



CENTRAL PIEDMONT COMMUNITY COLLEGE

Course Syllabus AUT-141 Suspension and Steering Systems General Curriculum

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Time Requirements:

- **16 Week Session**
- **2 Class Hours/Week**
- **3 Lab Hours/Week**
- **4 Semester Hours Credit**

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CENTRAL PIEDMONT COMMUNITY COLLEGE

Transport Systems Technology - Rules and Regulations

Year- Semester: 2011 Fall
Class Name: 141 Steering and Suspension
Class Number- Section: 60
Instructor: Scott Farrell

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.

AUT 141
General Curriculum
Suspension and Steering Systems

Prerequisites: None

Course description:

This course covers the principles of operation, types and diagnosis and repair of automotive suspension and steering systems. Includes steering geometry and alignment. Topics include most aspects of chassis suspension as relates to service industry. Upon completion student should be able to handle basic servicing of steering & suspension problems and components, check, adjust wheel alignment, and perform wheel servicing.

Course Objectives:

Course objectives are based upon NATEF requirements for steering and suspension automotive servicing and preparation for ASE steering and suspension test taking. Complete listing of hands on objectives can be found in student work text.

AUT 141
General Curriculum
Suspension and Steering Systems
COURSE OBJECTIVES

For every task in Suspension and Steering, the following safety requirement 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 Suspension and Steering Systems Diagnosis

1. Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction. P-1
- ~~12.~~ Identify and interpret suspension and steering concern; determine necessary action. P-1
- ~~23.~~ Research applicable vehicle and service information, such as suspension and steering system operation, vehicle service history, service precautions, and technical service bulletins. P-1
- ~~34.~~ Locate and interpret vehicle and major component identification numbers (VIN, vehicle certification labels, calibration decals). P-1

B. Steering Systems Diagnosis and Repair

1. Disable and enable supplemental restraint system (SRS). P-1
2. Remove and replace steering wheel; center/time supplemental restraint system (SRS) coil (clock spring). P-1
3. Diagnose steering column noises, looseness, and binding concerns (including tilt mechanisms); determine necessary action. P-2
4. Diagnose power steering gear (non-rack and pinion) binding, uneven turning effort, looseness, hard steering, noise, and fluid leakage concerns; determine necessary action. P-3
5. Diagnose power steering gear (rack and pinion) binding, uneven turning effort, looseness, hard steering, noise, and fluid leakage concerns; determine necessary action. P-3
6. Inspect steering shaft universal-joint(s), flexible coupling(s), collapsible column, lock cylinder mechanism, and steering wheel; perform necessary action. P-2
7. Adjust manual or power non-rack and pinion worm bearing preload and sector lash. P-3
8. Remove and replace manual or power rack and pinion steering gear; inspect mounting bushings and brackets. P-1
9. Inspect and replace manual or power rack and pinion steering gear inner tie rod ends (sockets) and bellows boots. P-1
10. ~~Inspect~~ Determine proper power steering fluid ~~level types~~; inspect fluid levels and condition. P-1
11. Flush, fill, and bleed power steering system. P-2
12. Diagnose power steering fluid leakage; determine necessary action. P-2
13. Remove, inspect, replace, and adjust power steering pump belt. P-1

14. Remove and reinstall power steering pump. P-3
15. Remove and reinstall power steering pump pulley; check pulley and belt alignment. P-3
16. Inspect and replace power steering hoses and fittings. P-2
17. Inspect and replace pitman arm, relay (centerlink/intermediate) rod, idler arm and mountings, and steering linkage damper. P-2
18. Inspect, replace, and adjust tie rod ends (sockets), tie rod sleeves, and clamps. P-1
19. Test and diagnose components of electronically controlled steering systems using a scan tool; determine necessary action. P-3
- [20. Inspect and test non-hydraulic electric-power assist steering. P-3](#)
- [21. Identify hybrid vehicle power steering system electrical circuits, service and safety precautions. P-3](#)

C. Suspension Systems Diagnosis and Repair

1. Front Suspension

1. Diagnose short and long arm suspension system noises, body sway, and uneven riding height concerns; determine necessary action. P-1
2. Diagnose strut suspension system noises, body sway, and uneven riding height concerns; determine necessary action. P-1
3. Remove, inspect, and install upper and lower control arms, bushings, shafts, and rebound bumpers. P-3
4. Remove, inspect and install strut rods (compression/tension) and bushings. P-2
5. Remove, inspect, and install upper and/or lower ball joints. [P-2P-1](#)
6. Remove, inspect, and install steering knuckle assemblies. P-2
7. Remove, inspect, and install short and long arm suspension system coil springs and spring insulators. [P-2P-3](#)
8. Remove, inspect, install, and adjust suspension system torsion bars; inspect mounts. P-3
9. Remove, inspect, and install stabilizer bar bushings, brackets, and links. P-2
10. Remove, inspect, and install strut cartridge or assembly, strut coil spring, insulators (silencers), and upper strut bearing mount. P-1
11. Lubricate suspension and steering systems. P-2

2. Rear Suspension

1. Remove, inspect, and install coil springs and spring insulators. P-2
 2. Remove, inspect, and install transverse links, control arms, bushings, and mounts. P-2
 3. Remove, inspect, and install leaf springs, leaf spring insulators (silencers), shackles, brackets, bushings, and mounts. P-3
 4. Remove, inspect, and install strut cartridge or assembly, strut coil spring, and insulators (silencers). P-2
- ### **3. Miscellaneous Service**
1. Inspect, remove, and replace shock absorbers. P-1
 2. Remove, inspect, and service or replace front and rear wheel bearings. P-1
 3. Test and diagnose components of electronically controlled suspension systems using a scan tool; determine necessary action. P-3

D. Wheel Alignment Diagnosis, Adjustment, and Repair

- ~~21~~. Diagnose vehicle wander, drift, pull, hard steering, bump steer, memory steer, torque steer, and steering return concerns; determine necessary action. P-1
- ~~32~~. Perform prealignment inspection; perform necessary action. P-1
- ~~43~~. Measure vehicle riding height; determine necessary action. P-1
- ~~54~~. Check and adjust front and rear wheel camber; perform necessary action. P-1
- ~~65~~. Check and adjust caster; perform necessary action. P-1
- ~~76~~. Check and adjust front wheel toe and center steering wheel.; adjust as needed. P-1
- ~~8. Center steering wheel. P-1~~ ~~97~~. Check toe-out-on-turns (turning radius); determine necessary action. P-2
- ~~108~~. Check SAI (steering axis inclination) and included angle; determine necessary action. P-2
- ~~119~~. Check and adjust rear wheel toe. P-2 P-1
- ~~1210~~. Check rear wheel thrust angle; determine necessary action. P-2 P-1
- ~~1311~~. Check for front wheel setback; determine necessary action. P-2
- ~~1412~~. Check front cradle (subframe) alignment; determine necessary action. P-3

E. Wheel and Tire Diagnosis and Repair

- 1. Diagnose tire wear patterns; determine necessary action. P-1
- 2. Inspect tires; check and adjust air pressure. P-1
- 3. Diagnose wheel/tire vibration, shimmy, and noise; determine necessary action. P-2
- 4. Rotate tires according to manufacturer's recommendations. P-1
- 5. Measure wheel, tire, axle, and hub runout; determine necessary action. P-2
- 6. Diagnose tire pull (lead) problem; determine necessary action. P-2
- 7. Balance wheel and tire assembly (static and dynamic). P-1
- 8. Dismount, inspect, ~~repair~~, and remount tire on wheel. P-2
- 9. Dismount, inspect, and remount tire on wheel equipped with wheel tire pressure sensor. P-3
- 10. Reinstall wheel; torque lug nuts. P-1
- 10-11. Inspect ~~and repair~~ tire and wheel assembly for air loss; perform necessary action. P-2
- 12. Repair tire using internal patch. P-1
- 13. Inspect, diagnose, and calibrate tire pressure monitoring system. P-3

Weekly Outline
AUT 141
Suspension and Steering Systems
General Curriculum

Text: (Required at class) Automotive Steering, Suspension and Alignment
James D. Halderman / Prentice Hall Publishing 7th edition

WEEK 1: Lecture: Service Info, tools and Safety and Environmental and Hazardous Materials

Assignment: Read Chapters 1 and 2, Service Info, tools and Safety and Environmental and Hazardous Materials. Complete review questions and Chapter Quiz for both Chapters 1 and 2

WEEK 2: Test on Chapters 1 and 2. Lecture: Wheels and Tires

Assignment: Read Chapter 3, Wheels and Tires. Complete review questions and Chapter Quiz

WEEK 3: Lecture: Wheel and Tire Service

Assignment: Read Chapter 5, Wheel and Tire Service. Complete Review Questions and Chapter Quiz

WEEK 4: TEST on Chapters 3 & 5. Lecture: Steering linkage and service.

Assignment: Read chapter 12, Steering linkage and service. Complete Review Questions and Chapter Quiz

WEEK 5: Test on Chapter 12. Lecture on Wheel Bearings and Service.

Assignment: Read Chapter 14, Wheel Bearings and Service. Complete Review Questions and Chapter Quiz

WEEK 6: TEST on Chapter 14. Lecture: Suspension System Components and Operation

Assignment: Read Chapter 6, Suspension System Components and Operation. Complete Review Questions

WEEK 7: Lecture: Front Suspension and Service.

Assignment: Read Chapter 7, Front Suspension and Service. Complete Review Questions and Chapter Quiz

WEEK 8: TEST on Chapter 7. Lecture: Rear Suspension and Service.

Assignment: Read Chapter 8, Rear Suspension and Service. Complete Review Questions and Chapter Quiz

WEEKS 9 & 10: TEST on Chapter 8. Lecture: Wheel Alignment Principles.

Assignment: Read Chapter 17. Complete Review Questions and Chapter Quiz for Chapter 17

WEEK 11: TEST on Chapter 17. Lecture: Alignment Diagnosis and Service.

Assignment: Read Chapter 18. Complete Review Questions and Chapter Quiz for Chapter 18

WEEK 12: TEST on Chapter 18. Lecture: Electronic Suspension Systems

Assignment: Read Chapter 9. Complete Review Questions and Chapter Quiz for Chapter 9

WEEK 13: Test on Chapter 9. Lecture: Drive axle shafts and CV Joints

Assignment: Read chapter 15

WEEK 14: Lecture: Drive Axle Shaft and CV Joint Service.

WEEK 15: On Vehicle Testing

WEEK 16: On Vehicle Testing

Final Exam

(Bold printing indicates completion mandatory)

Some quizzes requires a passing score of 100%

In shop (lab) work to be completed includes practical worksheets and turning them in to the instructor or lab facilitator Workbook sheets 2 through 37



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":

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

2. FOR A GRADE OF "B":

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

3. FOR A GRADE OF "C":

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

4. FOR A GRADE OF "D":

- a. Complete all written tests with an average of 70% to 76%.

- b. Attend 80% of all scheduled class/lab hours.
- c. Complete all lab/shop work in a manner as would be determined POOR in an actual repair shop.



CENTRAL PIEDMONT COMMUNITY COLLEGE

Automotive Department Student Dress Code Effective August 2005

All automotive students will have and wear safety glasses at all times in shop or lab areas. Failure to adhere to safety glasses rules may result in disciplinary action.

14. All students are required to wear their dealer sponsored uniform to school each day. If a student has not been sponsored by a dealer, the student may purchase approved CPCC shirts from Mr. Nicky Teeter. All shirts must be clean and tucked in. Rips and tears must be mended in a timely manner.
15. 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.** Rips and tears must be mended in a timely manner.
16. Facial jewelry of any type is **NOT** permitted. This includes ear, nose, lip, eyebrow, and cheek rings and/or studs. We also suggest that you refrain from wearing necklaces, rings, or bracelets of any kind as these items may pose a safety hazard.
17. All belts will be of the type that does not have an exposed buckle. No keys, chains or wallets hanging out of pockets. These maybe purchased from Mr. Nicky Teeter.
18. Hats are permitted in the shop area only! If a hat has a brim, it must be worn with it facing forward.
19. Students must wear leather work boots or shoes. We highly recommend oil resistant soles with steel toes. No sneakers, tennis shoes, open toed shoes, or dress shoes are permitted.
20. 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.

Any Student Not Following These Guidelines Will Be Dismissed From Class and Attendance Credit for That Day Will Not Be Given. No Excuses Will Be Considered.

- Students will bring tools required for class with them at class time.
 - **No Tools, No Lab Credit.**
- **Remember how you act and present yourself will reflect on the department and presentations to prospective employers.**



Automotive Department Student Guideline/Expectations

- No tobacco products usage is allowed inside any college building at any time.
- Eating or drinking in classrooms is with permission of instructor only; **there will be no eating or drinking in shop or lab or lab areas.**
- Students are expected to be in class on time and will be held responsible for any information covered by instructor, even if late or absent. Tests and quizzes missed may be made up only with instructor permission.
- Missed or late assignments will affect student's course grade.
- Tardiness is a problem; any student who is over 15 minutes late for a class will be counted as absent. CPCC attendance policy is in the on line student handbook.
- Students are expected to conduct themselves in a mature manner at all times. Students caught cheating, fighting, stealing, spinning tires, vandalizing or purposely damaging a vehicle or equipment will be **EXPELLED** from the automotive program. Care should be shown to college vehicles and property.
- Leaving class or shop/lab early without instructor permission will not be tolerated.
- Students are expected to come prepared for class. This means with paper, textbook, pens, pencils or other required material.
- Cell phones and pagers must be turned off during all class or lab times. Cell phones may only be used outside of the automotive buildings. Cell phones which ring during class will be subject to forfeiture or may result in student loss of privilege.
- The area in front of the main lab is not a parking area for students. The laneway must remain open for emergency vehicles. Vehicles inappropriately parked will be ticketed and towed. No parking means No Parking.
- All students are expected to clean up and put away all tools and equipment used during class or lab before leaving. Housekeeping is very important and will be part of your grade.
- Whenever you are unsure about anything ask your instructor! It is your responsibility to make sure that no physical damage occurs to any vehicle that you are working on or driving. Students are responsible for their actions!
- **Safety glasses** and student tools are mandatory in all shop/lab areas, no exceptions.
- All vehicles brought into the main lab will have a CPCC work order filled out and visible on windshield.



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
- 12-volt test light
- 1/4" drive socket set, standard and metric sockets, including ratchet
- Non-sparking drift punch, brass or aluminum
- Digital Volt, Ohm and Ammeter DVOM, with Leads Example Fluke model 83

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.