



El Camino College
 COURSE OUTLINE OF RECORD – Official

Course Acronym:	ATEC
Course Number:	23
Descriptive Title:	Engine Performance, Electrical and Fuel Systems
Division:	Industry and Technology
Department:	Automotive Technology
Course Disciplines:	Automotive Technology
Catalog Description:	<p>This course covers the study of major engine tune-up, service and testing of emission control systems. Laboratory activities stress the proper use of test equipment utilized in the automotive field.</p> <p><i>Note: The two-course sequence Automotive Technology 23 and 24 is equivalent to Automotive Technology 22A.</i></p>
Prerequisite:	
Co-requisite:	
Recommended Preparation:	Automotive Technology 1 or equivalent
Enrollment Limitation:	
Hours Lecture (per week):	3
Hours Laboratory (per week):	3
Outside Study Hours:	6
Total Course Hours:	108
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:	
Student Learning Outcomes:	<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 using the Automotive Compression/ Cylinder Leakage Test/ Vacuum Testing lab worksheet to manufacturer specifications.</p> <p>SLO #3 Engine Condition and Performance</p> <p>The student will test and evaluate engine condition and performance using an Engine Analyzer / Scanner lab worksheet to manufacturer specifications.</p>
Course Objectives:	<ol style="list-style-type: none"> 1. Demonstrate 100% accuracy on a safety test. 2. Distinguish between various engine components. 3. Determine engine condition by performing compression, cylinder leakage, and vacuum tests. 4. Measure and adjust valve lash. 5. Distinguish ignition components. 6. Evaluate, test, and service ignition systems. 7. Evaluate and test engine condition and performance using engine analyzer/scanner. 8. Analyze ignition scope patterns. 9. Diagnose and repair ignition systems. 10. Evaluate, inspect, and test fuel systems. 11. Evaluate, service, and test emission control systems. 12. Distinguish emission control components. 13. Interpret engine analyzer/scanner data and recommended repairs needed.
Major Topics:	<p>I. Course Overview and Safety (6 hours, lecture)</p> <ol style="list-style-type: none"> A. Safety information and test <ol style="list-style-type: none"> 1. Course requirements 2. Online Safety and Pollution Prevention training (S/P2) 3. Shop policies B. Personal Protective Equipment (PPE) C. Shop and environmental hazards <ol style="list-style-type: none"> 1. Commonly used shop chemicals 2. Safety Data Sheets (SDS) 3. Tool and shop equipment hazards D. Proper hand/power tool and shop equipment identification and usage E. Vehicle hoist operation F. Service information accessing procedures <ol style="list-style-type: none"> 1. Published repair procedures and specifications

- G. Repair orders
 - 1. Proper procedures and legal guidelines
 - 2. California Department of Consumer Affairs, Bureau of Automotive Repair (BAR) - "Write It Right"
 - 3. Purpose and workflow process
- H. Technician training and certifications

II. Tools and Safety (6 hours, lab)

- A. PPE usage
- B. Shop safety rules demonstration
 - 1. Proper hand tool identification and usage
 - 2. Shop equipment identification and usage
- C. Safe work area maintenance
 - 1. In-shop vehicle handling
 - 2. Proper in-shop engine emissions venting
 - 3. Safe vehicle hoisting
 - 4. Clean up procedures
- D. Automotive Service Excellence (ASE) technician certification process A-1 through A-8 lab sheet
- E. Properly complete vehicle repair work order
- F. Introduction to a Digital Volt-Ohmmeter (DVOM), Volt/Amperage Tester (VAT) and a Digital Storage Oscilloscope (DSO)

III. Engine Design and Operation (6 hours, lecture)

- A. Basic engine construction and engine performance
- B. Cooling, fuel, and air induction systems
- C. Introduction to ignition systems
 - 1. Distributor ignition systems
 - 2. Distributorless ignition systems
- D. Introduction to emission control systems
 - 1. Exhaust Gas Recirculation (EGR)
 - 2. Positive Crankcase Ventilation (PCV)
 - 3. Catalytic converter
 - 4. Evaporative emissions control systems
 - 5. Secondary Air Injection
- E. Differences between On Board Diagnostics Generation One (OBD I) and Generation Two (OBD II)

IV. General Engine Condition Diagnosis (6 hours, lab)

- A. General diagnostic procedure
 - 1. Accessing service information
 - 2. Diagnostic flow charts
 - 3. Fixing it right the first time
- B. Diagnosing fuel, engine oil and coolant leaks
- C. Diagnosing engine exhaust odor, color, and noise
- D. Engine overheating problems
 - 1. Pressure test the cooling system
- E. Diagnosing engine defects
 - 1. Intake manifold vacuum readings
 - 2. Engine power balance test

- 3. Engine compression test
- 4. Cylinder leakage test
- F. Performing valve adjustments on mechanical and hydraulic lifters

V. Distributor Ignition (18 hours, lecture)

- A. Major functions of the ignition system
- B. Operating conditions that affect ignition timing
- C. Basic operation of Distributor ignition systems and distributorless ignition systems
 - 1. Ignition primary circuit
 - 2. Ignition secondary circuit
 - 3. Ignition dwell
 - 4. Ignition triggering devices
 - 5. Spark timing systems
- D. Engine position sensors
- E. Spark plug internal design
 - 1. Hot and cold range spark plugs

VI. Distributor Ignition System Diagnosis and Service (18 hours, lab)

- A. Visual inspection and testing of ignition system components
 - 1. Ignition system troubleshooting using an oscilloscope
 - 2. Ignition system testing using a voltmeter, ohmmeter and test light
- B. Spark plug Removal and Replacement (R&R)
- C. Ignition timing testing and setting procedure
- D. Ignition spark advance evaluation

VII. Electronic Ignition (EI) Systems (6 hours, lecture)

- A. Purpose of the electronic control unit
- B. Spark timing systems
 - 1. Electronic switching systems
 - 2. Engine position sensors
- C. Fuel injection system reliance
- D. Distributorless EI systems
 - 1. Advantages and operation
 - 2. Secondary ignition wiring connections
- E. Coil-On-Plug (COP) operating principles
- F. Ion and compression sense ignition

VIII. Electronic EI Diagnosis and Service (6 hours, lab)

- A. No-start condition diagnosis
- B. Coil testing
- C. Camshaft and crankshaft sensor R&R and adjustment procedure
- D. Camshaft and crankshaft sensor test
- E. Magnetic sensor test
 - 1. Pickup coil/magnetic pulse generator
 - 2. Hall-effect switch

- F. Compression sense ignition diagnosis
- G. Ion sense ignition diagnosis

IX. Fuel Systems (6 hours, lecture)

- A. Performance characteristics of gasoline
 - 1. Octane ratings
 - 2. Various types of gasoline and additives
- B. Comparisons with different alternative fuels, including diesel
 - 1. Principles of operation of a fuel injection system
- C. Advantages of fuel injection
- D. Differences between Direct Fuel Injection (DFI) and Port Fuel Injection (PFI) systems
- E. Difference between a Sequential Fuel Injection (SFI) system and a Multiport Fuel Injection (MFI) system
- F. Design and function of major Electronic Fuel Injection (EFI) components
- G. Fuel tank design, mounting, fuel tank filler, and filler cap design
- H. Types of fuel lines and fuel line fittings
- I. Fuel filter designs and mountings
 - 1. Electric fuel pump operation
 - 2. Relief valve and check valve
 - 3. Pulse width modulated fuel pump systems
- J. Purpose of the inertia switch in a fuel pump circuit
- K. Purpose of the fuel pressure sensor in direct fuel injection systems
- L. Direct fuel injection basic operation

X. Fuel System Diagnosis and Service (6 hours, lab)

- A. Fuel system visual inspection
- B. Fuel alcohol content testing
- C. Fuel system pressure relief procedure
- D. Fuel tank inspection and service
- E. Electric fuel pump assembly R&R, inspection and service
- F. Fuel line and tubing inspection and service
- G. R&R fuel filter
- H. Electric fuel pump testing and service
 - 1. Electric fuel pump pressure and volume output test
 - 2. Pulse width modulated fuel system description and operation

XI. Electronic Fuel Injection (12 hours, lecture)

- A. Principles of operation of a fuel injection system
- B. DFI fuel systems
- C. Purpose of Variable valve timing and an Intake Manifold Tuning Valve (IMTV)
- D. Design and function of EFI systems
 - 1. Computer corrected air-fuel ratio MFI operational mode comparisons
- E. Pressure regulator operation
 - 1. Returnless EFI system
 - 2. Two-way return type system
- F. Central injector and poppet nozzles operation in a Central Port Injection (CPI) system

	<p>G. Idle Air Control bypass air motor (IAC) operation of the Throttle Actuator Control (TAC) system</p> <p>XII. Electronic Fuel Injection Diagnosis and Service (12 hours, lab)</p> <p>A. Fuel injection system preliminary diagnostic procedure</p> <p>B. Throttle body assembly removal, inspection, cleaning and installation</p> <p>C. Incorrect fuel pressure analysis</p> <p>D. Injector balance test</p> <ol style="list-style-type: none"> 1. Determine injector condition 2. Clean injectors <p>E. Injector sound, ohmmeter, and noid light test</p> <p>F. Fuel pump check valve and pressure regulator valve leakage check</p> <p>G. R&R fuel rail, injectors, and fuel pressure regulator</p> <p>H. Improper idle speed cause identification</p> <ol style="list-style-type: none"> 1. IAC diagnosis 2. IAC bypass air motor diagnosis 3. Remove, replace, and clean idle air control bypass air motors and related throttle body passages 4. IAC bypass air valve testing and analysis
Total Lecture Hours:	54
Total Laboratory Hours:	54
Total Hours:	108
Primary Method of Evaluation:	3) Skills demonstration
Typical Assignment Using Primary Method of Evaluation:	Draw a complete block diagram of a contemporary automotive ignition system. Submit diagram to the instructor.
Critical Thinking Assignment 1:	Perform a vehicle under-hood inspection. Analyze data using manufacturer's specifications to determine recommended service and/or repairs and parts required. Record findings on a vehicle under-hood inspection report and submit to the instructor.
Critical Thinking Assignment 2:	Perform a compression test on an engine and record data on a compression test lab sheet. Analyze data using the manufacturer's specifications to determine recommended service and/or repairs and parts required. Record findings on a compression test lab sheet and submit to the instructor.
Other Evaluation Methods:	<p>Performance Exams</p> <p>Other Exams</p> <p>Quizzes</p> <p>Laboratory Reports</p> <p>Class Performance</p> <p>Multiple Choice</p> <p>Completion</p> <p>Matching Items</p> <p>True/False</p> <p>Other (specify): PERFORMANCE OF MANUFACTURER'S SERVICE PROCEDURES</p>

Instructional Methods:	Demonstration Discussion Field trips Group activities Guest speakers Laboratory Lecture Multimedia presentations
If other:	COMPONENT MODELS
Work Outside of Class:	Problem solving activity Required reading Study
If Other:	
Up-To-Date Representative Textbooks:	James D. Halderman, <u>AUTOMOTIVE ENGINE PERFORMANCE</u> , 5th edition, Prentice Hall, 2017, Discipline Standard
Alternative Textbooks:	
Required Supplementary Readings:	Lab sheets, procedure sheets and manufacturer's service manuals
Other Required Materials:	Three ring binder notebook and paper Pen and pencil Safety glasses Shop safe clothing
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

Requisite and Matching skill(s): Bold the requisite skill. List the corresponding course objective under each skill(s).	<p>Safe use of automotive hand tools.</p> <p>A TEC 1 - Select and use the proper tools.</p> <p>Work safely in the automotive shop.</p> <p>A TEC 1 - Complete a safety test with 100% accuracy.</p>
Requisite Skill:	or equivalent
Requisite Skill and Matching skill(s): Bold the requisite skill. List the corresponding course objective under each skill(s). If applicable	If students have not taken Automotive Technology 1 but have taken a similar course at another college or have basic automotive work experience, students will have the skills needed to take this course. It is highly recommended that students have basic automotive skills to enhance their success in this course.
Enrollment Limitations and Category:	
Enrollment Limitations Impact:	
Course Created by:	Robert E. Beaudoin
Date:	10/25/1985
Original Board Approval Date:	
Last Reviewed and/or Revised by:	Michael Anderson
Date:	03/03/2022
Last Board Approval Date:	12/19/2022