This is a course that 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, re-assembly 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.
1. Demonstrate an ability to self-assess progress and development in a specific area and to further design and pursue a course of action based on the self-assessment.
2. Analyze and diagnose automotive engines and related components for correct system operation.
3. Demonstrate mastery of diagnostic tools and equipment used for automotive repair.
4. Perform precision measurement to solve power flow concerns through systematic analysis.

COURSE OBJECTIVES:
1. Pass the SP-2 Mechanical Safety and Mechanical Pollution Prevention Test.
2. Analyze and interpret 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. Retrieve and interpret service and repair information.
5. Perform precision measurements and compare against factory specifications.
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.

COURSE CONTENT:

LECTURE CONTENT:

A. Safety
   1. Basic Auto Technology shop safety instruction and demonstrations
   2. SP-2 Mechanical Safety and Mechanical Pollution Prevention tests

B. General Drive Train concepts, overview
   1. Drive Train layout
      a. Rear-wheel drive train components
      b. Front-wheel drive train components
   2. Mounting and insulating methods

C. General Drive Train Diagnosis
   1. Applicable vehicle and service Information
   2. Vehicle service history, service precautions, and Technical Service Bulletins (TSB’s)
   3. Vehicle and major component identification numbers (VIN, vehicle certification labels, calibration decals)
   4. Fluid usage, level, and condition concerns
   5. Noise, vibration and harshness concerns

D. Clutch Diagnosis and Repair
   1. Characteristics and theory of friction
   2. Clutch system components and operation
      a. Flywheel and ring gear
      b. Pressure plate assembly
      c. Clutch disk
      d. Release (throw-out) bearing
      e. Pilot bearing or bushing
      f. Clutch pedal linkage, cables, automatic adjuster mechanisms, brackets, bushings, pivots and springs
g. Hydraulic system, slave and master cylinders, lines, and hoses

E. Transmission/transaxle concepts diagnosis and repair
1. Power flow through the transmission/transaxle
2. Gear reduction and overdrive theory
3. Synchronizers
4. Bearings
5. Shift mechanisms
6. Endplay or preload (shim or spacer selection procedure) on transmission/transaxle shafts
   a. Synchronizer hub, sleeve, keys (inserts), springs, and blocking rings
   b. Speedometer drive gear, driven gear, vehicle speed sensor (VSS), retainers
   c. Transaxle final drive pinion gears (spiders), shaft, side gears, side bearings, thrust washers, and case assembly
   d. Lubrication devices (oil pump or slingers)

7. External components
   a. Shift cover, forks, levers, grommets, shafts, sleeves, detent mechanism, interlocks, and springs
   b. Transmission/transaxle sensors and switches
   c. Transmission/transaxle case, extension housing, case mating surfaces, bores, bushings, and vents
   d. Shift linkages, brackets, bushings, cables, pivots, and levers
   e. Powertrain mounts
   f. Gaskets, seals, and sealants

F. Driveshaft and Half Shaft, Universal and Constant-Velocity (CV) Joint Diagnosis and Repair
1. Constant-velocity (CV) joint noise and vibration concerns
2. Universal joint noise and vibration concerns
3. Front wheel drive (FWD), front wheel bearing
4. Shafts, yokes, boots and CV joints
5. Shaft center support bearings
6. Shaft balance, shaft runout, driveline angles
7. Companion flange and pinion seal

G. Drive Axle Diagnosis and Repair
1. Drive Shafts and Universal Joints
2. Drive shaft construction, placement, and operation.
3. Universal joints (U-joints)
4. Differentials / final drives
   a. Construction, purpose, power flow
   b. Gear reduction
   c. Differential action

H. Four-wheel Drive/All-Wheel Drive Component Diagnosis and Repair
1. System layout, construction
2. Power flow
3. 4-wheel drive shift control
4. Locking axles
5. Transfer case construction and operation
6. Electronic controls
7. Operation, shift controls
8. Electronic controls
LABORATORY CONTENT:

After acquiring the appropriate lecture information, the successful student will demonstrate skill accomplishment by completing worksheet-driven NATEF-approved tasks. NATEF (National Automotive Technicians Education Foundation) is a non-profit agency that evaluates technician training programs against standards developed by the automotive industry. All of the current NATEF approved tasks for this class are listed below, and are also contained in a separate document that is handed out on the first day of class.

MANUAL DRIVE TRAIN AND AXLES

For every task in Manual Drive Train and Axles, the following safety requirements must be strictly enforced: Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

A. General Drive Train Diagnosis

1. Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction
2. Identify and interpret drive train concern; determine necessary action
3. Research applicable vehicle and service information, such as drive train system operation, fluid type, vehicle service history, service precautions, and technical service bulletins
4. Locate and interpret vehicle and major component identification numbers
5. Diagnose fluid loss, level, and condition concerns; determine necessary action
6. Drain and fill manual transmission/transaxle and final drive unit

B. Clutch Diagnosis and Repair

1. Diagnose clutch noise, binding, slippage, pulsation, and chatter; determine necessary action
2. Inspect clutch pedal linkage, cables, automatic adjuster mechanisms, brackets, bushings, pivots, and springs; perform necessary action
3. Inspect hydraulic clutch slave and master cylinders, lines, and hoses; determine necessary action
4. Inspect and replace clutch pressure plate assembly, clutch disc, release (throw-out) bearing and linkage, and pilot bearing/bushing (as applicable)
5. Bleed clutch hydraulic system
6. Inspect flywheel and ring gear for wear and cracks; determine necessary action
7. Inspect engine block, core plugs, rear main engine oil seal, clutch (bell) housing, transmission/transaxle case mating surfaces, and alignment dowels; determine necessary action
8. Measure flywheel runout and crankshaft end play; determine necessary action

C. Transmission/Transaxle Diagnosis and Repair

1. Remove and reinstall transmission/transaxle
2. Disassemble, clean, and reassemble transmission/transaxle components
3. Inspect transmission/transaxle case, extension housing, case mating surfaces, bores, bushings, and vents; perform necessary action
4. Diagnose noise concerns using transmission/transaxle powerflow principles
5. Diagnose hard shifting and jumping out of gear concerns; determine necessary action
6. Inspect, adjust, and reinstall shift linkages, brackets, bushings, cables, pivots, and levers
7. Inspect, replace, and align powertrain mounts
8. Inspect and replace gaskets, seals, and sealants; inspect sealing surfaces
9. Remove and replace transaxle final drive
10. Inspect, adjust, and reinstall shift cover, forks, levers, grommets, shafts, sleeves, detent mechanism, interlocks, and springs
11. Measure end play or preload (shim or spacer selection procedure) on transmission/transaxle shafts; perform necessary action
12. Inspect and reinstall synchronizer hub, sleeve, keys (inserts), springs, and blocking rings
13. Diagnose transaxle final drive assembly noise and vibration concerns; determine necessary action
14. Remove, inspect, measure, adjust, and reinstall transaxle final drive pinion gears (spiders), shaft, side gears, side bearings, thrust washers, and case assembly
15. Inspect lubrication devices (oil pump or slingers); perform necessary action
16. Inspect, test, and replace transmission/transaxle sensors and switches
17. Describe the operational characteristics of an electronically controlled manual transmission/transaxle

D. Drive Shaft and Half Shaft, Universal and Constant-Velocity (CV) Joint Diagnosis and Repair
1. Diagnose constant-velocity (CV) joint noise and vibration concerns; determine necessary action
2. Diagnose universal joint noise and vibration concerns; perform necessary action
3. Remove and replace front wheel drive (FWD) front wheel bearing
4. Inspect, service, and replace shafts, yokes, boots, and CV joints
5. Inspect, service, and replace shaft center support bearings
6. Check shaft balance and phasing; measure shaft runout; measure and adjust driveline angles

E. Drive Axle Diagnosis and Repair

Ring and Pinion Gears and Differential Case Assembly
1. Diagnose noise and vibration concerns; determine necessary action
2. Diagnose fluid leakage concerns; determine necessary action
3. Inspect and replace companion flange and pinion seal; measure companion flange runout
4. Inspect ring gear and measure runout; determine necessary action
5. Remove, inspect, and reinstall drive pinion and ring gear, spacers, sleeves, and bearings
6. Measure and adjust drive pinion depth
7. Measure and adjust drive pinion bearing preload
8. 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)
9. Check ring and pinion tooth contact patterns; perform necessary action
10. Disassemble, inspect, measure, and adjust or replace differential pinion gears (spiders), shaft, side gears, side bearings, thrust washers, and case
11. Reassemble and reinstall differential case assembly; measure runout; determine necessary action

Limited Slip Differential
1. Diagnose noise, slippage, and chatter concerns; determine necessary action
2. Clean and inspect differential housing; refill with correct lubricant and/or additive
3. Inspect and reinstall limited slip differential components
4. Measure rotating torque; determine necessary action

Drive Axle Shaft
1. Diagnose drive axle shafts, bearings, and seals for noise, vibration, and fluid leakage
2. Inspect and replace drive axle shaft wheel studs
F. Practice sample ASE (A3) Manual Drive Train and Axles certification test

METHODS OF INSTRUCTION:

A. Lecture:
B. Lab:

INSTRUCTIONAL TECHNIQUES:

COURSE ASSIGNMENTS:

Reading Assignments
Required readings:
Websites
Web-based assignments: Autoshop101.com
CTEOnline.com
Other topic specific websites as needed

Out-of-class Assignments
1. Learn proper use of tools and equipment to overhaul transmissions

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

METHODS OF STUDENT EVALUATION:
Midterm Exam
Final Exam
Short Quizzes
Written Assignments
Essay Examinations
Objective Examinations
Report
Projects (ind/group)
Problem Solving Exercises
Oral Presentations
Skills Demonstration

Demonstration of Critical Thinking:
1. Analyze and troubleshoot manual drive train and axle components and restore them to proper service.
2. Analyze, confirm, and diagnose manual drivetrain faults based on symptoms indicated on repair orders.
3. Diagnose and confirm drivetrain system component failures by comparing actual readings or measurements with factory specifications.
4. Analyze wiring diagrams to determine integrity of circuits which support vehicle drivetrain systems.
Required Writing, Problem Solving, Skills Demonstration:
1. Create vehicle repair orders, perform math exercises for flat rate labor, parts and materials totals.
2. Demonstrate an understanding of gear ratio theory and concepts by performing related math exercises.
3. Use information and concepts learned in class to successfully pass a practicum exam or written test or assignment.
4. Use on-line service and repair information to compare factory specifications with actual readings and measurements acquired during drivetrain diagnostic activities.

TEXTS, READINGS, AND RESOURCES:
TextBooks:

Other:
1. Instructor prepared handouts

LIBRARY:
Adequate library resources include:

Comments:

Attachments:
*Attached Files*