

AUT 221 (A2)
AUTOMATIC TRANSMISSION/TRANSAXLE

Prerequisites: TRN 120
Corequisites: None

COURSE DESCRIPTION:

This course covers operation, diagnosis, service, and repair of automatic transmissions/transaxles. Topics include hydraulic, pneumatic, mechanical, and electrical/electronic operation of automatic drive trains and the use of appropriate service tools and equipment. Upon completion, students should be able to explain operational theory and diagnose and repair automatic drive trains. Course Hours per Week: Class, 2; Lab Hours, 3; Semester Hours Credits, 3.

SAFETY DISCLAIMER:

Automotive work presents many hazards. A moment's carelessness can cause injury to oneself or to others. Such mishaps can occur quickly due, in part, to the nature of the industrial tools used in automotive work. The weight of automobiles and the equipment used to fix them can even cause fatal injuries. Therefore, great care must always be taken in checking out equipment before use, and in using that equipment to work on automobiles.

As we work to insure the safety of everyone in the Durham Tech automotive lab, it is the instructor's responsibility to introduce students to equipment and to advise them on its safe operation. Those health and safety procedures are also presented in each textbook for each course in the automotive program. **Students are responsible for mastery of that safety information.** Durham Tech holds each student in every class responsible for reading and applying all of the information regarding personal and public safety and personal and public health in the required text.

While working in the Durham Tech automotive lab, safety glasses must be worn by everyone. However, safety glasses are only one small requirement so that students remain injury free. All safety recommendations in the text book and from the instructor must be followed. A student with any questions about a safety procedure should immediately ask an instructor for clarification.

Any student using equipment in the automotive lab must be responsible for using that equipment in a safe manner. Durham Tech holds each student in automotive classes responsible for acting to ensure a safe environment and to ensure both the student's own safety and the safety of his classmates.

LEARNING OUTCOMES:

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

- a. Observe automatic transmission/transaxle safety procedures
- b. Identify vehicle identification numbers, electronic service information, and service repair orders.
- c. Methodically approach and diagnosis problems in automatic transmissions/transaxles, in order to make a direct, thorough and economical diagnosis.
- d. Do basic adjustments and service on automatic transmissions.

- e. Perform basic “in-car” diagnostics and repairs.
- f. Understand the basic concepts and procedures to successfully rebuild late model transmissions and transaxles.

OUTLINE OF INSTRUCTION:

- I. Basic Gear Systems Theory
 - A. Speed versus Torque
 - B. Gear Ratios
- II. Planetary Gear Systems
 - A. Construction
 - B. Principles of Operation
 - 1) Rules of planetary gears
 - 2) Typical transmission power flow
 - 3) How various ratios can be obtained (including overdrive)
 - a. Hold one member
 - b. Drive two members
 - c. Neutral
 - 4) Compound Planetary (Simpson and Ravigneaux)
 - a. Used in pairs or as a multiple unit
 - b. Operation
- III. Friction Elements
 - A. Basic Principles of Hydraulics
 - B. Hydraulic System Components (Identification of Parts and Operation)
 - 1) Reservoir (sump)
 - 2) Pump
 - 3) Valving
 - a. Pressure regulator
 - b. Manual valve
 - c. Governor valve
 - d. Shift valve
 - e. Throttle modulator valve
 - f. Down-shift valve (detent)
 - g. Scheduling valve
 - h. Orifice control valve
 - i. Cut-back valve
 - j. Relief valve
 - k. Accumulator valve
 - l. Non-return valve (ball)
 - m. Converter check valve
 - C. Torque Converters
 - 1) Elements of the converter
 - 2) Principles of converter operation
 - 3) Stator
 - 4) Converter hydraulic circuit
 - 5) Lock-up (be familiar with various methods)
 - D. Fluids
 - 1) Types

- 2) Recommended Applications
- E. Bands, Clutches, One-Way Clutches
- F. Servos

IV. Transmission/Transaxle Maintenance and Adjustments

- A. Oil Level and Condition
- B. Linkage Adjustments
 - 1) Manual
 - 2) Throttle, kickdown, and accelerator pedal
 - 3) Neutral start systems
 - 4) Gear select indicator
 - 5) Cable for throttle valve (TV) kickdown and pedal
- C. Fluid/Filter
 - 1) Filter Service
 - 2) Fluid Exchange
- D. Adjust/Repair Electrical Kickdown Switch and Circuit H. Inspect/Adjust/Replace Electronic Sensors

V. Basic Problem/Diagnosis

- A. No Drive
- B. Drive in One Range Only
- C. Moves in Range Other Than One Selected
 - 1) Bad mounts/proper alignment
 - 2) Bent linkage/frozen cables
 - 3) Linkage adjustment (cable and hard rods)
- D. Noises/Problems-Pump
 - 1) Friction plates/bands
 - 2) Lock-up shudder
 - 3) Gears
 - 4) Roller and sprag clutches
- E. Vacuum Modulators (If Equipped)
 - 1) Late shift
 - 2) Early shift
 - 3) Rough downshift
 - 4) Rough upshift
 - 5) Checking vacuum
 - 6) Exhaust smoke
- F. Shifting Late and Early/Misses Shift
- G. Rough Shifting (Upshifts/Downshifts)
- H. Vehicle Does Not Hold in "P"
- I. Slip on Upshifts
- J. Harsh Engagement in Any Gear
- K. No Downshift
- L. Leaks (Internal/External)
- M. "Hunting" Gear Selection
 - 1) External
 - 2) Internal
- N. Fluid Usage
- O. Vibration (Including Flex Plate and Converter as a cause)

- P. Converter
 - 1) Stall testing procedures
 - 2) Slipping one-way clutch/frozen stator
 - 3) Overheating
- Q. Tests/Diagnostic Procedures
 - 1) Road testing (determine shift points)
 - 2) Pressure (test plug location)
 - 3) Vacuum
 - 4) Air (clutch pack and servo operation)

VI. Electronic Automatic Transmission Diagnostics/Testing

- A. Diagnostic Trouble Codes
 - 1) Retrieving
 - 2) Interpreting
 - 3) Following Diagnostic Trouble Code Charts
- B. Testing of Inputs
 - 1) Switches
 - 2) Throttle Position Sensor
 - 3) Mass Airflow or Manifold Absolute Pressure Sensor
 - 4) Temperature Sensors
 - 5) Speed Sensors
 - 6) Range Sensors
 - 7) Governor Sensors
- C. Testing of Actuators
 - 1) Shift Solenoids
 - 2) Pressure Control Solenoids
 - 3) Torque Converter Clutch Solenoids
 - 4) Torque Converter Clutch Pulse Width Modulated Solenoids

VII. Transmission/Transaxle Repair Procedures (In-Vehicle)

- A. Fluid Leaks
 - 1) Oil Pan
 - 2) Seals
- B. Mounts
- C. Cooler Lines
- D. Electrical Connections
- E. Replacement of Sensors
- F. Driveshaft/Driveaxles
- G. Extension Housing

VIII. Transmission/Transaxle Off-Vehicle Repair

- A. Required End-Play and Clearance Checks
- B. Inspection/Assembly of Components
 - 1) Foreign material in pan
 - 2) Gears (sun, ring, and carrier assembly)
 - 3) Pumps (including housings)
 - 4) Bands and clutches
 - 5) Machined surfaces
 - 6) Control valves
 - 7) Converter assembly (including bolts and pilot area)

- 8) Turbine shaft
 - 9) Flex plate
 - 10) Parking pawl, shaft, spring, and retainer
 - 11) Accumulator
 - 12) Extension housing, case, and slip yoke
 - 13) Governor cover, valve, weights, and gears
 - 14) Seal ring grooves
 - 15) Servo (including bore, piston, seal, pin, spring, and retainers)
 - 16) Clutch drum, piston, check balls, springs, and pressure plates
 - 17) Roller and sprag clutches
 - 18) Vents
 - 19) Transaxle drive chains and sprockets
- C. Seals (Including How to Check Fit)
- 1) Metal clad
 - 2) Lip
 - 3) Flat and o-ring
 - 4) Metal seal rings
 - 5) Plastic
 - 6) Teflon
- D. Bushings
- 1) Installation/tools
- E. Thrust Washers
- 1) Torrington
 - 2) Plastic
 - 3) Phenolic resin
- F. Assembly of Components
- 1) Clutch soak
 - 2) Converter flush/test for leaks
 - 3) Install valve body following torque specifications
 - 4) Indexing the manual shift valve
 - 5) Clearance checks/end play/preload
 - 6) Lubing the converter hub
 - 7) Converter drive lug installation position
 - 8) Flushing cooler lines
 - 9) Inspect oil delivery seal rings
 - 10) Speedometer gear /sensor installation
 - 11) Valve body surface and bore measurement/repair
 - 12) Inspecting, testing, adjusting or replacing electrical/electronic computers, solenoids, sensor, relays, and switches

IX. New Automatic Transmission/Transaxle Technologies

REQUIRED TEXTBOOKS AND MATERIALS:

To be announced by the instructor.

NATEF:

This course fulfills 80 of the 125 hours required by **NATEF** for A2. See COE 111.