



El Camino College
 COURSE OUTLINE OF RECORD – Official

Course Acronym:	ATEC
Course Number:	11
Descriptive Title:	Brakes, Suspension and Four Wheel Alignment
Division:	Industry and Technology
Department:	Automotive Technology
Course Disciplines:	Automotive Technology
Catalog Description:	<p>This course covers the theory and operation, diagnosis, service, and repair of automotive braking, suspension, and steering systems.</p> <p><i>Note: This course is the same as the two-course sequence Automotive Technology 14 and 16. Students who have completed Automotive Technology 14 and 16 will not receive credit for Automotive Technology 11.</i></p>
Prerequisite:	
Co-requisite:	
Recommended Preparation:	Automotive Technology 1 or Automotive Technology 22B or Automotive Technology 25 AND Automotive Technology 26, eligibility for English 1A
Enrollment Limitation:	
Hours Lecture (per week):	5
Hours Laboratory (per week):	10
Outside Study Hours:	10
Total Course Hours:	270
Course Units:	8
Grading Method:	Letter Grade only
Credit Status:	Credit, degree applicable
Transfer CSU:	Yes
Effective Date:	Prior to July 1992
Transfer UC:	
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 brake, suspension, and steering systems.</p> <p>SLO #3 Diagnosis and Repair</p> <p>Students will have comprehension of hydraulic system, disc brake, drum brake, and power-assist unit, 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 safely and efficiently. 3. Inspect, test and evaluate brake systems. 4. Service and adjust brake systems. 5. Diagnose and repair brake system malfunctions. 6. Inspect, test and evaluate suspension systems. 7. Service suspension and perform front and 4 wheel alignments. 8. Diagnose and repair suspension system malfunctions. 9. Inspect, test and evaluate steering systems. 10. Service and adjust steering systems. 11. Diagnose and repair steering system malfunctions. 12. Inspect, diagnose and service tires including tire removal and mounting on a rim and balancing tire/rim assembly.
Major Topics:	<p>I. SHOP POLICIES SAFETY, AUTOMOTIVE SERVICE INDUSTRY TERMS, PRECISION MEASURING 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 (5 hours, lab)</p>

- A. Precision measuring
 - 1. Metric and U.S. customary systems for length and torque
- B. Tools and equipment
 - 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 (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. TIRES AND WHEELS/TIRE SERVICING AND WHEEL BALANCING (10 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. DISC BRAKES (10 hours, lecture)

- A. Disc brakes
- B. Basic parts
- C. Types of rotors and hub assemblies
- D. Operation of a brake caliper
- E. Different kinds and parts of a brake caliper
- F. Friction material
- G. Brake pad wear indicators
- H. Parking brakes used in rear discs
- I. Types of wheel and axle bearings

VI. DISC BRAKES (20 hours, lab)

- A. Disc brake problems and causes

- B. Brake pads
- C. Caliper
- D. Caliper overhaul
- E. Asbestos containment
- F. Brake rotors replacing, inspecting, and measuring
- G. Machining to correct dimensions and finishing on a lathe
- H. Final brake system checks and adjustments
- I. Sealed wheel bearings
- J. Tapered roller wheel bearings

VII. WHEEL BEARINGS/WHEEL BEARING AND SEAL SERVICE (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

VIII. WHEEL BEARINGS/WHEEL BEARING AND SEAL SERVICE (10 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

IX. DRUM BRAKES (10 hours, lecture)

- A. Basic parts, operation, and different types
- B. Friction linings and placements on the shoe
- C. Wheel cylinder
- D. Duo-servo
- E. Leading-trailing shoe brake
- F. Self-adjusters

X. DRUM BRAKES (20 hours, lab)

- A. Drum brake problems
- B. Brake backing plates
- C. Wheel cylinder and overhauling
- D. Lubricating
- E. Edge code identifying and selecting
- F. Identifying correct positioning of shoes
- G. Drum service
- H. Refinishing drums on a brake lathe

- I. Making final adjustments

XI. PARKING BRAKES (5 hours, lecture)

- A. Basic types
- B. Controls
- C. Types of cables
- D. Operation of disc, drum and electric parking brakes

XII. PARKING BRAKES (10 hours, lab)

- A. Diagnosing problems
- B. Inspecting the system
- C. Cleaning and replacing all system parts as needed
- D. Lubricating the system
- E. Adjusting
- F. Servicing electric parking brake systems

XIII. POWER ASSIST (5 hours, lecture)

- A. Atmospheric pressure and vacuum
- B. Power brake vacuum booster the use of atmospheric pressure and vacuum
- C. Types of vacuum boosters
- D. Parts and operation
- E. Diaphragm assembly
- F. Air and vacuum systems
- G. Single diaphragm lever-reaction vacuum booster and reaction-disc vacuum booster
- H. Tandem diaphragm
- I. Hydro-boost hydraulic power-assist system

XIV. POWER ASSIST (10 hours, lab)

- A. Vacuum power booster problems
- B. Pedal free play
- C. Vacuum supply
- D. Inspecting for vacuum leaks and check valve operation
- E. Pedal linkage, vacuuming, booster, and pushrod
- F. Vacuuming booster disassembling, repairing and adjusting
- G. Inspecting and testing for leaks and proper operation
- H. Hydro-boost and accumulator
- I. Hydro-boost system adjusting, replacing components, flushing, bleeding, and testing

XV. HYDRAULIC SYSTEMS (5 hours, lecture)

- A. Hydraulic brake lines
- B. Flares and fittings used on brake line tubing
- C. Mounting of flexible brake line hoses
- D. Strength requirements for tubing and hoses construction
- E. Precautions for working with brake tubing and hoses
- F. Metering, proportioning, combination, and pressure differential valves

- G. Brake failure warning, fluid level, and stop lamp switch

XVI. HYDRAULIC SYSTEMS (10 hours, lab)

- A. Pressure tests
- B. Resetting a pressure differential valve
- C. Inspecting for brake lines and hose
- D. Double and International Standards Organization (ISO) flares, lines, hoses and fittings
- E. Fabricating and bending brake tubing
- F. Diagnosing conditions caused by brake lines, brake hoses, and system valves
- G. Metering valves, pressure differential, and combination valves
- H. Proportioning valves and height-sensing proportioning valve
- I. Diagnosing electrical problems

XVII. ANTI-LOCK BRAKE SYSTEMS (ABS) AND ELECTRICAL BRAKING SYSTEMS (5 hours, lecture)

- A. Electronic terms use on electrical braking systems
- B. Typical ABS components and operation
- C. Integrated ABS versus nonintegrated ABS
- D. Major components of two-wheel, four-wheel, three-channel and four-channel ABS
- E. Traction Control System (TCS)
- F. Integration of braking, steering, and suspension systems

XVIII. ANTI-LOCK BRAKE SYSTEMS - ELECTRICAL BRAKING SYSTEMS (10 hours, lab)

- A. Determine if a complaint is related to base brake or anti-lock system
- B. Relieving high pressure
- C. Bleeding an ABS
- D. Diagnostic trouble codes
- E. Charting voltage and resistance tests
- F. Tests on a speed sensor
- G. Oscilloscope resistance and voltage waveform
- H. Interpreting signal waveforms
- I. Removing and replacing wheel speed sensor and ABS computer (control module)

XIX. ANTI-LOCK BRAKE SYSTEMS - ADVANCED BRAKING SYSTEMS (5 hours, lecture)

- A. Stability control and sensors used
- B. Stability control with ABS/TCS systems
- C. Active braking
- D. Cruise control systems with active braking
- E. Regenerative braking system on a hybrid vehicle

XX. ANTI-LOCK BRAKE SYSTEMS - ADVANCED BRAKING SYSTEMS (10 hours, lab)

- A. ABS/TCS system service and diagnosis
- B. Service of the stability control sensors
- C. Diagnosis of active braking

- D. General diagnosis on regenerative braking system

XXI. FRONT SUSPENSION SYSTEMS/FRONT SUSPENSION SYSTEM SERVICE (2.5 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

XXII. FRONT SUSPENSION SYSTEMS/FRONT SUSPENSION SYSTEM SERVICE (5 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

XXIII. SHOCK ABSORBER AND 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

XXIV. SHOCK ABSORBER AND STRUT DIAGNOSIS AND SERVICE (5 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

**XXV. STEERING COLUMNS AND LINKAGE MECHANISMS DIAGNOSIS / SERVICE
COMPUTER-CONTROLLED SUSPENSION SYSTEM SERVICE (5 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

XXVI. STEERING COLUMNS AND LINKAGE MECHANISMS DIAGNOSIS AND SERVICE (10 hours, lab)

- A. Steering 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

XXVII. POWER STEERING PUMP DIAGNOSIS AND SERVICE (5 hours, lecture)

- A. Drive belts
- B. Steering components
- C. Pump reservoirs remote and in-vehicle
- 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

XXVIII. POWER STEERING PUMP DIAGNOSIS AND SERVICE (10 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 Electrohydraulic power steering (EHPS) systems

XXIX. REAR SUSPENSION SYSTEMS/REAR SUSPENSION SERVICE (2.5 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

XXX. REAR SUSPENSION SYSTEMS/REAR SUSPENSION SERVICE (5 hours, lab)

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

XXXI. FOUR WHEEL ALIGNMENT, 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 Wheel Axis Inclination (SAI) and scrub radius effect on steering quality

XXXII. FOUR WHEEL ALIGNMENT, PRIMARY ANGLES (20 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. Steering Axis Inclination (SAI)
- G. Rear alignment symptoms, and causes of improper alignment
- H. Rear Camber and toe adjustments
- I. Tracking problems

XXXIII. RACK AND PINION STEERING GEAR DIAGNOSIS (2.5 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)

XXXIV. RACK AND PINION STEERING GEARS/RACK AND PINION STEERING GEAR DIAGNOSIS (5 hours, lab)

- A. Manual or power rack and pinion steering gears
- B. Manual or power rack and pinion steering gears
- C. Column-driven electronic power steering systems

	<p>D. Active steering system</p> <p>E. Preliminary inspection on a Four-Wheel Steering (FWS) system</p> <p>XXXV. RECIRCULATING BALL STEERING GEAR DIAGNOSIS AND SERVICE (2.5 hours, lecture)</p> <p>A. Steering gear and gear ratio</p> <p>B. Worm shaft preload</p> <p>C. Sector shaft teeth and the recirculating ball teeth</p> <p>D. Recirculating ball steering gear constant ratio or variable ratio sector teeth</p> <p>E. Power steering fluid movement with engine running straight, right and left turn</p> <p>F. Kickback action</p> <p>XXXVI. RECIRCULATING BALL STEERING GEAR DIAGNOSIS AND SERVICE (5 hours, lab)</p> <p>A. Manual and power recirculating ball steering gear</p> <p>B. Manual and power recirculating ball steering gears adjust</p> <p>C. Repair oil leaks</p> <p>D. Manual and power recirculating ball steering gears disassemble, repair, and reassemble</p>
Total Lecture Hours:	90
Total Laboratory Hours:	180
Total Hours:	270
Primary Method of Evaluation:	3) Skills demonstration
Typical Assignment Using Primary Method of Evaluation:	Prepare a 2-3 page report on the latest brake technologies being used in the automotive industry. Submit report to the instructor.
Critical Thinking Assignment 1:	Complete a 7-10 page worksheet packet that covers specific National Automotive Technicians Education Foundation (NATEF) tasks for Automotive Service Excellence (ASE) A5 brakes. Once the worksheet packet is complete, submit packet to the instructor for evaluation.
Critical Thinking Assignment 2:	Complete a 5-6 page report that covers specific information on working with wheel alignment. This report will be composed based of the work performed on a pre-alignment inspection, set up of alignment machine, and repairs performed to correct alignment. Once completed, submit report to the instructor for evaluation.
Other Evaluation Methods:	<p>Performance Exams</p> <p>Quizzes</p> <p>Written Homework</p> <p>Laboratory Reports</p> <p>Class Performance</p> <p>Multiple Choice</p> <p>Completion,</p> <p>Homework Problems</p> <p>Matching Items</p>

	<p>Other Exams True/False</p> <p>Class Performance, Completion, Homework Problems, Laboratory Reports, Matching Items, Multiple Choice, Other Exams, Performance Exams, Quizzes, True/False, Written Homework</p>
Instructional Methods:	<p>Demonstration Discussion Laboratory Lecture Multimedia presentations Other (please specify) Written materials Field trips Group Activities Lab Lecture</p>
If other:	<p>INTERNET PRESENTATION/RESOURCES AUTOMOTIVE COMPONENT MODELS and DEMOS</p>
Work Outside of Class:	<p>Study Answer questions Required reading Written work Journal Problem solving activity</p>
If Other:	
Up-To-Date Representative Textbooks:	<p>James D. Halderman, <u>AUTOMOTIVE CHASSIS SYSTEMS</u>, 7th edition, Prentice Hall Pearson, 2016 DISCIPLINE STANDARD</p>
Alternative Textbooks:	
Required Supplementary Readings:	
Other Required Materials:	<p>Shop safe clothing Safety glasses Closed toed shoes (leather preferred)</p>
Requisite:	
Category:	
Requisite course(s): List both prerequisites and corequisites in this box.	
Requisite and Matching skill(s): Bold the requisite skill. List the corresponding course	

objective under each skill(s).	
Requisite Skill:	
Requisite Skill and Matching Skill(s): Bold the requisite skill(s). If applicable	
Requisite course:	Automotive Technology 1 or Automotive Technology 22B or Automotive Technology 25 AND Automotive Technology 26, eligibility for English 1A
Requisite and Matching skill(s):Bold the requisite skill. List the corresponding course objective under each skill(s).	<p>Safe use of hand tools.</p> <p>ATEC 1 - Select and use the proper tools.</p> <p>Work safely in the automotive shop.</p> <p>ATEC 1 - Complete a safety test with 100% accuracy.</p> <p>ATEC 26 - Perform engine diagnosis using a flow chart.</p> <p>ATEC 22B - Perform engine diagnosis using a flow chart.</p> <p>ATEC 26 - Test, diagnose and repair electrical systems.</p> <p>ATEC 25 - Diagnose and repair electrical circuits.</p> <p>ATEC 25 - Examine electrical components.</p> <p>ATEC 25 - Diagnose electrical circuits (Automotive Service Excellence (ASE) tests).</p> <p>ATEC 26 - Test, diagnose and repair computer controlled systems.</p> <p>ATEC 22B - Evaluate, diagnose and repair electrical systems.</p> <p>ATEC 25 - Diagnose and repair computer controlled systems.</p> <p>ATEC 25 - Evaluate computer controlled components.</p> <p>ATEC 25 - Analyze electrical testing data and recommend needed repairs.</p> <p>ATEC 22B - Evaluate, test, diagnose and repair computer controlled systems.</p> <p>Ability to read automotive related material.</p> <p>Summarize, analyze, evaluate, and synthesize college-level texts.</p> <p>Ability to write an automotive report.</p> <p>Write a well-reasoned, well-supported expository essay that demonstrates application of the academic writing process.</p>
Requisite Skill:	

Requisite Skill and Matching skill(s): Bold the requisite skill. List the corresponding course objective under each skill(s). If applicable	
Enrollment Limitations and Category:	
Enrollment Limitations Impact:	
Course Created by:	John Lewis
Date:	09/01/1986
Original Board Approval Date:	
Last Reviewed and/or Revised by:	Edward Matykiewicz
Date:	03/03/2022
Last Board Approval Date:	11/21/2022