



El Camino College
 COURSE OUTLINE OF RECORD – Official

Course Acronym:	ATEC
Course Number:	16
Descriptive Title:	Suspension and Four Wheel Alignment
Division:	Industry and Technology
Department:	Automotive Technology
Course Disciplines:	Automotive Technology
Catalog Description:	This course covers the theory and operation, diagnosis, service, and repair of automotive suspension and steering systems. <i>The two-course sequence Automotive Technology 14 and 16 is the same as Automotive Technology 11.</i>
Prerequisite:	
Co-requisite:	
Recommended Preparation:	Automotive Technology 1 and Automotive Technology 22A or Automotive Technology 23 and Automotive Technology 24 and Automotive Technology 22B or Automotive Technology 25 and Automotive Technology 26 and eligibility for English 1A
Enrollment Limitation:	
Hours Lecture (per week):	2.5
Hours Laboratory (per week):	4.5
Outside Study Hours:	5
Total Course Hours:	126
Course Units:	4
Grading Method:	Letter Grade only
Credit Status:	Credit, degree applicable
Transfer CSU:	Yes
Effective Date:	03/20/1995
Transfer UC:	no
Effective Date:	
General Education: ECC	
Term:	
Other:	
CSU GE:	
Term:	
Other:	

IGETC:	
Term:	
Other:	
Student Learning Outcomes:	<p>SLO #1 Safety</p> <p>Students must comply with shop safety practices through safety exam proficiency.</p> <p>SLO #2 General</p> <p>Students will examine general suspension and steering systems.</p> <p>SLO #3 Diagnosis and Repair</p> <p>Students will have comprehension of steering, suspension, and related component systems diagnosis and repair.</p>
Course Objectives:	<ol style="list-style-type: none"> 1. Complete a safety test with 100% accuracy. 2. Select and use the proper tools and equipment safely and efficiently. 3. Inspect, test and evaluate suspension systems. 4. Perform front wheel and four wheel alignments. 5. Diagnose and repair suspension system malfunctions. 6. Inspect, test and evaluate steering systems. 7. Service and adjust steering systems. 8. Diagnose and repair steering system malfunctions. 9. Demonstrate the proper removal and installation of tires and wheels.
Major Topics:	<p>I. Shop policies safety, automotive service industry terms, precision measuring, and tools (2.5 hours, lecture)</p> <ol style="list-style-type: none"> A. Safety information and test <ol style="list-style-type: none"> 1. Course requirements 2. Safety and Pollution Prevention (SP2) 3. Shop policies B. Automotive service industry terms <ol style="list-style-type: none"> 1. Service information resources 2. Requirements for Automotive Service Excellence (ASE) certification 3. Legal rights and responsibilities under repair orders C. Precision measuring, tools and instruments <ol style="list-style-type: none"> 1. Micrometer 2. Rulers 3. Drum micrometer 4. Dial indicator D. Math and measuring instruments for ensuring measurements within specifications <p>II. Precision measuring, tool, safety, and repair orders (7 hours, lab)</p> <ol style="list-style-type: none"> A. Precision measuring <ol style="list-style-type: none"> 1. Metric and U.S. customary systems for length and torque B. Tools and equipment <ol style="list-style-type: none"> 1. Diagnostic tools for brakes, steering and suspension 2. Safety practices

- 3. Hazardous materials
- 4. Occupational Safety and Health Administration (OSHA)
- C. Repair Orders
 - 1. Vehicle inspections
 - 2. Service repair order
 - 3. Parts and labor calculations
 - 4. Using workshop, electronic or other service information

III. Tire and wheels/tire servicing and wheel balancing (2.5 hours, lecture)

- A. Tire function, construction and components
- B. Contact area
- C. Free and rolling tire diameter
- D. Tire ply and belt designs
- E. Ratings and designations in the rating
- F. Uniform Tire Quality Grading (UTQG)
- G. Static and Dynamic balance
- H. Wheel tramp and shimmy
- I. Tire pressure monitoring systems

IV. Tire and wheels/tire servicing and wheel balancing (7 hours, lab)

- A. Tire thump, vibration and steering pull
- B. Rotating tires to manufacturer's procedure
- C. Tire-and-wheel assemblies
- D. Dismounting, repairing and remounting tires
- E. Tire Pressure Monitoring Systems (TPMS)
- F. Radial and lateral runout
- G. Tire tread wear
- H. Off-car wheel balance

V. Wheel bearing/wheel bearing and seal service (2.5 hours, lecture)

- A. Purposes and types
- B. Types of loads
- C. Rear-wheel drive rear axle bearings
- D. Seal location
- E. Seals designs and purpose
- F. Garter spring for a seal lip
- G. Flutes on seal lips
- H. Grease classifications

VI. Wheel bearing/wheel bearing and seal service (3 hours, lab)

- A. Defects
- B. Cleaning
- C. Repacking
- D. Measuring end play
- E. Adjusting
- F. Seal installation
- G. Front drive axles and hub units
- H. Rear axle bearings on rear-wheel drive cars

- I. Diagnosing wheel bearings and hub units

VII. Shock absorber, strut diagnosis and service (2.5 hours, lecture)

- A. Purposes
- B. Vehicle safety
- C. Wheel jounce and rebound
- D. Shock absorber and spring operation
- E. Nitrogen gas-filled
- F. Ratios
- G. Travel-sensitive operation
- H. Adjustable shock absorber
- I. Load-leveling struts or shock absorbers

VIII. Shock absorber, strut diagnosis and service (3 hours, lab)

- A. Determining shock absorber condition
- B. Removing and replacing front and rear struts
- C. Removing and installing coil springs from struts
- D. Manufacturer's recommended strut disposal
- E. Off-car and on-car strut cartridge replacement
- F. Diagnosing noise complaints with shock absorbers and struts
- G. Electronically-controlled shock absorbers

IX. Front suspension systems/front suspension system service (9 hours, lecture)

- A. Springs
- B. Linear versus variable rate
- C. Sagged front springs effect on front end alignment and directional stability
- D. Front suspension and parts
- E. Load-carrying ball joints
- F. Short arm long arm, wishbone, McPherson, Modified McPherson, I-beam and solid axle
- G. Stabilizer bar and strut rod

X. Front suspension systems/front suspension system service (15 hours, lab)

- A. Curb riding height purpose and problems
- B. Front suspension noise and body sway
- C. Inspection, removing and replacing all front end parts
- D. Torsion bar adjusting, replacing and checking

XI. Rear suspension systems/rear suspension system service (4 hours, lecture)

- A. Leaf or coil spring rear suspension system
- B. Axle wind up
- C. Tracking bar
- D. Semi-independent and independent
- E. MacPherson and modified MacPherson strut
- F. Differential housings used in independent Rear System (IRS)
- G. Multilink independent system vibration, noise and shock

- H. Sagged rear springs affect alignment angles and steering

XII. Rear suspension systems/rear suspension system service (10 hours, lab)

- A. Rear suspension noises
- B. Sway, lateral movement and curb riding height
- C. Inspecting, removing and replacing springs and all other parts

XIII. Steering columns and linkage mechanisms diagnosis/service computer-controlled suspension system service (3 hours, lecture)

- A. Driver safety and clock spring
- B. Locking mechanisms
- C. Multi-link steering types and linkage components
- D. Rack and pinion, center take off and steering linkage
- E. Driver protection module Supplemental Restraint System (SRS)
- F. Programmed Ride Control (PRC) and electronic air suspension system
- G. Automatic Ride Control (ARC) system in relation to transfer case modes
- H. Electronic Suspension Control (ESC) and road sensing suspension system
- I. Rear electronic level control
- J. Speed-sensitive steering
- K. Stability Control System (SCS) versus Traction Control System (TCS)
- L. Safety active cruise control, lane departure warning and collision-mitigation systems

XIV. Steering columns and linkage mechanisms diagnosis (3 hours, lab)

- A. Steering service wheels
- B. Steering columns
- C. Airbag deployment modules
- D. Clock spring electrical connectors
- E. Steering columns disassemble, assemble and inspect collapsible column
- F. Steering linkage mechanisms and arms
- G. Flexible couplings and universal joints
- H. Tie-rod ends, pitman arms, center links and idler arms
- I. Steering dampers

XV. Four-wheel alignment and primary angles (10 hours, lecture)

- A. Four-wheel alignment advantages, variables and reasons
- B. Safety hazards created by wheel alignment, worn suspension or steering
- C. Camber, caster and toe
- D. Alignment effects on vehicle directional stability, steering effort and ride quality
- E. Adjustments and defects causing improper alignment
- F. Tread wear caused by inaccurate wheel alignment settings
- G. Rear axle side set, setback and dog tracking
- H. Steering Axis Inclination (SAI) and scrub radius effect on steering quality

XVI. Four-wheel alignment and primary angles (15 hours, lab)

- A. Pre-alignment inspection, ride height inspection and diagnose wheel alignment
- B. Wheel runout compensation procedure

- C. Front wheel camber, caster and toe
- D. Front and rear wheel setback
- E. Front engine cradle position
- F. SAI
- G. Rear alignment symptoms and causes of improper alignment
- H. Rear camber and toe adjustments
- I. Tracking problems

XVII. Power steering pump diagnosis and service (3 hours, lecture)

- A. Drive belts
- B. Steering components
- C. Pump reservoirs remote and in-plant
- D. Hydro-boost system and integral power steering system
- E. Power steering pump rotor designs
- F. Pressure relief
- G. Electrohydraulic power steering module
- H. Electrohydraulic Power Steering (EHPS) system
- I. Hybrid Electric Vehicle (HEV) power steering system

XVIII. Power steering pump diagnosis and service (6 hours, lab)

- A. Belt
- B. Fluid
- C. System service
- D. Pump pressure test
- E. Pumps and pump mounts inspect
- F. Pump pulleys, rotating components, seals, o-rings and integral reservoirs
- G. Flow control and pressure relief valve
- H. Power steering lines
- I. Hybrid Electric Vehicles (HEV) and EHPS systems

XIX. Rack and pinion steering gear diagnosis (3 hours, lecture)

- A. Steering system compared
- B. Rack and pinion, center take off and tie rods connections
- C. Recirculating ball steering gear and multi-link steering linkage
- D. Power steering fluid movement with the spool valve and rotary valve
- E. Electronic Variable Orifice (EVO) steering
- F. Electronic power steering
- G. Active Front Steering (AFS), Four-Wheel Steering (FWS) or Rear Active Steering (RAS)

XX. Rack and pinion steering gears/rack and pinion steering gear diagnosis (6 hours, lab)

- A. Manual or power rack and pinion steering gears
- B. Column-driven electronic power steering systems
- C. Active steering system
- D. Preliminary inspection on a Four-Wheel Steering (FWS) system

	<p>XXI. Recirculating ball steering gear diagnosis and service (3 hours, lecture)</p> <ul style="list-style-type: none"> A. Steering gear and gear ratio B. Worm shaft preload C. Sector shaft teeth and the recirculating ball teeth D. Recirculating ball steering gear constant ratio or variable ratio sector teeth E. Power steering fluid movement with engine running straight and right and left turn F. Kickback action <p>XXII. Recirculating ball steering gear diagnosis and service (6 hours, lab)</p> <ul style="list-style-type: none"> A. Manual and power recirculating ball steering gear B. Manual and power recirculating ball steering gears adjust C. Repair oil leaks D. Manual and power recirculating ball steering gears disassemble, repair and reassemble
Total Lecture Hours:	45
Total Laboratory Hours:	81
Total Hours:	126
Primary Method of Evaluation:	3) Skills demonstration
Typical Assignment Using Primary Method of Evaluation:	Prepare a two- to three-page report on the latest steering and suspension technologies being used in the automotive industry. Submit report to the instructor.
Critical Thinking Assignment 1:	Complete a three- to five-page worksheet packet that covers specific Automotive Service Education Foundation tasks for wheel alignment. Submit worksheet packet to the instructor.
Critical Thinking Assignment 2:	Perform a pre-alignment inspection on a vehicle. Set up alignment machine and perform needed repairs to correct alignment. Complete a five- to six-page report that includes specific information on the pre-alignment inspection and repairs needed to correct alignment. Submit to the instructor.
Other Evaluation Methods:	Performance exams Other exams Quizzes Reading reports Laboratory reports Class Performance Homework Problems Multiple Choice Completion Matching Items True/False Term and other papers Journal kept throughout the course
Instructional Methods:	Demonstration Discussion Field trips Group Activities

	<p>Internet Presentation/Resources</p> <p>Laboratory</p> <p>Lecture</p> <p>Multimedia presentations</p> <p>Simulation</p>
If other:	<p>Internet Presentation/Resources</p> <p>Automotive Component Models</p> <p>Collaborative Learning</p> <p>E Based Learning</p>
Work Outside of Class:	<p>Study</p> <p>Answer questions</p> <p>Skill practice</p> <p>Required reading</p> <p>Problem solving activities</p> <p>Written work</p> <p>Observation of or participation in an activity related to course content</p>
If Other:	<p>Web-based training</p>
Up-To-Date Representative Textbooks:	<p>Mark Schnubel, <u>Today's Technician: Automotive Suspension & Steering Classroom Manual and Shop Manual</u>. 7th Edition, 2020 (Bundle), Cengage Learning</p>
Alternative Textbooks:	
Required Supplementary Readings:	<p>Lab sheets, procedure sheets and automotive shop manuals</p>
Other Required Materials:	<p>Three-ring binder</p> <p>Notebook and paper</p> <p>Pen and pencil</p> <p>Safety glasses</p> <p>Shop safe clothing</p> <p>Closed-toe shoes</p> <p>Tools (optional)</p>
Requisite:	
Category:	
Requisite course(s): List both prerequisites and corequisites in this box.	

<p>Requisite and Matching skill(s): Bold the requisite skill. List the corresponding course objective under each skill(s).</p>	
<p>Requisite Skill:</p>	
<p>Requisite Skill and Matching Skill(s): Bold the requisite skill(s). If applicable</p>	
<p>Requisite course:</p>	<p>Automotive Technology 1 and Automotive Technology 22A or Automotive Technology 23 and Automotive Technology 24 and Automotive Technology 22B or Automotive Technology 25 and Automotive Technology 26</p>
<p>Requisite and Matching skill(s): Bold the requisite skill. List the corresponding course objective under each skill(s).</p>	<p>Ability to perform electrical diagnosis. ATEC 24 - Perform engine diagnosis using a flow chart. ATEC 23 - Determine engine condition by performing compression, cylinder leakage, and vacuum tests. ATEC 24 - Test and diagnosis of an engine using engine testing equipment. ATEC 26 - Perform engine diagnosis using a flow chart. ATEC 26 - Test and diagnose an engine using OBD 2 scan tools/engine analyzers. ATEC 25 - Diagnose and repair electrical circuits. ATEC 25 - Examine electrical components. ATEC 23 - Evaluate and test engine condition and performance using engine analyzer/scanner. ATEC 25 - Diagnose electrical circuits (Automotive Service Excellence (ASE) tests). ATEC 26 - Test, diagnose and repair computer controlled systems. ATEC 24 - Evaluate and repair fuel injection systems. ATEC 22A - Test, evaluate, and repair electrical circuits.</p>

	<p>ATEC 25 - Diagnose and repair computer controlled systems.</p> <p>ATEC 26 - Analyze electrical testing data and recommend repairs.</p> <p>ATEC 25 - Evaluate computer controlled components.</p> <p>ATEC 24 - Analyze computer controlled engine data and form a conclusion of recommended needed repairs.</p> <p>ATEC 23 - Interpret engine analyzer/scanner data and recommended repairs needed.</p> <p>Work safely in the automotive shop.</p> <p>ATEC 1 - Complete a safety test with 100% accuracy.</p> <p>Select and use the proper tools.</p> <p>ATEC 1 - Select and use the proper tools.</p> <p>Inspection process of tires</p> <p>ATEC 1 - Inspect and evaluate tire wear.</p> <p>Maintenance of chassis components and fluid levels.</p> <p>ATEC 1 - Perform chassis lubrication and "top off" fluid levels for steering and suspension.</p> <p>Perform diagnostic tasks using a flow chart.</p> <p>ATEC 22B - Perform engine diagnosis using a flow chart.</p> <p>Test, evaluate, and repair electrical circuits.</p> <p>ATEC 22A - Test, evaluate, and repair electrical circuits.</p> <p>Evaluate, diagnose and repair electrical systems</p> <p>ATEC 22B - Evaluate, diagnose and repair electrical systems.</p>
Requisite Skill:	Eligibility for English 1A
Requisite Skill and Matching skill(s): Bold the requisite skill. List the corresponding course objective under each skill(s). If applicable	<p>Ability to read automotive related material. Summarize, analyze, evaluate, and synthesize college-level texts.</p> <p>Ability to write an automotive report. Write a well-reasoned, well-supported expository essay that demonstrates application of the academic writing process.</p>
Enrollment Limitations and Category:	

Enrollment Limitations Impact:	
Course Created by:	Robert Beaudoin/John Lewis
Date:	09/01/1994
Original Board Approval Date:	03/20/1995
Last Reviewed and/or Revised by:	Edward Matykiewicz
Date:	03/21/2022
Last Board Approval Date:	1/17/2023