



# CENTRAL PIEDMONT COMMUNITY COLLEGE

## Course Syllabus AUT 231-01 Manual Drive Trains/Axles

### Syllabus Contents:

- Course Description
- Course Objectives
- Weekly Outline
- Student Evaluation
- Safety Regulations
- Tool List

### Time Requirements:

- 8 Week Session (1/13/2014 thru 3/7/2014)
- 4 Class Hours/Week
- 6 Lab Hours/Week
- 3 Semester Hours Credit

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**Office hours: By appointment**

# AUT 231-01

## MANUAL DRIVE TRAINS/ AXLES

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**Prerequisites:** None

### **Course Description:**

This course covers the operation, diagnosis, and repair of manual transmissions/transaxles, clutches, drive shafts, axles, and final drives. Topics include theory of torque, power flow, and manual drive train service and repair using appropriate service information, tools, and equipment. Upon completion, students should be able to explain operational theory and diagnose and repair drive trains.

### **Core Competency Category:**

Critical Thinking

**Key Indicator:** *(Please choose one of more key indicators that will focus your efforts on the core competency initiative).*

### **Applies Knowledge In Practical Ways**

*Briefly describe the instructional methodology or activity designed to teach or incorporate the Core Competency:*

**Students receive classroom and hands on instruction. Topics included are principles Of operation and diagnosis of manual drive train components.**

*Briefly describe the primary methods of assessment and how they specifically measure and give feedback regarding students' attainment of the core competency. Attach any rubrics, tests, evaluation instruments, questions, etc.*

**Student teams are given a work order/lab sheet assignment on a drive train component/system.**

**Using computer based repair information, shop equipment, and tools, students will perform required diagnostic test procedures, analyze data, and then perform repairs. Students will also perform unit disassembly, measurement, and reassembly of individual components.**

**Work order data is then reviewed by the instructor and feedback is provided.**

# AUT-231-01 COURSE OBJECTIVES

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## **A. CLUTCH DIAGNOSIS AND REPAIR**

1. Diagnose clutch noise, binding, slippage, pulsation, and chatter problems; determine needed repairs.
2. Inspect, adjust, and replace clutch pedal linkage, cables and automatic adjuster mechanisms, brackets, bushings, pivots, and springs.
3. Inspect, adjust, repair, and replace hydraulic clutch slave and master cylinders, lines, and hoses.
4. Inspect, adjust, and replace release (throw-out) bearing, lever, and pivot.
5. Inspect and replace clutch pressure plate assembly and clutch disc.
6. Inspect and replace pilot bearing.
7. Inspect, repair, service, or replace flywheel and ring gear.
8. Inspect engine block, clutch (bell) housing, and transmission case mating surfaces; determine needed repairs.
9. Measure flywheel-to-block run-out and crankshaft end play; determine needed repairs.
10. Measure clutch (bell) housing bore-to-crankshaft run-out and face squareness; determine needed repairs.

## **B. TRANSMISSION DIAGNOSIS AND REPAIR**

1. Diagnose transmission noise, hard shifting, jumping out of gear, and fluid leakage problems; determine needed repairs.
2. Inspect, adjust, and replace column and floor shifter levers, cables, bushings, tubes, and springs.
3. Inspect, adjust, and replace transmission shift linkages, brackets, bushings, cables, pivots, and levers.
4. Inspect, replace and align power train mounts.
5. Inspect and replace transmission gaskets, seals, and sealant, inspect sealing surfaces.
6. Remove and replace transmission.
7. Disassemble and clean transmission components.
8. Inspect, adjust, and replace transmission shift cover, forks, grommets, levers, shafts, sleeves, detent mechanisms, interlocks, and springs.
9. Inspect and replace input (clutch) shaft and bearings.
10. Inspect and replace main shaft, gears, thrust washers, bearings, and retainers.
11. Inspect and replace synchronizer hub, sleeve, keys (inserts), springs, and blocking rings.
12. Inspect and replace counter (cluster) gear, shaft, bearings, thrust washers, and retainers; check end play, adjust as required.
13. Inspect and replace reverse idler gear, shaft, bearings, thrust washers, and retainers; check end play, adjust as required.
14. Inspect lubrication devices.
15. Inspect, repair, and replace extension housing and transmission case including mating surfaces, bores, bushings, and vents.
16. Inspect and replace speedometer drive gear, driven gear, and retainers.

## **C. TRANSAXLE DIAGNOSIS AND REPAIR**

1. Diagnose transaxle noise, hard shifting, jumping out of gear, and fluid leakage problems; determine needed repairs.
2. Inspect, adjust, and replace transaxle shift linkages, brackets, bushings, cables, pivots, and levers.
3. Inspect, replace and align power train mounts.
4. Inspect and replace transaxle gaskets, seals, and sealant; inspect sealing surfaces.
5. Remove and replace transaxle final drive (if applicable).
6. Disassemble and clean transaxle final drive (if applicable).
7. Inspect, adjust, and replace transaxle shift cover, forks, levers, grommets, shafts, sleeves, detent mechanisms, interlocks, and springs.
8. Inspect and replace input shaft and bearings.
9. Inspect and replace output shaft, gears, thrust washers, bearings, and retainers.
10. Measure end play/ preload (shim/spacer selection procedure) on all transaxles shafts; adjust as required.
11. Inspect and replace synchronizer hub, sleeve, keys (inserts), springs, and blocking rings.
12. Inspect and replace reverse idler gear, shaft, bearings, thrust washers, and retainers.
13. Inspect, repair, and replace transaxle case including mating surfaces, bores, bushings, and vents.
14. Inspect and replace speedometer drive gear, driven gear, and retainers.
15. Diagnose differential case assembly noise and vibration problems; determine needed repairs.
16. Remove and replace differential case assembly.
17. Inspect, measure, adjust and replace differential case assembly including pinion gears (spiders), shaft, side gears, thrust washers, and case.
18. Inspect and replace differential side bearings.
19. Inspect lubrication devices.

#### **D. DRIVE (HALF) SHAFT AND UNIVERSAL JOINT DIAGNOSIS AND REPAIR**

1. Diagnose FWD and RWD shaft and universal / constant-velocity (CV) joint noise and vibration problems; determine needed repairs.
2. Inspect, service, and replace FWD and RWD shafts, yokes, boots, and universal / CV joints.
3. Inspect, service, and replace shaft center support bearings.
4. Check shaft balance and run-out; determine needed repairs.
5. Measure and adjust shaft angles.

#### **E. REAR AXLE DIAGNOSIS AND REPAIR**

1. Diagnose noise, vibration, and fluid leakage problems; determine needed repairs.
2. Inspect and replace companion flange and pinion seal.
3. Inspect ring gear and measure run-out; determine needed repairs.
4. Remove and inspect drive pinion gear, spacers, sleeves, and bearings.
5. Measure and adjust drive pinion depth.
6. Measure and adjust drive pinion bearing preload.
7. Measure and adjust side bearing preload and ring and pinion backlash on a differential carrier assembly (threaded cup and shim type).
8. Check ring and pinion tooth contact pattern; make needed adjustments.
9. Disassemble, inspect, measure, and adjust or replace differential case assembly including pinion gears (spiders), shaft, side gears, thrust washers, and case.

10. Inspect and replace differential side bearings.
11. Reassemble and install differential case assembly; measure run-out; determine needed repairs.

**F. AXLE SHAFTS**

1. Diagnose rear axle shafts, bearings and seals for noise, vibration, and fluid leakage problems; determine needed repairs.
2. Inspect and replace rear axle shaft wheel studs.
3. Remove and replace rear axle shafts.
4. Inspect and replace rear axle shaft seals, bearings, and retainers.
5. R & R axle shaft bearings (pressed - on type).
6. Measure rear axle flange run-out and shaft end play; determine needed repairs.

**G. FOUR-WHEEL DRIVE COMPONENT DIAGNOSIS AND REPAIR**

1. Diagnose four-wheel drive assembly noise, vibration, hard shifting, and unusual steering problems; determine needed repairs.
2. Inspect, adjust, and repair transfer case shifting mechanisms, bushings, mounts, levers, and brackets.
3. Inspect and service transfer case and components ( includes checking lube level).
4. Inspect, service, and replace front-drive (propeller) shafts and universal joints.
5. Inspect, service, and replace front-drive axle knuckles and driving shafts.
6. Inspect, service, and replace front-wheel bearings and locking hubs.
7. Check four-wheel drive unit seals and remote vents.

**WEEKLY OUTLINE**  
**AUT 231-01**  
**MANUAL DRIVE TRAINS/AXLES**

**REQUIRED TEXT:** *Manual Drive Trains and Axles*  
*Sixth Edition c2012*  
**BY:** ***TOM BIRCH***

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**WEEK 1**

Orientation, Shop Practices, and Safety  
Reading Assignment: Chapter 1, 2

Introduction to Automotive Drive Trains  
Reading Assignment: Chapter 3

**Test- Safety**

**WEEK 2**

Clutches  
Reading Assignment: Chapter 4, 5

**Test-Chapter 3**

Manual Transmissions Fundamentals  
Worksheets in Lab (Hand-out)  
Reading Assignment: Chapter 6, 8

**Test-Chapter 4, 5**

**WEEK 3**

Manual Transaxles Fundamentals  
Worksheets in Lab (Handout)  
Reading Assignment Chapter 7, 8

**Test-Chapter 6**

**WEEK 4**

Driveline Diagnosis and Service  
Worksheets (Handout)  
Reading Assignment: Chapter 9, 10  
Driveline Vibration Service

**Test-Chapter 7, 8**

**WEEK 5**

Drive Axles Fundamentals  
Reading Assignment: Chapter11

**Test Chapter 9, 10**

**WEEK 6**

Drive Axle Service  
Reading Assignment: Chapter12

**WEEK 7**

Four Wheel Drive Systems  
Worksheets (Handout)  
Reading Assignment: Chapter 13, 14

**Test Chapter 11, 12**

**WEEK 8**

Four Wheel Drive Systems

**Test Chapter 13, 14**



# CENTRAL PIEDMONT COMMUNITY COLLEGE

## STUDENT GRADE POINT AVERAGE

Students will be graded according to the following grade point system.

Grade	Point Value	Description
A	4	Excellent
B	3	Very Good
C	2	Satisfactory
D	1	Poor
F	0	Failing

**The following grades will not be used in computing the grade point average.**

I = Incomplete		W = Withdrawal
S = Satisfactory		U = Unsatisfactory
AUD = Audit		N = Never Attended
X = Credit by Examination		

• **Since this course is preparatory to entering the automotive service industry, job attitude, neatness, promptness and care of equipment will be considered part of the final grade. The final grade on these items will be determined by the instructor and based upon accepted industry standards.**

### GRADING

#### **1. FOR A GRADE OF "A":**

- Complete all written tests with an average of 93% to 100%.
- Attend 90% of all scheduled class/lab hours.
- Complete all lab/shop work in a manner as would be determined EXCELLENT in an actual shop.

#### **2. FOR A GRADE OF "B":**

- Complete all written test with an average of 85% to 92%.
- Attend 85% of all scheduled class/lab hours.
- Complete all lab/shop work in a manner as would be determined VERY GOOD in an actual shop.

#### **3. FOR A GRADE OF "C":**

- Complete all written tests with an average of 77% to 84%.
- Attend 80% of scheduled class/lab hours.
- Complete all lab/shop work in a manner as would be determined SATISFACTORY in an actual repair shop.

#### **4. FOR A GRADE OF "D":**

- Complete all written tests with an average of 70% to 76%.
- Attend 80% of all scheduled class/lab hours.
- Complete all lab/shop work in a manner as would be determined POOR





# CENTRAL PIEDMONT COMMUNITY COLLEGE

## Transport Systems Technology - Rules and Regulations

**Year- Semester:** 2014 Spring

**Class Name:** Manual Drivetrains/Axles

**Class Number- Section:** AUT-231-01

**Instructor:** James Viehmann

As a participant in the Transport Systems Technology division of CPCC, my classes include participation in hands-on activities in a lab setting. These labs can be in a large shop or small lab facility. In order to protect myself and others from harm, I agree to participate in those labs in a safe and professional manner.

### **Dress/Appearance/Hygiene**

1. **Safety Glasses:** I agree to wear approved, non-tinted Safety Glasses at all times while in the lab.

“At all times” means from the moment I enter the lab until I leave. This includes any time working, not working, referencing a computer, washing hands, etc. If I am found to not be wearing my safety glasses appropriately (covering my eyes), I agree to the following consequences:

- a. First offense – Verbal warning from the instructor
- b. Second offense – I will be excluded from that lab for the remainder of the lab
- c. Third offense – I will be excluded from that lab for the remainder of the lab and my grade will be reduced
- d. Any offenses while underneath a vehicle – skip automatically to the next highest penalty. There are no verbal warnings; exclusion for the day is automatic and a second occurrence will affect my grade

I understand that there are no exceptions from the above penalties. *In addition, warnings and exclusions can and will be made by any member of the CPCC faculty, staff, lab facilitators, Division Director, etc., and carry the same weight.*

2. **Dress:** All students are required to wear their dealer sponsored uniform to school each day. All shirts must be clean and tucked in. Dark colored work-style pants are recommended or proper fitting jeans that meet the following requirements (length above the shoes, jeans above the hip with belt). No oversized jeans will be permitted. Shorts are not allowed. No keys, chains or wallets hanging out of pockets. Rips and tears must be mended in a timely manner. All belts must be of the type that does not have an exposed buckle, or buckle turned to side of body.

3. **Shoes:** Students must wear leather work boots/shoes. We highly recommend steel toes and oil resistant soles. No sneakers, tennis shoes, open toed shoes, or dress shoes are permitted.
4. **Jewelry:** Facial jewelry of any type is NOT permitted. This includes ear, nose, lip, eyebrow, cheek rings, studs, etc. Also prohibited are necklaces, rings (only one wedding ring permitted), or bracelets of any kind as these items may pose a safety hazard. It is strongly recommended that you not wear a wristwatch.
5. **Hats:** Hats are permitted in the shop area only! If a hat has a bill, it must be worn with it facing forward. (skullies or beanies are not permitted)
6. **Hair:** Hair that is below the collar must be pulled back appropriately. Facial hair must be well groomed and not constitute a safety hazard.
7. **Hygiene:** Good personal hygiene must be maintained at all times.

*Other appearance issues not directly covered by these rules will be considered on a case-by-case basis. CPCC staff will decide what is professional in appearance and what is not.*

### **Attendance**

8. **Attendance:** All Students are required to be on time. Students are expected to discuss tardiness with the instructor after class. Students that do not attend 80% of the classes will automatically receive a failing grade.
9. **Illness-Emergency Reporting Procedures:** All students must notify the Instructor whenever he/she will be absent and state the reason for the absence. If the Instructor cannot be reached, leave a voice mail or e-mail. If no message is received from the student, this will constitute an absence. A MESSAGE MUST BE RECEIVED.
10. **Tardiness:** Tardiness in any manner will not be tolerated. Students are expected to be in class on time both in the morning and after lunch. Class begins at exactly the scheduled time. Three unexcused tardies will result in lowering of one grade level. Six or more excused tardies will result in lowering by one grade level and /or penalty to be determined by the instructor.

### **Participation/Behavior**

11. **Participation:** Students are to participate in all areas of instruction to the fullest extent of their ability.
12. **Disrespectful Behavior:** Talking, whispering, sleeping, laying your head on the desk, passing notes, etc. while the instructor is teaching is disrespectful behavior and will not be tolerated. One warning will be given; a second violation will result in immediate dismissal from the class; third violation will result in dismissal from the program.
13. **Instructors/Staff/Guests:** All persons must be treated with full courtesy and respect. Students, during any association with the instructional staff and/or guests, shall refer to them as “Sir” or “Ma’am” as the case may be. Students are expected to sit straight in their seats and give instructors their undivided attention while in class.
14. **Language:** Profanity of any kind will not be tolerated.
15. **Cheating:** Cheating in any manner WILL NOT be tolerated. Any student caught cheating or allowing or assisting in cheating, will be immediately dismissed from the program by the Instructor.

16. **Cell Phones:** Pagers, cell phones, or other electronic devices are not to be used in class. NO EXCEPTIONS!!

17. **Food/Tobacco/Alcohol/Drugs/Medications:**

- Smoking or use of any tobacco products are not permitted on campus.
- The unlawful manufacture, distribution, dispensation, possession, or use of illegal drugs presents a hazard to students, employees, and property and is not permitted at any property in use by the College or while participating in a co-op. Any student who violates this policy is subject to disciplinary action. Refer to CPCC's Policy and Procedures No.7.01 at <http://www.cpcc.edu/administration/policies-and-procedures/7-01-drug-free-college> for complete details.
- NO FOOD OR DRINK (EXCEPT BOTTELD WATER) IS ALLOWED IN THE LAB AT ANY TIME. You may eat and drink only in the break areas or outside. Food and drink in the classroom is at the instructor's discretion.
- No alcohol is permitted on campus. If this occurs it will result in immediate dismissal from the program.
- No student is to be on campus under the influence of alcohol or with the odor of alcohol on or about them.

18. **Breaks:** Students are not permitted to gather in the hallways or other areas of the building. During breaks students are allowed in the break areas, restrooms, or outside. Students are not to block walkways or doorways.

Refer to "CPCC Student Code of Conduct and Disciplinary Procedures" and/or CPCC's Policies and Procedures at <http://www.cpcc.edu/administration/policies-and-procedures/7-students> for the College's expectations of its students.

*Any student not following these guidelines will be dismissed from class and attendance credit for that day will not be given. After a student has been warned or dismissed from class three times he or she will be dropped from the program.*

**No excuses will be considered.**

By signing this form I am attesting to the fact that I have read or had read to me and I understand all of the Rules and Regulations of Central Piedmont Community College's Transport Systems Technology program. By affixing my signature to this form I am also agreeing to abide by each and every rule. I understand that any and all violations of these rules will be made part of my record and that any violation could result in termination from this program.

Student Name (Print) \_\_\_\_\_ Date \_\_\_\_\_

Student ID# \_\_\_\_\_

Student Signature \_\_\_\_\_



# CENTRAL PIEDMONT COMMUNITY COLLEGE

## Automotive Technology, Tool List

### Safety Glasses or Goggles Mandatory in Labs

- Toolbox
- Common slotted screwdrivers, 4"x3/16, 6"x1/4, 8"x1/4
- Phillips screwdrivers number 1 and number 2
- Torx bit set T10 to T60
- Standard combination wrench set 5/16 to 1 1/4"
- Metric combination wrench set 6mm to 22mm
- 16 oz ball peen hammer
- 6" needle nose pliers
- Regular slip joint pliers
- 10 or 12" Channel Lock pliers
- 6 or 7" side cutting pliers
- Set of punches and chisels
- Feeler gauge set
- 3/8" drive socket set, including ratchet, extensions, standard and metric sockets,
  - 3/8 to 7/8 and 8mm to 17mm
- 3/8" to 1/2" socket adapter, 1/2" to 3/8" socket adapter
- 1/2" drive socket set with extensions and ratchet,
- 1/2" drive flex handle at least 18" long (breaker bar)
- 1/2" drive sockets, 7/16 to 1 1/4 and 10mm to 22mm
- 1/2" inch drive torque wrench
- Spark plug sockets 5/8" and 13/16" 3/8" drive
- Gasket scraper
- Set of Allen wrenches
- 1/4" drive socket set, standard and metric sockets, including ratchet
- Non-sparking drift punch, brass or aluminum
- Assorted snap ring pliers

**You may wish to purchase additional tools for the specific program you are enrolled in such as ASEP, BMW, T-TEN, CAP. Check with your instructor for a list.**



# CENTRAL PIEDMONT COMMUNITY COLLEGE

## Automotive Technology Safety Regulations

- An Instructor must be present any time a class or session is working in the lab

### *Use of safety glasses is required/mandatory in lab areas.*

- Any safety hazard will be reported to the instructor immediately. Floor will be kept clear of all liquids and tripping hazards.
- No equipment will be operated by students until they have received instruction on proper and safe operation of same equipment.
- Vehicle lifts must be secured with mechanical locks prior to working under vehicle
- Jack stands will be used when jacking up a vehicle for service.
- Brake asbestos "dust" will be controlled any time work is done which could lead to asbestos exposure.
- Floor exhaust system will be used anytime an engine is running in the lab.
- Use of tobacco is not permitted in any lab or classroom.
- Use of audio equipment is not permitted during class/lab hours.
- Students and faculty must follow OSHA rules concerning exposure to blood borne diseases.
- Proper disposal of automotive waste products, including hazardous wastes, is required.