AUT 231 (A3)
MANUAL TRANSMISSION/TRANSAXLE AND DRIVETRAIN

COURSE DESCRIPTION:

Prerequisites: TRN 120
Corequisites: None

This course covers the operation, diagnosis, and repair of manual transmissions/transaxles, clutches, driveshafts, axles, and final drives. Topics include theory of torque, power flow, gear theory, and manual drive train servicing and repair using appropriate service information, tools, and equipment. Upon completion, students should be able to explain operational theory, diagnose and repair manual drive trains. Course Hours Per Week: Class Hours, 2; Lab, 3. Semester Credit Hours, 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, students should be able to:

a. Identify vehicle information and observe proper safety procedures.
b. Complete repair orders and use service information systems.
c. Inspect, diagnose, and repair automotive clutches.
d. Service, inspect, diagnose, and repair manual transmissions and transaxles.
e. Inspect, diagnose, and repair drivelines including; driveshafts and universal joints, half shafts, and constant velocity joints, and carrier bearings.

II. Manual Transmission/Transaxle
- A. Power Flow (3-speed, 4-speed, 5-speed, and 6-speed)
- B. Components (Identification and Replacement)
  - 1) Shafts and retainers
  - 2) Gears-nomenclature
  - 3) Bearings, bores, and bushings
  - 4) Thrust washers and thrust bearings
  - 5) Synchromesh devices-operation
  - 6) Shift levers, cables, and guides
  - 7) Interlock mechanisms/detents
  - 8) Speedometer drive gear and driven gear
  - 9) Extension housing and/or case
  - 10) Gaskets and seals (include sealants)
  - 11) Mounts/dampers
  - 12) Shifter mechanisms
  - 13) Vents
  - 14) Shift cover, grommets, and linkage (hard rods) 15. Lubrication devices
- C. Rebuilding Procedures/Clearance/Checks/Adjustments/Cleaning
  - 1) Shim/spacer selection
  - 2) End play/preload
  - 3) Shrink fit gear and bearing race installation
- D. Problem/Diagnosis
  - 1) Noises
  - 2) Jumping out of gear
  - 3) Gears do not engage
  - 4) Backlash or end-play
  - 5) Stays locked in gear
  - 6) Leaks
  - 7) Hard shifting
  - 8) Premature bearing failure

III. Drive Line
- A. Type of Drive
  - 1) Hotchkiss
  - 2) Four wheel
  - 3) Front wheel drive half shafts
    - a. Diagnose noise and vibration
    - b. Replace shaft, boots, and universal joints
- B. Types of Universal Joints
  - 1) Cross/yoke
  - 2) Constant velocity
    - a. No speed fluctuation
  - 3) Half shaft inboard and outboard joints
  - 4) Service procedures
    - a. Grease fitting direction
    - b. Relieving in order to prevent bind
    - c. "Burping" the boot
- C. Shaft Design
  - 1) Tube
  - 2) Solid
  - 3) Two-piece/three-piece
    - a. Phasing

b. Checking stub shaft runout
c. Working angle limits
d. "Odd" joint assemblies

4) Damper rings
5) Balance weights

D. Drive Shaft
1) Lateral runout
2) Companion flange runout
3) Bend

E. Problem/Diagnosis
1) Noise
a. Acceleration rumble (launch shudder)
b. Deceleration clunk or rattle
c. Squeaking/drone
d. Steer torque
e.

V. Differential Service/Adjustments
   A. Terms
      1) Preload (how measured)
      2) Backlash (how measured)
      3) Depth
      4) Pattern
   B. Drive Pinion Preload Adjustment
      1) Crush sleeve (purpose)
      2) Shims (location)
      3) New bearings versus used bearings
   C. Drive Pinion Depth Setting
      1) Shims (location)
      2) Thickness and effect of change
      3) Depth markings
      4) Depth setting tools
      5) Gear marking compound
   D. Carrier Bearing Preload
      1) Shims
      2) Threaded adjusters
   E. Ring Gear Backlash
      1) Effected by movement of carrier
      2) Shims
      3) Threaded adjusters
      4) Specifications
   F. Ring Gear Runout
   G. Differential Case Runout
   H. Tooth Contact Patterns
      1) Coast side
      2) Drive side
      3) Toe contact heavy
      4) Heel contact heavy
      5) Face contact high
      6) Flank contact low
      7) Determine correction needed
   I. Rebuilding Procedures
      1) Visual checks
      2) Housing spreader (using in conjunction with dial indicator)
      3) Clutch (cone/plate) pack replacement and adjustment
   J. Replacement
         1) Companion flange (mayor may not have attached weight)
         2) Ring and pinion (as a matched set)
         3) Case assembly
            a. “Spiders"
            b. Shaft
            c. Side gears
            d. Thrust washers
            e. Case
      4) Pinion seal

K. Problem/Diagnosis
   1) Noises
      a. Coast
      b. Drive
      c. Float
      d. On turns
      e. Chatter
      f. Seal fit
      g. Clunks
      h. Improper lubricant (limited slip differential)
      i. Limited slip differential operational test
      j. Vibration
      k. Fluid leaks
      l. Axle shaft/flange runout
      m. Bearing wear
      n. Whine/howl
   2) “Spewing” out lubricant

VI. Four-Wheel Drive Component Diagnosis and Repair
   A. Diagnose
      1) Noise
      2) Vibration
      3) Hard shifting
      4) Steering problems
   B. Inspect, Adjust, and/or Repair
      1)