



El Camino College
 COURSE OUTLINE OF RECORD – Official

Course Acronym:	ATEC
Course Number:	43
Descriptive Title:	Engine Diagnosis & Repair
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 engines.
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:	Prior to July 1992
Transfer UC:	Yes
Effective Date:	
General Education: ECC	
Term:	
Other:	
CSU GE:	
Term:	
Other:	
IGETC:	
Term:	
Other:	

<p>Student Learning Outcomes:</p>	<p>SLO #1 Safety Exam</p> <p>Given an in-class exam, based on readings, classroom discussions and demonstrations , the student will be able to work in the Automotive Shop safely and pass the Automotive Safety Exam with 100% accuracy.</p> <p>SLO #2 Engine Analysis</p> <p>The student will perform an analysis of an engine to manufacturer specifications and complete Automotive Compression/ Cylinder Leakage Test/ Vacuum and Oil Pressure lab worksheets.</p> <p>SLO #3 Cooling System Analysis</p> <p>The student will test and analyze an automotive engine cooling system using manufacturer procedures and specifications, then complete a lab sheet.</p>
<p>Course Objectives:</p>	<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. Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction when identifying and interpreting engine concerns; determine necessary action. 4. Research applicable vehicle and service information, such as internal engine operation, vehicle service history, service precautions, and technical service bulletins by locating and interpreting a vehicle and it's major component identification numbers (VIN, vehicle certification labels, and calibration decals). 5. Inspect engine assembly for noise, vibration, fuel, oil, coolant, and other leaks; to diagnose the cause of excessive oil consumption, unusual engine exhaust color, odor, and sound; determine necessary action. 6. Perform cylinder power balance, engine vacuum tests, cylinder cranking compression tests and cylinder leakage tests; determine necessary action. 7. Install engine covers using gaskets, seals and sealers as required after removing and reinstalling cylinder heads and gaskets then tighten fasteners according to manufacturer's specifications and procedures. 8. Visually inspect cylinder head(s) for cracks; check gasket surface areas for warpage and leakage; check passage condition while inspecting valve springs for squareness and free height comparison plus valve guides for wear; check valve stem-to-guide clearance; determine necessary action. 9. Inspect valves, valve seats, pushrods, rocker arms, rocker arm pivots and shafts for wear, bending, cracks, looseness, and blocked oil passages (orifices) while also inspecting hydraulic or mechanical lifters; determine necessary action and adjust valves using either mechanical or hydraulic lifters.

	<ol style="list-style-type: none"> 10. Inspect camshaft drives (including gear wear and backlash, sprocket and chain wear); determine necessary action while inspecting and replacing timing belts (chains), overhead cam drive sprockets, and tensioners; check belt/chain tension; adjust as necessary. 11. Inspect camshaft for runout, journal wear and lobe wear plus camshaft bearing surface for wear, damage, out-of-round, alignment and establish camshaft(s) timing and cam sensor indexing according to manufacturer's specifications and procedures; determine necessary action. 12. Disassemble engine block; clean and prepare components for inspection, inspect and measure cylinder walls/sleeves for damage, wear, or ridges; plus repair common fastener and thread by removing broken bolts, restoring internal and external threads, and repairing internal threads with thread insert. 13. Inspect crankshaft for end play, straightness, journal damage, keyway damage, thrust flange and sealing surface condition, and visual surface cracks; check oil passage condition; measure journal wear; check crankshaft sensor reluctor ring (where applicable); inspect or replace crankshaft vibration damper (harmonic balancer); determine necessary action. 14. Inspect, measure, and install pistons and piston rings; determine necessary action then assemble the engine block assembly according to manufactures guidelines. 15. Perform oil and filter change after an inspection, diagnostic, and replacement of oil temperature and pressure switches and sensors combined with performing oil pressure tests, inspecting oil pump gears or rotors, housing, pressure relief devices, and pump drive; perform necessary action. 16. Perform cooling system pressure tests; check coolant condition; inspect and test radiator, pressure cap, coolant recovery tank, and hoses; determine necessary action. 17. Inspect, replace, and adjust drive belts, tensioners, and pulleys; check pulley and belt alignment after inspecting, testing, removing, and replacing water pump and radiator. 18. Inspect, test, and replace thermostat and gasket plus test coolant; drain and recover coolant; flush and refill cooling system with recommended coolant; bleed air as required plus inspect, and test fans(s) (electrical or mechanical), fan clutch, fan shroud, and air dams.
<p>Major Topics:</p>	<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
 - 1. Precision measuring, tools and instruments
 - 2. Math and measuring correcting clearances

II. Precision Measuring, Tool, Safety and Repair Orders (7 hours, lab)

- A. Precision measuring
 - 1. Metric and U.S. customary systems for distance and torque
- B. Tools and equipment
 - 1. Diagnostic tools for engine repair
 - 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. Automotive Engine Systems, Engines Configuration, Four Stroke Operation, Engine Measurement, Diesel Engines Engine and Operating Systems (7.5 hours, lecture)

- A. Engine systems, intake, exhaust, cylinder head and related components
- B. Engines configuration
- C. Engine block and related components
- D. Operation
- E. Valvetrain types
- F. Engine dimensions and ratings
- G. Operating systems starting system, lubrication system and cooling system
- H. Engine oil
- I. Anti-freeze types

IV. Diagnosing and Servicing Engine Operating Systems (11 hours, lab)

- A. Engine diagnostic and customer complaints
- B. Oil and filter change
- C. Oil temperature and pressure switches and sensors
- D. Oil pressure tests
- E. Inspect oil pump, coolers and lines
- F. Coolant system inspect, diagnostic tests and replace
- G. Coolant components and service
- H. Bi-directional control power balance and compression tests

V. Engine Materials, Fasteners, Gaskets and Seals (2.5 hours, lecture)

- A. Materials used in engine construction
- B. Usages of aluminum alloys manufacturing processes
- C. Heat treating, tempering, annealing, case hardening and shot peening
- D. Cracks in castings locating and repair
- E. Fasteners required to assemble engine
- F. Engine gaskets and different gasket materials
- G. Engine seals
- H. Room-Temperature Vulcanizing (RTV) and anaerobic sealant

VI. Repair and Replacement of Engine Fasteners, Gaskets and Seals (5.5 hours, lab)

- A. Internal thread inserts, taps and chasers
- B. External threads repairs and dies
- C. Threadlocker types and uses
- D. Replacing engine gaskets and seals
- E. Choose sealants oxygen sensor safe

VII. Intake and Exhaust Systems (2.5 hours, lecture)

- A. Air filter
- B. Intake manifolds
- C. Dual runners
- D. Engine vacuum and used to operate and control devices
- E. Exhaust system components
- F. Turbochargers and superchargers

VIII. Intake and Exhaust System Diagnosis and Service (5.5 hours, lab)

- A. Air filters
- B. Intake system vacuum leaks and drivability problems
- C. Vacuum gauge diagnostic
- D. Exhaust system inspection and restriction test
- E. Turbocharger or supercharger system proper boost and boost control

IX. Factors Affecting Engine Performance (7.5 hours, lecture)

- A. Causes of improper engine performance
- B. Engine mechanical components that seal the combustion chamber
- C. Fuel volatility and octane rating
- D. Abnormal combustion potential causes and effects

X. Diagnosing Engine Performance Concerns (11.5 hours, lab)

- A. Spark plugs evaluate and replace
- B. Nickel alloy steel electrodes versus platinum spark plugs
- C. Power balance test

- D. Blue, white and black smoke reasons and diagnostic
- E. Excessive oil consumption
- F. Cranking compression test
- G. Wet compression test and determining low readings
- H. Running compression test evaluate the condition of valvetrain
- I. Cylinder leakage test
- J. Engine noises possible causes and methods of diagnosis

XI. Engine Configurations, Mounts and Remanufactured Engines (2.5 hours, lecture)

- A. Engine configurations
- B. Mounting the engine
- C. Accessories on the engine assembly
- D. Remanufactured engine benefits and limitations

XII. Engine Removal, Engine Swap and Engine Installation (6 hours, lab)

- A. Removing an engine from front or rear wheel drive vehicle
- B. Steps required to prepare for removal
- C. Removing accessories for repair or replacement
- D. Engine cleaning methods
- E. Installing an engine on a stand

XIII. Cylinder Heads (2.5 hours, lecture)

- A. Design of a valve, including an explanation of the various parts of a valve
- B. Burned valves
- C. Valve channeling
- D. Valve seats
- E. Valve stem seals
- F. Worn valve stems
- G. Combustion chamber designs and combustion process effects on emissions and performance

XIV. Cylinder Head Disassembly, Inspection and Service (5.5 hours, lab)

- A. Removing a cylinder head and disassemble inspect and clean
- B. Valve inspection for failures or damage
- C. Wear of the valves by use of measuring instruments and specifications
- D. Cylinder head casting for cracks
- E. Mating surface warpage, amount of and recommended needed repairs
- F. Valve seat inspection
- G. Camshaft bearing bore alignment
- H. Grind valves

XV. Camshafts and Valvetrains (2.5 hours, lecture)

- A. Function of the valvetrain and parts

- B. Overhead valve valvetrains versus overhead camshaft valvetrains
- C. Camshaft lobe lift, duration, overlap and overlap benefits and limitations
- D. Methods of mounting the rocker arms
- E. Rocker arm geometry

XVI. Valvetrain Service (5.5 hours, lab)

- A. Camshaft inspect for straightness, measure lobes and journals
- B. Lifters solid inspect and determine repairs and hydraulic leak-down test determine repairs
- C. Pushrods and rocker arm geometry
- D. Rocker arms
- E. Valve springs evaluate and measure
- F. Adjusting the valvetrain
- G. Cylinder head reinstall

XVII. Timing Mechanisms (5 hours, lecture)

- A. Valve timing system
- B. Timing chain system
- C. Timing belt system
- D. Gear-driven timing system
- E. Interference engine versus a freewheeling engine
- F. Variable valve timing systems operation of variable valve timing or variable lift system

XVIII. Timing Mechanism Service (5.5 hours, lab)

- A. Jumped or broken timing mechanism
- B. Performing a chain/belt deflection test and interpreting the results
- C. Inspecting the timing belt and assembly
- D. Extent of damage on an interference engine with the customer before offering an estimate
- E. Time the timing mechanism on an Overhead Cam (CHC) or Overhead Valve (OHV) engine using a timing belt or chain
- F. Variable valve timing

XIX. Engine Block Construction (7.5 hours, lecture)

- A. Construction and components
- B. Short block, long block and crate engine and their uses
- C. Crankshaft and the relationship of crankshaft throw to stroke and firing impulses
- D. Forces applied to the crankshaft
- E. Manufacturing processes and materials used in crankshaft design
- F. Harmonic balancer and flywheel

	<p>XX. Short Block Component Service and Engine Assembly (12.5 hours, lab)</p> <ul style="list-style-type: none"> A. Inspecting and performing accurate failure analysis and determining condition on major engine components B. Inspecting connecting rods for and bends and twists C. Reconditioning connecting rods D. Press-fit and full-floating piston pins E. Piston rings F. Installing camshaft bearings and camshaft into an OHV engine G. Crankshaft installation then measuring end play, main bearings clearance and rod bearings clearance H. Oil clearances I. Installing the piston assemblies <p>XXI. Alternative Fuel and Advanced Technology (2.5 hours, lecture)</p> <ul style="list-style-type: none"> A. Alternative fuel vehicle use B. Propane vehicles C. E85 and Flexible Fuel Vehicles (FFV) D. Compressed Natural Gas (CNG) vehicles <ul style="list-style-type: none"> 1. Cylinder safety 2. Vehicle safety 3. Vehicle operation E. Electric vehicles F. Hybrid Electric Vehicles (HEV) <ul style="list-style-type: none"> 1. Operation 2. Batteries and electric motors 3. Other hybrid technology components G. Fuel cell vehicles <p>XXII. Alternative Fuel and Advanced Technology Vehicle Service (5.5 hours, lab)</p> <ul style="list-style-type: none"> A. Servicing propane-fueled engines B. Servicing CNG vehicles C. Servicing HEV D. Servicing the Toyota Prius and Honda Civic Hybrid E. HEV warranties
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:	Complete a twenty-five to thirty-page worksheet packet that covers specific National Automotive Technicians Education Foundation (NATEF) tasks for Automotive Service Excellence (ASE) A1 Engine Repair. Submit worksheet packet to the instructor.
Critical Thinking Assignment 1:	Prepare a three- to five-page report on the evaluation of the condition and needed repairs following the teardown of the engine assembly.

	Submit report to the instructor for evaluation on the correct processes used.
Critical Thinking Assignment 2:	Given a problem with an engine, research shop manual diagnostic references. Report findings on a one-page repair order indicating correct repair procedures and perform needed repairs according to manufacturer's specifications. Submit report to the instructor for evaluation.
Other Evaluation Methods:	Performance Exams Other Exams Quizzes Laboratory Reports Class Performance Homework Problems Multiple Choice Completion Matching Items True/False
Instructional Methods:	Demonstration Discussion Laboratory Lecture Multimedia presentations Field trips Guest speakers
If other:	Internet Presentation/Resources Automotive Component Models Collaborative Learning E Based Learning Learning Management System (LMS) based learning
Work Outside of Class:	Study Answer questions Required reading Problem solving activities Written work Skill practice Observation of or participation in an activity related to course content
If Other:	
Up-To-Date Representative Textbooks:	Ken Pickerill, <u>Today's Technician™ Classroom Manual and Shop Manual: for Automotive Engine Performance</u> , 6th Edition, 2020
Alternative Textbooks:	
Required Supplementary Readings:	
Other Required Materials:	Three-ring binder Notebook and paper Pen and pencil Safety glasses Shop safe clothing

	Closed toe shoes Tools (optional)
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 and Automotive Technology 22A or Automotive Technology 23 and Automotive Technology 24 and Automotive Technology 22B or Automotive Technology 25 and Automotive Technology 26
Requisite and Matching skill(s):Bold the requisite skill. List the corresponding course objective under each skill(s).	<p>Ability to use the correct tools in the automotive lab.</p> <p>ATEC 1 - Select and use the proper tools.</p> <p>Complete safety exam with 100% accuracy.</p> <p>ATEC 1 - Complete a safety test with 100% accuracy.</p> <p>Ability to perform a compression test and evaluate the engine condition from the results of the compression test.</p> <p>ATEC 1 - Perform an analysis of engine condition by conducting a compression test.</p> <p>Ability to pressure test the cooling system and evaluate the systems condition and check for leaks in the system.</p> <p>ATEC 1 - Service, test, and evaluate a liquid cooling system.</p> <p>Ability to inspect and change the oil filter and engine oil on a vehicle.</p> <p>ATEC 1 - Perform an engine oil and filter change.</p> <p>Ability to perform electrical diagnosis.</p> <p>ATEC 24 - Perform engine diagnosis using a flow chart.</p> <p>ATEC 23 - Determine engine condition by performing compression,</p>

	<p>cylinder leakage, and vacuum tests.</p> <p>ATEC 24 - Test and diagnosis of an engine using engine testing equipment.</p> <p>ATEC 26 - Perform engine diagnosis using a flow chart.</p> <p>ATEC 26 - Test and diagnose an engine using OBD 2 scan tools/engine analyzers.</p> <p>ATEC 25 - Diagnose and repair electrical circuits.</p> <p>ATEC 25 - Examine electrical components.</p> <p>ATEC 23 - Evaluate and test engine condition and performance using engine analyzer/scanner.</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 24 - Evaluate and repair fuel injection systems.</p> <p>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>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	Ability to read automotive related material.

corresponding course objective under each skill(s). If applicable	Summarize, analyze, evaluate, and synthesize college-level texts. Basic writing and report preparation. Write a well-reasoned, well-supported expository essay that demonstrates application of the academic writing process.
Enrollment Limitations and Category:	
Enrollment Limitations Impact:	
Course Created by:	Hiram T. Hironaka
Date:	10/20/1985
Original Board Approval Date:	
Last Reviewed and/or Revised by:	Mike Anderson
Date:	05/10/2020
Last Board Approval Date:	1/17/2023