages, brackets, bushings, cables, pivots, and levers Inspect, replace, and align powertrain mounts Inspect, replace gaskets, seals, and sealants; inspect sealing surfaces Remove and replace transaxle final drive Inspect, adjust, and reinstall shift cover, forks, levers, grommets, shafts, sleeves, detent mechanisms, interlocks, and springs Measure endplay or preload (shim or spacer selection procedure) on transmission/transaxle shafts; perform necessary action Inspect and re-install synchronizer hub sleeve, keys (inserts), springs, and blocking rings Diagnose transaxle final drive assembly noise and vibration concerns; determine necessary action Remove, inspect, measure, adjust and reinstall transaxle final drive pinion gears (spiders), shaft, side gears, side bearings, thrust washers, and case assembly Inspect lubrication devices (oil pump or slingers); perform necessary action Inspect, test, and replace transmission/transaxle sensors and switches Describe the operational characteristics of an electronically controlled manual transmission/transaxle Drive Shaft and Half-Shaft, U-joint, and CV Joint Diagnosis and Repair Diagnose CV joint noise and vibration concrns; determine necessary action Diagnose U-joint noise and vibration concerns; perform necessary action Remove and replace front wheel drive (FWD) front wheel bearing Inspect, service, and replace shafts, yokes, boots, and CV joints Inspect, service, and replace shaft center support bearings Check shaft balance and phasing; measure shaft runout; measure and adjust driveline angles Dive Axle Diagnosis and Repair Diagnose noise and vibration concerns; determine necessary action Diagnose fluid leakage concerns;determine necessary action Inspect and replace companion flange and pinion seal; measure companion flange runout Inspect ring gear and measure runout; determine necessary action Remove, inspect, and reinstall drive pinion and ring gear, spacers, sleeves, and bearings Measure and adjust drive pinion depth Measure and adjust drive pinion bearing preload 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 type) Check ring and pinion tooth contact patterns; perform necessary action Disassemble, inspect, measure, and adjust or replace differential pinion gears (spiders), shaft, side gears, side bearings, thrust washers, and case Reinstall Differential case assembly, measure runout; determine necessary action. Diagnose noise, slippage, and chatter concerns on a limited slip differential; determine necessary action Clean and inspect differential housing, refill with correct lubricant and/or additive for a limited slip differential Inspect and re-install limited slip differential components, measure rotating torque; determine necessary action Diagnose drive axle shafts, bearings, and seals for noise, vibration, and fluid leakage concerns; determine necessary action Inspect and replace drive axle shafts wheel studs.

Method(s) of Instruction

- Lecture (02)
- DE Live Online Lecture (02S)
- DE Online Lecture (02X)
- Lab (04)
- DE Live Online Lab (04S)
- DE Online Lab (04X)

Reading Assignments

Textbook Reading Assignments

Writing Assignments

Create vehicle repair orders which include industry accepted documentation of repairs (Complaint, Cause, and Correction). Repair orders should also include mathematical computation of part costs and labor totals.

Out-of-class Assignments

Interactive Web-based training modules

Demonstration of Critical Thinking

Analyze and troubleshoot manual drive train and axle components and restore them to proper service. Analyze, confirm, and diagnose manual drivetrain faults based on symptoms indicated on repair orders. Diagnose and confirm drivetrain system component failures by comparing actual readings or measurements with factory specifications. Analyze wiring diagrams to determine integrity of circuits which support vehicle drivetrain systems.

Required Writing, Problem Solving, Skills Demonstration

Create vehicle repair orders, perform math exercises for flat rate labor, parts and materials totals. Demonstrate an understanding of gear ratio theory and concepts by performing related math exercises. Use information and concepts learned in class to successfully pass a practicum exam or written test or assignment. Use online service and repair information to compare factory specifications with actual readings and measurements acquired during drivetrain diagnostic activities.

Eligible Disciplines

Automotive technology: Any bachelor's degree and two years of professional experience, or any associate degree and six years of professional experience.

Textbooks Resources

1. Required James D Halderman. Manual Drivetrains and Axles, ninth ed. New Jersey: Pearson Education, 2024

Other Resources

1. Instructor prepared handouts