AUTO-2300: AUTOMATIC TRANSMISSIONS

Cuyahoga Community College

Viewing: AUTO-2300 : Automatic Transmissions

Board of Trustees:
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Academic Term:
Fall 2022

Subject Code
AUTO - Automotive Technology

Course Number:
2300

Title:
Automatic Transmissions

Catalog Description:
Operation of automotive transmissions and transaxles. Emphasis on knowledge and skills needed to properly diagnose transmission faults related to hydraulic, mechanical, and electrical systems that effect transmission operation. Specifics covered in this course include transmission operation, diagnostic, and service procedures, hydraulic fundamentals, controls and planetary gear train theory. Maintenance, diagnosis, inspection, overhaul proper assembly techniques of transmissions are included.

Credit Hour(s):
3

Lecture Hour(s):
1

Lab Hour(s):
6

Other Hour(s):
0

Requisites

Prerequisite and Corequisite
AUTO-1502 Automotive Electrical Fundamentals.

Outcomes

Course Outcome(s):
Diagnose, repair, and maintain automatic transmission and transaxle components, units, and systems.

Essential Learning Outcome Mapping:
Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

Objective(s):
1. Inspect, adjust, and replace external manual valve shift linkage, transmission range sensor/switch, and park/neutral position switch.
2. Inspect for leakage; replace external seals, gaskets, and bushings.
3. Inspect, test, adjust, repair, and/or replace electrical/electronic components and circuits including computers, solenoids, sensors, relays, terminals, connectors, switches, and harnesses; demonstrate understanding of the relearn procedure.
4. Drain and replace fluid and filter(s); use proper fluid type per manufacturer specification.

Course Outcome(s):
Diagnose and isolate problems on a vehicles transmission or transaxle.

Essential Learning Outcome Mapping:

Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

Objective(s):

1. Perform lock-up converter system tests; determine necessary action.
2. Diagnose transmission/transaxle gear reduction/multiplication concerns using driving, driven, and held member (power flow) principles.
3. Diagnose electronic transmission/transaxle control systems using appropriate test equipment and service information.
4. Diagnose pressure concerns in a transmission using hydraulic principles (Pascal's Law).
5. Identify and interpret transmission/transaxle concerns; differentiate between engine performance and transmission/transaxle concerns; and determine necessary action.
6. Research vehicle service information including fluid type, vehicle service history, service precautions, and technical service bulletins.
7. Diagnose fluid loss and condition concerns; determine necessary action.
8. Check fluid level in a transmission or a transaxle equipped with a dip-stick.
9. Check fluid level in a transmission or a transaxle not equipped with a dip-stick.
10. Perform pressure tests (including transmissions/transaxles equipped with electronic pressure control); determine necessary action.
11. Diagnose noise and vibration concerns; determine necessary action.
12. Inspect, leak test, flush, and/or replace transmission/transaxle oil cooler, lines, and fittings.

Course Outcome(s):

Diagnose, repair, and maintain automatic transmission or transaxle assemblies

Essential Learning Outcome Mapping:

Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

Objective(s):

1. Remove and reinstall transmission/transaxle and torque converter; inspect engine core plugs, rear crankshaft seal, dowel pins, dowel pin holes, and mating surfaces.
2. Inspect converter flex (drive) plate, converter attaching bolts, converter pilot, converter pump drive surfaces, converter end play, and crankshaft pilot bore.
3. Describe the operational characteristics of a continuously variable transmission (CVT).
4. Describe the operational characteristics of a hybrid vehicle drive train.
5. Disassemble, clean, and inspect transmission/transaxle.
6. Inspect, measure, clean, and replace valve body (includes surfaces, bores, springs, valves, switches, solenoids, sleeves, retainers, brackets, check valves/balls, screens, spacers, and gaskets).
7. Inspect servo and accumulator bores, pistons, seals, pins, springs, and retainers; determine necessary action.
8. Assemble transmission/transaxle.
9. Inspect, measure, and reseal oil pump assembly and components.
10. Measure transmission/transaxle end play or preload; determine necessary action.
11. Inspect, measure, and replace thrust washers and bearings.
12. Inspect oil delivery circuits, including seal rings, ring grooves, and sealing surface areas, feed pipes, orifices, and check valves/balls.
13. Inspect bushings; determine necessary action.
14. Inspect and measure planetary gear assembly components; determine necessary action.
15. Inspect case bores, passages, bushings, vents, and mating surfaces; determine necessary action.
16. Diagnose and inspect transaxle drive, link chains, sprockets, gears, bearings, and bushings; perform necessary action.
17. Inspect, measure, repair, adjust or replace transaxle final drive components.
18. Inspect clutch drum, piston, check-balls, springs, retainers, seals, friction plates, pressure plates, and bands; determine needed action.
19. Measure clutch pack clearance; determine necessary action.
20. Air test operation of clutch and servo assemblies.
21. Inspect one-way clutches, races, rollers, sprags, springs, cages, retainers; determine needed action.

Methods of Evaluation:

1. Participation and discussion
2. Written Assignments
3. Observation
4. Exams
5. Quizzes

6. Lab tasks
7. Classroom recitations

Course Content Outline:

1. Powertrain components
   a. Engine
      i. engine operation
      ii. torque and speed modification
      iii. engine operating load
   b. Transmission
      i. vehicle gearing needs
      ii. manual transmission and clutch basic theory
   c. Automatic transmission
      i. torque converter
      ii. gear train
      iii. hydraulic system
      iv. oil pump
      v. apply devices
      vi. valve body and valves
   d. Shifts and shift timing
   e. Pressure signals
      i. electronic control system
      ii. electronic pressure control solenoid
2. Gearing and gearsets
   a. Transmission gearing
   b. Final drive gearing
      i. final drives and differentials
      ii. final drive types and designs
   c. Overall gear ratio
3. Electronic automatic transmissions
   a. Transmission operating parameters
   b. Automatic transmission control strategies
   c. Introduction to control systems
      i. control system operations
      ii. Power Control Module controls
      iii. Transmission Control Module controls
4. Gear types
   a. Spur and helical gears
   b. External and internal ring gears
   c. Bevel, worm, and hypoid gears
      i. bevel gears
      ii. worm gear
      iii. hypoid gears
5. Gear ratios
   a. Direct drive
   b. Gear reduction
   c. Overdrive
   d. Idler gears
6. Torque, speed, and power
   a. Torque and speed relationship
   b. Torque multiplication
   c. Engine torque characteristics
7. Powertrain gear ratios
   a. Final drive gearing
   b. Transmission gearing
      i. first gear
      ii. second gear
      iii. third gear
      iv. fourth gear

8. Planetary gearsets
9. Planetary gearset power flow
10. Planetary gearset operations
    a. Gear reduction
    b. Overdrive
    c. Reverse
    d. Direct drive
    e. Neutral
11. Simple planetary gearset systems
12. Compound planetary gearset systems
13. Hydraulic principals
    a. Hydraulics
    b. Fluids and fluid characteristics
    c. Pascal's law
    d. Force
    e. Pressure
    f. Multiplication of force
    g. Transmission of motion
    h. Hydraulics and work
14. Simple hydraulic system
    a. Reservoir
    b. Pump
        i. mechanical pressure regulation
        ii. electronic pressure regulation
    c. Valves and solenoids
        i. valve operation
        ii. pressure regulating valves
            1. pressure regulator valve
            2. pressure relief valve
            3. electronic pressure regulation
        iii. flow directing valves
            1. one-way valves
            2. two-way valve
            3. manual valve
            4. transmission pressure valves
            5. shift valves
            6. valve body
        iv. shafts, tubes, and passages
    d. Actuators
        i. servos
        ii. pistons
15. Pressure development and control
    a. Pump types
        i. gear pump
        ii. rotor pump
        iii. vane pump
        iv. variable displacement vane pump
    b. Pressure regulation
    c. Electronic pressure control
16. Transmission hydraulic pressures
    a. Mainline pressure
        i. regulated mainline pressure
        ii. boosted mainline pressure
    b. Throttle pressure
    c. Governor pressure
    d. Torque converter pressure
    e. Torque converter clutch apply pressure
    f. Oil cooler flow and pressure

g. Lubrication flow and pressure
h. Band and clutch apply pressure

17. Transmission shifting and shift operations
    a. Manual valve
    b. Throttle valve
        i. mechanically operated throttle valve
        ii. vacuum operated throttle valve
    c. Downshift valves
    d. Governor valve
        i. gear-driven governors
            1. spool-valve designs
            2. check-ball designs
        ii. shaft-mounted governors
    e. Shift valve operation
    f. Shift timing and smoothing
        i. shift valve sequencing
        ii. accumulators and orifices
            1. orifices
            2. accumulators
        iii. shift overlap
        iv. automatic transmission fluid
    g. Electronic shift control
18. Fluid couplings
    a. Fluid flow and resultant force
    b. Speed ratio
    c. Fluid coupling operation
19. Torque converters
    a. Torque converter construction
        i. torque converter attachments
        ii. torque converter operation
    b. Torque multiplication phase
    c. Coupling phase
    d. Stall speed
    e. Torque converter diameter
    f. Torque converter capacity
    g. Variable-pitch stator
20. Lockup torque converters
    a. Hydraulically locking torque converters
        i. converter clutch control
        ii. lockup converter strategy variations
    b. Viscous torque converter
    c. Centrifugally locking torque converters
    d. Splitter-gear torque converter
    e. Split-path torque converter
21. Transmission bands
    a. Band designs
    b. Band adjustment
22. Hydraulic servos
    a. Servo force
    b. Servo linkages
        i. servo linkage adjustment
23. Accumulators
    a. Independent piston-type accumulators
    b. Integral piston-type accumulators
    c. Valve-type accumulators
24. Multiple-disc clutches
    a. Holding clutches
    b. Driving clutches
25. Clutch operation

    a. Clutch vent port and check ball
    b. Clutch piston return springs
26. Clutch application and control
    a. Variable clutch holding force
27. One-way clutches
    a. One-way roller clutch
    b. One-way sprag clutch
    c. One-way clutch operation
28. Interaction of apply devices
    a. Basic two-speed transmission
    b. Modified two-speed transmission
29. Automatic transmission fluid
    a. Torque transfer
    b. Cooling, cleaning, and lubrication
    c. Shift control and apply device operation
30. General ATF properties
    a. Miscibility test
    b. Viscosity test
    c. Flash point and flame point tests
    d. Foaming test
    e. Oxidation resistance test
    f. Rust, corrosion, and compatibility tests
    g. Friction and wear tests
31. ATF friction properties
    a. Fluid type and transmission design
    b. ATF friction testing
    c. Improper fluid use
    d. Universal transmission fluids
32. Specific ATF types
    a. Type A fluid
    b. DEXRON fluids
    c. MERCON fluid
    d. MOPAR ATF-plus fluid (type 7176)
    e. Proprietary ATF types
33. Transmission filters
    a. Screen filters
    b. Paper filters
    c. Felt filters
    d. Secondary filters
34. Transmission oil coolers
    a. Oil-to-water coolers
    b. Oil-to-air coolers
35. ATF change intervals
36. Gaskets
    a. Gasket compressibility
    b. Pan gaskets
    c. Mating assembly gaskets
    d. Gasket sealants
37. Transmission seals
    a. Static and dynamic seals
38. Rubber seals
    a. Rubber compounds
        i. nitrile rubbers
        ii. polyacrylic rubbers
        iii. silicone rubbers
        iv. fluoroelastomer rubbers
39. Rubber type seals
    a. O-ring seals
    b. Square-cut seals

   c. Lip seals
      i. shaft seals
      ii. piston seals
40. Teflon seals
41. Bushings, bearings, and thrust washers
   a. Bushings
   b. Thrust washers
   c. Roller thrust bearings
   d. Transmission endplay
      i. measuring enplay
      ii. installing selective-fit thrust washers
42. Snaprings
43. Onboard diagnostics Generation Two (OBD II)
   a. Diagnostic trouble codes
      i. DTC classification
         1. hard codes
         2. soft codes
      ii. diagnostic strategies
   b. OBD II requirements for automatic transmissions
   c. DTC structure
      i. base system
      ii. code type
      iii. vehicle system
      iv. fault definition
44. Sensors
   a. Reference voltage sensors
      i. switches
      ii. potentiometers
      iii. thermistors
   b. Voltage generating sensors
      i. Hall-effect switch
      ii. galvanic battery
   c. Pressure measurement sensors
45. Actuators
   a. Solenoids
   b. Pulse-width modulation and duty cycle
46. Torque Converter Clutch (TCC) enable requirements
   a. TCC apply conditions
   b. TCC release conditions
47. TCC control
   a. Pulse with modulated TCC control
48. Electronic lockup systems
   a. Chrysler electronic TCC control
   b. Ford electronic TCC control
   c. General Motors TCC control
49. Electronic control functions
   a. Advantages of electronic control
   b. Transmission control system organization
   c. Adaptive control
   d. Limited operating strategy
   e. Control system test characteristics
50. Transmission control system inputs
   a. Engine related input
   b. Driver demand input
      i. transmission range
      ii. tp sensor
      iii. brake switch
      iv. overdrive cancel switch
      v. operating mode switch
   c. Transmission related sensors

        i. transmission fluid temperature sensor
        ii. turbine speed sensor
        iii. output shaft speed sensor
        iv. vehicle speed sensor
        v. transmission pressure switches
51. Electronic shift control
    a. Shift control
    b. Shift control options
        i. selective shift programs
        ii. adaptive shift algorithms
52. Laboratory Topics
53. Shop practices
    a. Personal safety
    b. Shop safety
        i. work area maintenance
        ii. fire prevention
        iii. work habits
54. Measurement tools
    a. Straightedges
    b. Feeler gauges
        i. blade-type
        ii. go, no-go type
    c. Calipers
        i. vernier calipers
        ii. dial calipers
    d. Micrometers
        i. using a micrometer
            1. reading a vernier inch micrometer
            2. reading a vernier metric micrometer
        ii. digital micrometers
    e. Dial indicators
        i. dial indicator stands
        ii. dial indicator accessories
    f. Torque wrenches
55. Automatic transmission fluid
56. Checking fluid level
    a. Fluid level check
        i. Chrysler precautions
        ii. Ford precautions
        iii. General Motors precautions
        iv. import procedures
            1. Audi
            2. Acura
            3. Hyundai
            4. Mitsubishi
            5. Porsche
            6. Saab
            7. Toyota
            8. Volkswagen
57. Fluid diagnosis
    a. Analyzing ATF color and odor
    b. Other ATF diagnoses
58. Draining the transmission
    a. Oil pan
    b. Fluid filler tube
    c. Oil drain plug
59. Draining the converter
60. Filter and screen service

   a. Filter removal
   b. Filter design
      i. metal mesh screens
      ii. nylon screens
      iii. paper and synthetic filters
61. Filter and oil pan installation
   a. Filter installation
   b. Oil pan installation
62. Refilling the transmission with fluid
63. Transmission cooler operation
64. Cooler and line inspection
   a. Fluid cooler flow check
   b. Fluid cooler leak test
65. Fluid cooler line repair and replacement
66. Fabricating a cooler line
67. Fluid cooler flushing
   a. Manual flushing
   b. Machine flushing
68. Auxiliary fluid coolers
69. Transmission band adjustment
   a. Ford transmissions
      i. low-reverse band adjustment
      ii. overdrive band adjustment
      iii. servo apply pin adjustment
   b. General Motors transmissions
      i. intermediate band adjustment
      ii. low-intermediate band adjustment
      iii. servo apply pin selection
   c. Import transmissions
70. Transmission linkage adjustments
   a. Gearshift linkage
      i. gearshift linkage adjustment check
      ii. gearshift linkage adjustment
   b. Throttle valve linkage
      i. adjusting TV linkage
         1. TV control rod adjustment
         2. TV cable adjustment
   c. Downshift linkage
71. Vacuum modulator service
   a. Modulator testing
      i. manifold vacuum test
      ii. diaphragm leakage test
      iii. dual-area diaphragm testing
   b. Modulator removal
   c. Modulator bench tests
      i. diaphragm movement and leakage test
      ii. transmission fluid leakage test
      iii. spring and bellows comparison test
   d. Modulator installation
      i. installing screw-in units
      ii. installing push-fit units
   e. Modulator adjustment
72. Preliminary inspection
   a. Fluid leaks
      i. fluid color
      ii. determine the source
   b. Vacuum lines, hoses, and components
      i. vacuum hose inspection
      ii. verifying manifold vacuum
      iii. checking modulator operation

    c. Linkage adjustment
    d. Electrical and electronic checks
        i. wiring harnesses
        ii. diagnostic trouble code checks
            1. Chrysler
            2. Ford
            3. General Motors
        iii. Import vehicles
73. Electronic test equipment
    a. Digital multimeter
    b. Scan tool
    c. Laboratory oscilliscope
    d. Dedicated transmission testers
74. Service information
    a. Clutch and band apply chart
    b. Shift speed apply chart
    c. Pressure specifications chart
75. Stall testing
    a. Stall test procedures
    b. Stall test results
        i. stall speed too high
        ii. stall speed too low
        iii. stall speed noise
76. Hydraulic pressure testing
    a. Pressure testing equipment
    b. Pressure test procedure
        i. preliminary checks
        ii. mainline pressure test
        iii. governor pressure test
    c. Evaluating line pressure test results
77. Air pressure testing
    a. Air test equipment
    b. Air test procedure
78. Road test
    a. Road test procedure
        i. overdrive range
        ii. drive range
        iii. manual second range
        iv. manual low range
        v. reverse range
    b. Analyzing the road test
    c. Torque converter problems
        i. torque converter test results
79. Circuit testing
    a. Using serial data
    b. Using a digital multimeter
        i. voltage
        ii. resistance
        iii. voltage drop
        iv. amperage
        v. frequency
        vi. duty cycle
    c. Operating range test
    d. Using a lab scope
        i. test connections
        ii. waveforms
80. Input sensors and signals
    a. Switch
    b. Potentiometer

    c. Thermistor
    d. Piezoresistive sensor
    e. Speed sensor
        i. pickup coil
        ii. Hall-effect switch
        iii. Reed switch
        iv. optical sensor
81. Output actuators and circuits
    a. Relay
    b. Solenoid
        i. two-position solenoids
        ii. pulse-width modulated solenoids
        iii. variable-force solenoids
82. TCM replacement
83. Transmission removal equipment
    a. Hoist (lift)
    b. Jack stands
    c. Transmission jacks
    d. Engine support fixture
84. Where to begin
85. Removing the transmission
    a. Under the hood
    b. Under the vehicle
    c. Removing the transmission
86. Installing the transmission
87. Diagnosis and inspection of torque converters
    a. Noises
    b. Stator clutch failure
    c. Visual inspection
        i. physical damage
        ii. fluid leakage in the converter area
88. Inspection and bench testing of torque converters
    a. Visual inspections
        i. drive stud or lug inspection
        ii. converter hub inspection
    b. Dynamic bench test
        i. stator-to-impeller interference test
        ii. stator-to-turbine interference test
        iii. stator one-way clutch test
    c. Internal endplay check
    d. Friction material coefficient test
89. Converter cleaning
    a. Converter flushing
        i. hand flushing
        ii. machine flushing
    b. Cleaning without solvent
90. Electronic lockup torque converters
    a. Verifying TCC operation
        i. circuit checks
        ii. electronic checks
    b. Solenoid tests
91. Converter rebuilding
    a. Disassembly, cleaning and inspection
    b. Assembly and testing
    c. converter leakage test
    d. balancing
92. Transmission endplay

   a. Measuring shaft endplay
      i. input shaft endplay
      ii. output shaft endplay
      iii. transfer shaft endplay
93. Transmission disassembly
   a. Helpful hints
   b. Teardown
      i. housings
      ii. valve bodies
      iii. servos
      iv. accumulators
      v. governors
      vi. oil pumps
      vii. clutch housings and planetary gearsets
94. Component cleaning
95. Component inspection
   a. Accumulators and servos
   b. Bands
   c. Clutch packs
      i. friction disc inspection
      ii. steel disc inspection
      iii. clutch piston removal and inspection
         1. return spring inspection
         2. clutch piston inspection
   d. Hubs, drums, and shells
   e. Governors
   f. One-way clutches
   g. Planetary gearsets
   h. Pumps
      i. gear and rotor pumps
         1. end clearance
         2. side clearance
         3. tip clearance
      ii. vane pumps
   i. Shafts
   j. Thrust washers, thrust bearings, and bushings
      i. thrust washers
      ii. thrust bearings
      iii. bushings
   k. Transmission cases
   l. Valve bodies
96. Gaskets
   a. Surface preparation
   b. Gasket installation
97. Seals
   a. Lip seals
      i. shaft seal removal
      ii. shaft seal installation
      iii. piston seal removal
      iv. piston seal installation
   b. O-ring and square cut seals
      i. o-ring replacement
      ii. square cut seal replacement
   c. Sealing rings
      i. open-end ring replacement
      ii. butt-end ring replacement
      iii. locking-end ring replacement
      iv. solid ring replacement
98. Bushings

a. Bushing removal
b. Installing bushings

99. Repairing damaged threads
    a. Using taps and dies
        i. identifying threads
        ii. selecting the correct tap
        iii. using a tap to chase threads
        iv. using a die to chase threads
    b. Thread restorers and thread cutting files
100. Internal thread replacement
    a. Drilling oversize
    b. Tapping new threads
    c. Thread inserts
    d. Thread repair with epoxies
101. Case porosity repair
    a. Casting repair with epoxies
102. An organized approach to transmission assembly
103. Case build-up
    a. Final inspection and cleaning
    b. Installing servos and accumulators
    c. Installing clutches
104. Adjusting clutch pack clearance
    a. Snap ring
    b. Pressure or retaining plate
    c. Steel disc
    d. Washer
    e. Snap ring, pressure plate, and steel disc selection
105. Pump build-up
    a. Bushing and seal installation
    b. Gear and rotor pump assembly
    c. Vane pump assembly
106. Clutch and planetary build-up
    a. Output shaft and direct clutch
    b. Forward planetary and gear support
    c. Forward clutch assembly
    d. Reverse clutch assembly
107. Valve body build-up
    a. Lower housing
    b. Transfer plate
    c. Upper housing
    d. Final assembly
108. Transmission reassembly

Resources

Halderman, James D. *Automotive Technology: Principles, Diagnosis, and Service*. 6th ed. New Jersey: Pearson, 2020.

Erjavec, Jack. *Automative Technology: A Systems Approach*. 7th ed. Boston, MA: Cengage Learning, 2019.

Johanson, Chris and James E. Duffy. *Automatic Transmission and Transaxles Revised, Textbook*. 5th ed. New Jersey: Goodheart-Wilson, 2019.

Halderman, James D. *Automatic Transmissions & Transaxles*. 7th ed. Boston; Pearson Education , 2018.

Jack Erjavec and Ken Pickerill. *Today's Technician: Automatic Transmissions and Transaxles Classroom Manual*. 7th ed. Cengage Learning, 2019.

Resources Other

1. Back to CarParts.com. Classroom on the Web. A Short Course on Automatic Transmissions. http://www.carparts.com/transmission.htm . Ofria, Charles. Copyright 2000-2016.
2. Transmission Repair Guy: Helping to Solve Your Transmission Problems. http://www.transmissionrepairguy.com/how-does-a-transmission-work/ Copyright 2016. Transmission Repair Guy. All Rights Reserved.
3. Sonnax: Automatic Transmission Tech Resources. Sonnax Tech Resources - Articles, Videos & More (https://www.sonnax.com/tech_resources/) 2021 Sonnax Transmission Company, Inc.
4. Tom Broxholm's Skyline Automotive page (smccd.edu) (http://accounts.smccd.edu/broxholm/Index.html)
5. Brake & Front End Magazine: Auto Brake Repair Shop, Cars, Trucks (brakeandfrontend.com) (https://www.brakeandfrontend.com/) Copyright © 2021 Babcox Media Inc. All Rights Reserved.

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