



ILLINOIS VALLEY COMMUNITY COLLEGE

COURSE OUTLINE

DIVISION: Workforce Development

COURSE: ATO 1260 Steering and Suspension Systems

Date: Spring 2022

Credit Hours: 4.5

Complete all that apply or mark "None" where appropriate:

Prerequisite(s): None

Enrollment by assessment or other measure? Yes No

If yes, please describe:

Corequisite(s): None

Pre- or Corequisite(s): None

Consent of Instructor: Yes No

Delivery Method: **Lecture** **2 Contact Hours** (1 contact = 1 credit hour)
 Seminar **0 Contact Hours** (1 contact = 1 credit hour)
 Lab **5 Contact Hours** (2-3 contact = 1 credit hour)
 Clinical **0 Contact Hours** (3 contact = 1 credit hour)
 Online
 Blended
 Virtual Class Meeting (VCM)

Offered: **Fall** **Spring** **Summer**

CATALOG DESCRIPTION and IAI NUMBER (if applicable):

This course describes the various styles of automotive suspension and steering systems and their components. They include wheel bearings, tires, shock absorbers and struts, front and rear suspension systems, steering columns, power steering, gear boxes, rack and pinion steering, four wheel steering systems, alignment angles and four-wheel alignment. The main emphasis in this class will be on performing a complete 4-wheel alignment on any vehicle.

ACCREDITATION STATEMENTS AND COURSE NOTES:

The Automotive Technology program at Illinois Valley Community College is a ASE Education Foundation Master Certified Automotive Technology Program.

The program goes through an on-site evaluation every five years and the ASE Education Foundation tasks that are taught in this course are also updated every five years to align with any changes made by the ASE Education Foundation national automotive advisory council.

COURSE TOPICS AND CONTENT REQUIREMENTS:

- I. Basic Shop Safety
 - A. Occupational Safety and Health Act
 - B. Shop Hazards
 - C. Shop Safety Rules
 - D. Shop Safety Equipment
 - E. Hazardous Waste Disposal
- II. Tools and Safety
 - A. Measuring Systems
 - B. Suspension Tools
 - C. Hydraulic Jack and Safety Stand Safety
 - D. Lift/Hoist Safety
 - E. Power Tool Safety
- III. Wheel Bearings
 - A. Bearing Loads
 - B. Tapered, Roller, Needle, and Ball Bearing Design
 - C. Front and Rear Bearing Design
 - D. FWD and RWD Bearing Design
 - E. Bearing Lubrication
 - F. Diagnosis of Bearing Problems
 - G. Proper Service and Adjustment of Tapered Roller Bearing Design
 - H. FWD Bearing Replacement
 - I. RWD Bearing Replacement
 - J. Axle Shaft Removal Procedures
- IV. Tires and Wheels
 - A. Tire Design
 - B. Tire Ratings and Sidewall Information
 - C. Specialty Tires
 - D. Replacement Tires
 - E. Tire Valves
 - F. Compact Spare Tires
 - G. Run-Flat Tires
 - H. Tire Placard Information and Location
 - I. Diagnosis of Tire Noises
 - J. Proper Tire Rotation
 - K. Tire and Wheel Service
 - L. Wheel Rim Service
 - M. Tire Changer Procedures
 - N. Tread Wear Measurements
 - O. Tire Inflation Pressure
 - P. Wheel Weights

- Q. Static Wheel Balance Procedure
- R. Dynamic Wheel Balance Procedure
- V. Shock Absorbers and Struts
 - A. Shock Absorber Designs and Ratios
 - B. Shock Absorber Operation
 - C. Nitrogen Gas-Filled Shock Absorbers and Struts
 - D. Strut Design for Front and Rear Suspension
 - E. Adjustable Struts
 - F. Load Leveling Shock Absorbers
 - G. Electronically Controlled Shock Absorbers
 - H. Visual Tests for Shocks and Struts
 - I. Bounce Tests for Shocks and Struts
 - J. Shock and Strut Replacement Procedures
 - K. Strut Cartridge Replacement Procedures
 - L. Diagnosis of Electronically Controlled Shock Absorbers
- VI. Front Suspension Systems
 - A. System Components
 - B. I-Beam Front Suspension
 - C. Short-and-Long Arm Suspension
 - D. MacPherson Strut
 - E. High Performance Front Suspension Systems
 - F. Torsion Bar Suspension
 - G. Curb Ride Height
 - H. Front Spring Sag
 - I. Front Suspension Diagnosis and Service
 - J. Control Arm Diagnosis and Service
 - K. Removing and Replacing Torsion Bars
- VII. Rear Suspension Systems
 - A. Noise, Vibration, and Harshness Identification
 - B. Live-Axle Rear Suspension Systems
 - C. Semi-Independent Rear Suspension Systems
 - D. Independent Rear Suspension Systems
 - E. Curb Ride Height and Spring Sag
 - F. Rear Suspension Diagnosis and Service
 - G. Lower Control Arm and Ball Joint Diagnosis and Replacement
- VIII. Computer-Controlled Suspension Systems
 - A. Programmed Ride Control System
 - B. Computer Command Ride Control System
 - C. Electronic Air Suspension System
 - D. Rear Load-Leveling Air Suspension System
 - E. Automatic Air Suspension System
 - F. Automatic Ride Control – Four-Wheel Drive Vehicles
 - G. Continuously Variable Road Sensing Suspension Systems
 - H. Integrated Electronic Systems
 - I. Vehicle Stability Control
 - J. Active Roll Control Systems
 - L. Inspection and Diagnosis of All Above Systems
- IX. Steering Columns and Steering Linkage Mechanisms
 - A. Conventional Non-Tilt Steering Column

- B. Tilt Steering Column
- C. Steering Linkage Mechanisms and Steering Damper
- D. Air Bag Deployment Components
- E. Air Bag Service and Repair
- F. Steering Column Diagnosis, Service, and Repair
- G. Steering Linkage Diagnosis and Repair
- X. Power Steering Pumps
 - A. Drive Belts Designs and Service
 - B. Types of Power-Assisted Steering Systems
 - C. Power Steering Pump Design
 - D. Power Steering Pumps and 42-Volt Electrical Systems
 - E. Power Steering Pump Fluid Service
 - F. Power Steering Pump Diagnosis and Service
 - G. Inspecting and Servicing Power Steering Lines and Hoses
 - H. Power Steering Hose Replacement
- XI. Recirculating Ball Steering Gears
 - A. Manual Recirculating Ball Steering Gears Design
 - B. Power Recirculating Ball Steering Gears Design
 - C. Manual Recirculating Ball Steering Gear Diagnosis and Replacement
 - D. Power Recirculating Ball Steering Gear Diagnosis and Replacement
 - E. Manual and Power Recirculating Ball Steering Gear Adjustments
- XII. Rack and Pinion Steering Gears
 - A. Manual Rack and Pinion Steering Gear Design
 - B. Power Rack and Pinion Steering Gear Design
 - C. Types of Power Rack and Pinion Steering Gears
 - D. Steering Gear Ratio
 - E. Electronic Power Steering Designs
 - F. Rack and Pinion On-Car Inspection and Removal Procedures
 - G. Manual and Power Rack and Pinion Steering Gear Adjustments
 - H. Diagnosis of Electronic Power Steering Systems
- XIII. Four-Wheel Steering Systems
 - A. Quadrasteer Four-Wheel Steering Systems
 - B. Electronically Controlled Four-Wheel Steering
 - C. Preliminary Inspection
 - D. Fail-Safe Function
 - E. Damper Control
 - F. Trouble Code Diagnosis
 - G. Rear Steering Actuator Adjustment
- XIV. Four-Wheel Alignment
 - A. Wheel Alignment Theory
 - B. Rear Wheel Alignment and Tracking Problems
 - C. Types of Wheel Alignments
 - D. Camber, Caster, and Steering Axis Inclination Fundamentals
 - E. Scrub Radius, Wheel Setback, Toe, and Turning Radius Fundamentals
 - F. Proper Pre-Alignment Inspection
 - G. Adjustments Available to Wheel Alignment Angles by OEM and Aftermarket Companies for Front and Rear Wheels
 - H. Computer Wheel Alignment Adjustment Screens
 - I. Proper Method for Centering Steering Wheel

INSTRUCTIONAL METHODS:

1. Lecture
2. Demonstrations
3. Practical (Lab)
4. Power Point
5. Videos

EVALUATION OF STUDENT ACHIEVEMENT:

1. Complete all lab objectives (ASE Education Foundation Tasks)
2. Practical Application
3. Attendance
4. Work Habits
5. Attitude
6. Safety Practices
7. Ability to Work with Others
8. Written Exams and Quizzes
9. Class Participation

INSTRUCTIONAL MATERIALS:

Textbooks

1. Electude Online software

Resources

1. Pro-Demand – Information System
2. All Data Pro - Information System

LEARNING OUTCOMES AND GOALS:

Institutional Learning Outcomes

- 1) Communication – to communicate effectively;
- 2) Inquiry – to apply critical, logical, creative, aesthetic, or quantitative analytical reasoning to formulate a judgement or conclusion;
- 3) Social Consciousness – to understand what it means to be a socially conscious person, locally and globally;
- 4) Responsibility – to recognize how personal choices affect self and society.

Course Outcomes and Competencies

ASE Education Foundation 2022 Tasks

IV. SUSPENSION AND STEERING

A. General

1. Research vehicle service information such as fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including vehicles equipped with advanced driver assistance systems (ADAS).
2. Identify suspension and steering system components and configurations.
3. Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed.
4. Disable and enable supplemental restraint system (SRS); verify indicator lamp operation.
5. Identify and interpret suspension and steering system concerns; determine needed action.

IV. SUSPENSION AND STEERING

B. Steering Systems

1. Inspect rack and pinion steering gear tie rod ends (sockets) and bellows boots; repair or replace as needed.
2. Inspect power steering fluid level and condition.
3. Drain and replace power steering system fluid; use proper fluid type per manufacturer specification.
4. Inspect for power steering fluid leakage; determine needed action.
5. Remove, inspect, replace, and/or adjust power steering pump drive belt.
6. Inspect, remove, and/or replace power steering hoses and fittings.
7. Inspect, remove, and/or replace pitman arm, relay (centerlink/intermediate) rod, idler arm, mountings, and steering linkage damper.
8. Inspect, replace, and/or adjust tie rod ends (sockets), tie rod sleeves, and clamps (non-rack and pinion).
9. Inspect and test electric power steering system; determine needed action.
10. Remove and replace steering wheel; center/time supplemental restraint system (SRS) coil (clock spring).
11. Diagnose steering column noises, looseness, and binding concerns (including tilt/telescoping mechanisms); determine needed action.
12. Diagnose power steering gear (non-rack and pinion) binding, uneven turning effort, looseness, hard steering, and noise concerns; determine needed action.
13. Diagnose power steering gear (rack and pinion) binding, uneven turning effort, looseness, hard steering, and noise concerns; determine needed action.
14. Inspect steering shaft universal joint(s), flexible coupling(s), collapsible column, lock cylinder mechanism, and steering wheel; determine needed action.
15. Remove and replace rack and pinion steering gear; inspect mounting bushings and brackets.
16. Remove and reinstall power steering pump.
17. Remove and reinstall press fit power steering pump pulley; check pulley and belt alignment.
18. Test power steering system pressure; determine needed action.

IV. SUSPENSION AND STEERING

C. Suspension Systems

1. Inspect, remove, and/or replace upper and/or lower control arms, bushings, and shafts.
2. Inspect and replace rebound/jounce bumpers.
3. Inspect, remove, and/or replace track bar, strut rods/radius arms, and related mounts and bushings.
4. Inspect, remove, and/or replace upper and/or lower ball joints (with or without wear indicators).
5. Inspect, remove, and/or replace suspension system coil springs and spring insulators.
6. Inspect, remove, and/or replace torsion bars and mounts
7. Inspect, remove, and/or replace front/rear stabilizer bar (sway bar) bushings, brackets, and links.
8. Inspect, remove, and/or replace strut assembly, strut coil spring, insulators, and upper strut bearing mount.

9. Inspect, remove, and/or replace components of suspension systems (Coil, Leaf, and Torsion).
10. Inspect, remove, and/or replace components of electronically controlled suspension systems.
11. Inspect, remove, and/or replace steering knuckle assemblies.
12. Diagnose suspension system noises, body sway, and uneven ride height concerns; determine needed action

IV. SUSPENSION AND STEERING

D. Related Suspension and Steering Service

1. Inspect, remove, and/or replace shock absorbers; inspect mounts and bushings.
2. Inspect, service, and/or replace front and rear wheel bearings.
3. Describe the function of electronically controlled suspension and steering systems and components, (i.e., active suspension and stability control).

IV. SUSPENSION AND STEERING

E. Wheel Alignment

1. Perform pre-alignment inspection; measure vehicle ride height; determine needed action.
2. Describe four-wheel alignment angles (camber, caster, and toe) and effects on vehicle handling\tire wear.
3. Prepare vehicle for wheel alignment on alignment machine; perform four-wheel alignment by checking and adjusting front caster, front and rear camber, and toe as required; center steering wheel.
4. Check toe-out-on-turns (turning radius); determine needed action.
5. Check steering axis inclination (SAI) and included angle; determine needed action.
6. Check rear wheel thrust angle; determine needed action.
7. Check for front wheel setback; determine needed action.
8. Identify front and/or rear cradle (subframe) misalignment; determine needed action.
9. Reset steering angle sensor.
10. Diagnose vehicle wander, drift, pull, hard steering, bump steer, memory steer, torque steer, and steering return concerns; determine needed action.

IV. SUSPENSION AND STEERING

F. Wheels and Tires

1. Inspect tire condition/age; identify tire wear patterns; check for correct tire size, application (service-class, load, and speed ratings), and air pressure as listed on the tire information placard/label.
2. Rotate tires according to manufacturer's recommendation including vehicles equipped with tire pressure monitoring systems (TPMS).
3. Dismount, inspect, and remount tire on wheel (with/without TPMS); balance wheel and tire assembly.
4. Inspect tire and wheel assembly for air loss; determine needed action.
5. Repair tire following tire manufacturer approved procedure.
6. Identify indirect and direct tire pressure monitoring system (TPMS); calibrate/relearn system; verify operation of instrument panel lamps.
7. Demonstrate knowledge of steps required to remove and replace sensors (per OEM/sensor manufacturer) in a tire pressure monitoring system (TPMS).
8. Perform Road Force balance/match mounting.

9. Diagnose wheel/tire vibration, shimmy, and noise; determine needed action.
10. Measure wheel, tire, axle flange, and hub runout; determine needed action.
11. Diagnose tire pull problems; determine needed action.

ASE Education Foundation - FOUNDATIONAL TASKS – 2022

Shop and Personal Safety

1. Identify general shop safety rules and procedures.
2. Utilize safe procedures for handling of tools and equipment.
3. Identify and use proper placement of floor jacks and jack stands.
4. Identify and use proper procedures for safe lift operation.
5. Utilize proper ventilation procedures for working within the lab/shop area.
6. Identify marked safety areas.
7. Identify the location and the types of fire extinguishers and other fire safety equipment; demonstrate knowledge of the procedures for using fire extinguishers and other fire safety equipment.
8. Identify the location and use of eye wash stations.
9. Identify the location of the posted evacuation routes.
10. Comply with the required use of safety glasses, ear protection, gloves, and shoes during lab/shop activities.
11. Identify and wear appropriate clothing for lab/shop activities.
12. Secure hair and jewelry for lab/shop activities.
13. Identify vehicle systems which pose a safety hazard during service such as: supplemental restraint systems (SRS), electronic brake control systems, stop/start systems, and remote start systems.
14. Identify vehicle systems which pose a safety hazard during service due to high voltage such as: hybrid/electric drivetrain, lighting systems, ignition systems, A/C systems, injection systems, etc.
15. Locate and demonstrate knowledge of safety data sheets (SDS).

Tools and Equipment

1. Identify tools and their usage in automotive applications.
2. Identify standard and metric designation.
3. Demonstrate safe handling and use of appropriate tools.
4. Demonstrate proper cleaning, storage, and maintenance of tools and equipment.

Preparing for Vehicle Service

1. Identify information needed and the service requested on a repair order.
2. Identify purpose and demonstrate proper use of vehicle protection such as: fender covers, mats, seat, and steering wheel covers.
3. Perform a vehicle walk-around inspection; identify and document existing vehicle conditions such as body damage, paint damage, windshield damage.
4. Perform a vehicle multi-point inspection and complete a vehicle inspection report.
5. Demonstrate use of the three C's (concern, cause, and correction).
6. Create a plan of action for each specific service or diagnostic situation.
7. Review vehicle service history.

8. Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction.

Preparing Vehicle for Customer

1. Ensure vehicle is prepared to return to customer per school/company policy (floor mats, steering wheel cover, etc.).

Personal Standards

1. Reports to work daily on time; able to take directions and motivated to accomplish the task at hand.
2. Dresses appropriately and uses language and manners suitable for the workplace.
3. Maintains personal hygiene appropriate for the workplace.
4. Meets and maintains employment eligibility criteria, such as drug/alcohol-free status, clean driving record, etc.
5. Demonstrates honesty, integrity, and reliability.

Work Habits / Ethic

1. Complies with workplace policies/laws.
2. Contributes to the success of the team, assists others and requests help when needed.
3. Works well with all customers and coworkers.
4. Negotiates solutions to interpersonal and workplace conflicts.
5. Contributes ideas and initiative.
6. Follows directions.
7. Communicates effectively, both in writing and verbally, with customers and coworkers.
8. Reads and interprets workplace documents; writes clearly and concisely.
9. Analyzes and resolves problems that arise in completing assigned tasks.
10. Organizes and implements a productive plan of work.
11. Uses scientific, technical, engineering and mathematics (STEM) principles and reasoning to accomplish assigned tasks.
12. Identifies and addresses the needs of all customers, providing helpful, courteous, and knowledgeable service and advice as needed.
13. Respectful of tools and property used in school and workplace environment.
14. Contributes to an inclusive environment where every coworker and customer feels welcomed, heard, and valued.