



El Camino College
COURSE OUTLINE OF RECORD – Official

Course Acronym:	ATEC
Course Number:	26
Descriptive Title:	Automotive Testing and Diagnosis
Division:	Industry and Technology
Department:	Automotive Technology
Course Disciplines:	Automotive Technology
Catalog Description:	<p>This course covers the study of advanced automotive testing and diagnostic procedures of modern computer controlled engine management systems including ignition, fuel trim, electrical and electronic systems, On-board Diagnostics generation II (OBD II) computer control systems and related network multiplexing and communications. Electronic body control operations, networking and diagnostics are also explored. Laboratory activities stress the proper use of modern diagnostic equipment utilized in the automotive field.</p> <p><i>Note: The two course sequence Automotive Technology 25 and 26 is the same as Automotive Technology 22B.</i></p>
Prerequisite:	A total of 8 units from the following courses: Automotive Technology 22A, Automotive Technology 23, Automotive Technology 24, Automotive Technology 25 with a minimum grade of C in prerequisite or equivalent
Co-requisite:	
Recommended Preparation:	
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:	Approved
Transfer UC:	No
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 Powertrain Control Module</p> <p>The student will be able to test the performance of the automotive computer controlled system using the Automotive Powertrain Control Module Data lab worksheet and manufacturer specifications.</p> <p>SLO #3 Engine Condition & 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. Complete a safety test with 100% accuracy. 2. Perform an analysis of an engine by performing compression, cylinder leakage, cylinder balance and vacuum testing. 3. Perform engine diagnosis using a flow chart. 4. Test, diagnose and repair electrical systems. 5. Test and diagnose an engine using OBD II scan tools/engine analyzers. 6. Evaluate and repair fuel systems. 7. Diagnose and evaluate emission systems. 8. Test, diagnose and repair computer controlled systems. 9. Evaluate and repair fuel injection systems. 10. Analyze digital engine analyzer data and recommend repairs. 11. Analyze electrical testing data and recommend repairs. 12. Analyze computer controlled engine data and recommend repairs. 13. Distinguish between various engine component.
Major Topics:	<p>I. Course Overview and Safety (1.5 hours, lecture)</p> <ol style="list-style-type: none"> A. Personal Protective Equipment (PPE) B. Shop and environmental hazards <ol style="list-style-type: none"> 1. Commonly use shop chemicals 2. Material Safety Data Sheets (MSDS) 3. Tool and shop equipment hazards C. Proper hand/power tool and shop equipment identification and usage D. Vehicle hoist operation

- E. Service information accessing procedures
 - 1. Published repair procedures and specifications
- F. 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
- G. Technician training and certifications

II. Tools and Safety (1.5 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

III. Electrical Theory Review (6 hours, lecture)

- A. Ohm's Law
 - 1. Definition, formulas and application
 - 2. Watt's Law
- B. Series circuits
 - 1. Ohm's Law applications
 - 2. Kirchhoff's Voltage Law applications and usage
 - 3. Series circuit laws
- C. Parallel circuits
 - 1. Kirchhoff's Current Law
 - 2. Parallel circuit laws
 - 3. Determining total resistance - 5 methods
- D. Series-parallel circuits
 - 1. Circuit faults
 - 2. Problem solving

IV. Electrical Theory Application (6 hours, lab)

- A. Circuit component labeling and circuit fault type descriptions
- B. Ohm's Law and problem solving
- C. Series circuits
 - 1. Ohm's Law applications and problem solving
 - 2. Kirchhoff's Voltage Law applications and usage
 - 3. Voltage drops
 - 4. Circuit board usage and building of operational series circuits
- D. Parallel circuits
 - 1. Kirchhoff's Current Law applications

- 2. Determining total resistance
- 3. Circuit board usage and building of operational parallel circuits
- E. Series-parallel circuits
 - 1. Circuit faults and advanced problem solving
 - 2. Circuit board usage and building of operational series-parallel usage

V. Wiring Schematics and Circuit Testing (9 hours, lecture)

- A. Wiring schematic interpretation and symbols
 - 1. Terminology and circuit information
 - 2. Wire size, color and circuit identification
 - 3. Electrical component identification
- B. Single-stranded or multi-stranded wire usage
- C. Resistive wire usage
- D. Purpose of wiring diagrams
- E. Fuse and relay terminal identification
- F. Connector end views, legends and terminal identification
- G. Component locators
- H. Circuit troubleshooting procedures
 - 1. Locating opens and shorts
 - 2. Common power or ground
 - 3. Locating intermittent problems
 - 4. Methods of fault locaton

VI. Wiring Schematics and Circuit Testing (9 hours, lab)

- A. Wiring schematic acquisition, interpretation and circuit diagnostic application
- B. Circuit specific testing procedures
 - 1. Wiper motor circuit
 - 2. Brake and tail light circuit
 - 3. Horn circuit
 - 4. Blower motor circuit
- C. Electrical fault diagnosis
 - 1. Visual inspection and circuit testing
 - 2. Circuit fault location and identification
 - 3. Relay testing and inspection

VII. Electronic Fundamentals (7.5 hours, lecture)

- A. Semiconductors - definition, construction and examples
- B. Diode construction and operation
 - 1. Zener diodes
 - 2. High voltage spike protection
 - 3. Diode ratings
 - 4. Light emitting and photodiodes
 - 5. Rectifier bridges
- C. Photoresistors
- D. Thermistors
- E. Transistors - purpose, function and construction
 - 1. Operating principles

- 2. Types of transistors
- 3. Integrated circuits and transistor gates
- F. Component failures and testing
- G. Converters and inverters

VIII. Electronic Fundamentals (7.5 hours, lab)

- A. Diode types and differences
- B. Photoresistor operation
- C. Negative temperature coefficient thermistor identification, testing and description
- D. Electrostatic (ESD) service precautions
- E. Transistor identification
- F. Electronic circuit oscilloscope waveform reading and interpretation

IX. Computer Fundamentals (9 hours, lecture)

- A. Computerized automotive control systems purpose and function
- B. Computer functions
- C. Digital computer components and terminology
- D. Input sensors
- E. Output controls
 - 1. Output drivers
 - 2. Pulse-width modulation

X. Computer Fundamentals (9 hours, lab)

- A. Powertrain Control Module (PCM) connector pin identification
- B. Powertrain management schematics
- C. PCM controlled actuator testing
 - 1. Fuel injection
 - 2. Ignition
 - 3. Electronic throttle control
 - 4. Emission control systems
- D. Actuator output waveform reading

XI. Computer Controlled Ignition Systems (6 hours, lecture)

- A. Major functions
- 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. Purpose of the electronic control unit
- E. Spark timing systems
- F. Distributorless Electronic Ignition (EI) systems
- G. Coil-On-Plug (COP) operating principles

H. Ion and compression sense ignition

XII. Computer Controlled Electronic Ignition Systems (EI) Diagnosis and Service (6 hours, lab)

- A. No-spark condition diagnosis
- B. P0300 random misfire code diagnosis
- C. Coil testing
- D. Camshaft and crankshaft sensor Remove & Replace (R&R) and adjustment procedure
- E. Camshaft and crankshaft sensor test
- F. Magnetic sensor test
 - 1. Pickup coil (magnetic pulse generator)
 - 2. Hall-effect switch
- G. Compression sense ignition diagnosis
- H. Ion sense ignition diagnosis

XIII. Introduction to the Body Computer (3 hours, lecture)

- A. Basic functions
- B. Body Control Module (BCM) communications
- C. Logic gate operation
- D. Common output actuators

XIV. Body Computer System Diagnosis (3 hours, lab)

- A. BCM location and connector pin identification
- B. Service precautions
- C. BCM network schematics
 - 1. Voltage supply
 - 2. Ground circuits
- D. BCM scan tool diagnostics
- E. Fault code reading analysis, diagnosis and erasure
- F. Visual inspection
- G. BCM controlled actuator testing
- H. BCM input sensor testing

XV. Vehicle Communication Networks (12 hours, lecture)

- A. Multiplexing operating principles
- B. Communication protocols
- C. Network communications classifications
- D. Controller Area Network (CAN) bus system
 - 1. Components and operation
 - 2. Supplemental data bus networks
 - 3. Local Area Network (LAN)
- E. GM, Ford and Chrysler communication protocols
- F. Honda/Toyota communications
- G. European bus communications
- H. Media Oriented System Transport (MOST) data bus
- I. Bluetooth technology
- J. Network communications diagnosis

	<p>K. OBD II data link connector</p> <p>XVI. Vehicle Multiplexing Diagnostics (12 hours, lab)</p> <p>A. Module communication error scan tool check B. Software transfers, updates and flash programming C. OBD II Diagnostic Link Connector (DLC) pin identification and verification D. ISO 9141-2 bus system diagnosis E. ISO-K bus system diagnosis F. Class A bus system diagnosis G. J1850 bus system diagnosis H. Controller Area Network (CAN) diagnosis</p>
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:	Perform a self diagnosis test on a computer controlled fuel injection system and record data on a diagnostic report. Analyze data using the manufacturer's specifications to determine recommended service and/or repairs and parts required. Submit diagnostic report and supporting data to the instructor for evaluation.
Critical Thinking Assignment 1:	Perform a digital scanner test to include a data printout. Analyze data to determine recommended service and/or repairs and parts required. Submit digital scanner data printout and supporting data to the instructor for evaluation.
Critical Thinking Assignment 2:	Perform a comprehensive digital engine analyzer test to include a printout. Analyze data using manufacturer's specifications to determine recommended service and/or repairs and parts required. Submit engine analyzer printout and supporting data to the instructor for evaluation.
Other Evaluation Methods:	<p>Performance exams Other exams Quizzes Written homework Laboratory reports Class performance Homework problems Multiple choice Matching items True/false Other (specify):</p> <p>Compliance with manufacturer's service procedures</p>
Instructional Methods:	<p>Demonstration Guest Speakers Internet Presentation/Resources Laboratory Lecture</p>

	Multimedia Presentations
If other:	Component Models
Work Outside of Class:	Study Required reading Problem solving activities Written work
If Other:	
Up-To-Date Representative Textbooks:	James D. Halderman, <u>AUTOMOTIVE ENGINE PERFORMANCE</u> , 5th edition, Prentice Hall, 2017, Discipline Standard James D. Halderman, <u>AUTOMOTIVE ELECTRICITY AND ELECTRONICS</u> , 6th edition, Prentice Hall, 2021
Alternative Textbooks:	
Required Supplementary Readings:	Lab sheets Procedure sheets Shop manuals
Other Required Materials:	Three ring binder notebook and paper Pen and pencil Safety glasses Shop safe clothing including boots Calculator (portable type) Digital Volt Ohm Meter (optional) Tools (optional) Tape recorder (optional)
Requisite:	Prerequisite
Category:	sequential
Requisite course(s): List both prerequisites and corequisites in this box.	A total of 8 units from the following courses: Automotive Technology 22A, Automotive Technology 23, Automotive Technology 24, Automotive Technology 25

<p>Requisite and Matching skill(s): Bold the requisite skill. List the corresponding course objective under each skill(s).</p>	<p>Identify engine components. ATEC 22A - Identify engine components.</p> <p>Operate an engine analyzer to obtain engine data and perform tests. ATEC 24 - Test and diagnosis of an engine using engine testing equipment. ATEC 24 - Diagnose and repair a computer controlled fuel system. ATEC 23 - Evaluate and test engine condition and performance using engine analyzer/scanner. ATEC 25 - Evaluate an engine using engine analyzers. ATEC 23 - Interpret engine analyzer/scanner data and recommended repairs needed. ATEC 24 - Analyze computer controlled engine data and form a conclusion of recommended needed repairs.</p> <p>Service, test and evaluate the following: battery, starting, charging, fuel system and emission controls. ATEC 25 - Service, test and diagnose a lead-acid battery. ATEC 25 - Evaluate, service and repair charging systems. ATEC 25 - Service, test, evaluate and repair cranking systems. ATEC 24 - Diagnose and repair a computer controlled fuel system. ATEC 24 - Evaluate and repair fuel injection systems. ATEC 24 - Diagnose and repair emission control systems.</p> <p>Operate a scan tool/network analyzer to obtain powertrain data and perform diagnostic procedures. ATEC 25 - Analyze computer controlled engine data and recommend needed repairs.</p>
<p>Requisite Skill:</p>	<p>or equivalent</p>
<p>Requisite Skill and Matching Skill(s): Bold the requisite skill(s). If applicable</p>	<p>If students have taken similar courses at another college similar to Auto Technology 22A, 23, 24, or 25, or have worked in the automotive field, they will have the skills required to enroll in this course. If students do not have automotive experience, students will not succeed in this class.</p>
<p>Requisite course:</p>	
<p>Requisite and Matching skill(s): Bold the requisite skill. List the corresponding course objective under each skill(s).</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:	Robert Beaudoin
Date:	09/01/1985
Original Board Approval Date:	
Last Reviewed and/or Revised by:	Michael Anderson - 03/03/2022
Date:	05/10/2020
Last Board Approval Date:	12/19/2022