



El Camino College
COURSE OUTLINE OF RECORD – Official

Course Acronym:	ATEC
Course Number:	52
Descriptive Title:	Introduction to Hybrid, Electric and Fuel-Cell Vehicle Technology
Division:	Industry and Technology
Department:	Automotive Technology
Course Disciplines:	Automotive Technology
Catalog Description:	This course explores the use of hybrid and electric battery power for vehicle transportation. Topics will include safety when using high voltage, maintenance, drivability, inverter, Direct Current to Alternating Current (DC/AC), power transfer, and battery technology. The physics of battery storage, hybrid generation systems, electric vehicle applications and their integrated systems from various manufacturers will be presented. Hybrid and high voltage service and maintenance procedures will also be discussed. Students will develop the knowledge and skills to complete the L-3 Automotive Service Excellence (ASE) exam.
Prerequisite:	Automotive Technology 1 with a minimum letter grade of "C" or concurrent enrollment
Co-requisite:	
Recommended Preparation:	Eligibility for English 1A and Automotive Technology 51
Enrollment Limitation:	
Hours Lecture (per week):	2
Hours Laboratory (per week):	3
Outside Study Hours:	4
Total Course Hours:	90
Course Units:	3
Grading Method:	Letter Grade only
Credit Status:	Credit, degree applicable
Transfer CSU:	Yes
Effective Date:	Proposed
Transfer UC:	Yes
Effective Date:	
General Education: ECC	
Term:	
Other:	

CSU GE:	
Term:	
Other:	
IGETC:	
Term:	
Other:	
Student Learning Outcomes:	<p>SLO #1 Safety</p> <p>Explain safety concerns and protocols related to hybrid, electric and hydrogen vehicles and service equipment.</p> <p>SLO #2 Maintenance, Research, and Diagnostics</p> <p>Perform basic maintenance, research proper safety precautions, research proper diagnostic procedures and diagnose a basic fault with a hybrid, electric or hydrogen vehicle.</p> <p>SLO #3 Function and Operation</p> <p>Explain hybrid and electric vehicle powertrain operation including the function and operation of key components.</p>
Course Objectives:	<ol style="list-style-type: none"> 1. Comply with shop and vehicle safety practices relevant to electric, hybrid, and fuel cell vehicles. 2. List principles of fuel cell operations. 3. Explain the operation of Proton Exchange Membrane (PEM) fuel cells. 4. Discuss the operation of fuel cell hybrid electric drives. 5. Explain the operation of internal combustion hybrid electric drives. 6. Utilize proper safety precautions when working with various types of storage batteries used in hybrid electric vehicles. 7. Perform basic maintenance related to hybrid/electric/fuel-cell vehicles. 8. Demonstrate the precautions, personal and shop safety procedures needed to safely work with high-voltage systems. 9. Practice basic maintenance procedures for internal combustion hybrid drives. 10. Demonstrate acquired knowledge related to the components used on modern hybrid/electric/fuel-cell vehicles. 11. Demonstrate familiarity with reference materials such as schematics, flow charts, logic trees, and workshop manuals to aid in battery system troubleshooting. 12. Demonstrate how to diagnose a basic hybrid or electric or fuel-cell vehicle fault using standard diagnostic equipment.
Major Topics:	<p>I. Overview (2 hours, lecture)</p> <ol style="list-style-type: none"> A. General safety and environmental concerns B. Web-based safety training modules C. Web-based training simulations

II. Overview (2 hours, lab)

- A. General lab safety policies and procedure
- B. Safety and Pollution Prevention (SP2) training
- C. Instructor-led general safety demonstrations

III. Alternative Fuel Vehicle Safety (2 hours, lecture)

- A. High-Voltage safety
- B. Gaseous fuel safety
- C. National Fire Protection Association (NFPA) and Society of Automotive Engineers (SAE) high-voltage standards

IV. Alternative Fuel Vehicle Safety (4 hours, lab)

- A. High Voltage (HV) battery isolation
- B. Powering down and verification with a Digital Multimeter (DMM)
- C. Instructor-lead, alternative vehicle specific, safety demonstrations

V. Electrical Basics (2 hours, lecture)

- A. Ohm's Law
- B. Circuit fundamentals
- C. Circuit failures
- D. Basic circuit troubleshooting

VI. Electrical Basics (6 hours, lab)

- A. Electrical measurements on the vehicle
- B. Circuit diagnosis on a vehicle using a DMM
- C. Service information analysis

VII. Hybrid, Electric and Fuel-Cell Vehicle Sub-Systems (10 hours, lecture)

- A. Electric power steering components and operation
- B. High-voltage air conditioning components and operation
- C. Electric braking components and operation
- D. Regenerative energy collection components and operation

VIII. Hybrid, Electric and Fuel-cell vehicle Sub-Systems (16 hours, lab)

- A. Electric power steering service
- B. High-voltage air conditioning service
- C. Electric braking service
- D. Regenerative energy collection service

IX. Inverters and Fuel-cells (4 hours, lecture)

- A. Principles of Direct Current/Direct Current (DC/DC) inversion
- B. Principles of Alternating Current/Direct Current (AC/DC) inversion
- C. Principles of DC/AC inversion

	<p>D. Principles of fuel-cell operation</p> <p>X. High-Voltage Wiring and Control Modules (4 hours, lecture)</p> <ul style="list-style-type: none"> A. High-voltage electrical system components, function and operation B. Powertrain control module function and operation C. High-voltage battery controller function and operation D. Inverter control module function and operation E. Fuel-cell control module function and operation F. Sub-system control modules function and operation <p>XI. High-Voltage Wiring and Control Modules (6 hours, lab)</p> <ul style="list-style-type: none"> A. High-voltage electrical system troubleshooting and service B. Powertrain control module troubleshooting and service C. High-voltage battery controller troubleshooting and service D. Inverter control module troubleshooting and service E. Fuel-cell control module troubleshooting and service F. Sub-system control modules troubleshooting and service <p>XII. Vehicle Maintenance (8 hours, lecture)</p> <ul style="list-style-type: none"> A. Discuss engine oil and filter change B. Discuss coolant system service C. Discuss wheel and tire maintenance D. Discuss battery, starting and charging system maintenance <p>XIII. Vehicle Maintenance (12 hours, lab)</p> <ul style="list-style-type: none"> A. Perform engine oil and filter change B. Perform coolant system service C. Perform wheel and tire maintenance D. Perform battery, starting and charging system maintenance <p>XIV. Automotive Scan tools (4 hours, lecture)</p> <ul style="list-style-type: none"> A. Basic features and functions of scan tools B. Unique features and functions of scan tools related to hybrid, electric and fuel-cell vehicles C. Connection of and navigation with scan tool related to hybrid, electric and fuel-cell vehicles <p>XV. Automotive Scan tools (8 hours, lab)</p> <ul style="list-style-type: none"> A. Retrieving fault codes B. Analyzing input data C. Operating actuators D. Special tests
<p>Total Lecture Hours:</p>	<p>36</p>

Total Laboratory Hours:	54
Total Hours:	90
Primary Method of Evaluation:	3) Skills demonstration
Typical Assignment Using Primary Method of Evaluation:	Assemble a four-page list of the necessary steps to "safe" the vehicle for performing an engine oil and filter service, servicing an air conditioning compressor and removing an inverter converter. Demonstrate these steps on the vehicle in the laboratory. When completed, consult the instructor for evaluation.
Critical Thinking Assignment 1:	Given a scenario where a hybrid vehicle has a "Check Engine" light on and you have the appropriate service information. Perform the five-step troubleshooting procedure. Provide a three-page report to the instructor listing the possible causes and troubleshooting tests necessary to determine root failure within 60 minutes and to 80% accuracy.
Critical Thinking Assignment 2:	Remove and reinstall the high voltage battery in a hybrid vehicle. Following the service manual procedures, pay close attention to all warnings, cautions and safety procedures. When completed, consult the instructor for evaluation.
Other Evaluation Methods:	Essay Exams Homework Problems Journal kept throughout course Laboratory Reports Multiple Choice True/False Written Homework
Instructional Methods:	Demonstration Discussion Field trips Group activities Lab Lecture Multimedia presentations Role play/simulation
If other:	Internet Presentation/Resources Observation
Work Outside of Class:	Answer questions Journal (done on a continuing basis throughout the semester) Problem solving activity Required reading Study Written work (such as essay/composition/report/analysis/research)
If Other:	
Up-To-Date Representative Textbooks:	Jack Erjavec. <u>Hybrid, Electric & Fuel-Cell Vehicles</u> . 2nd edition. Cengage, 2013. (Discipline Standard)
Alternative Textbooks:	
Required Supplementary Readings:	
Other Required Materials:	Electude: Simulation-based learning solutions for visual and kinesthetic learners

Requisite:	Prerequisite
Category:	sequential
Requisite course(s): List both prerequisites and corequisites in this box.	Automotive Technology-1
Requisite and Matching skill(s):Bold the requisite skill. List the corresponding course objective under each skill(s).	<p>Practice basic maintenance procedures for internal combustion hybrid drives.</p> <p>ATEC 1 - Perform an analysis of engine condition by conducting a compression test.</p> <p>ATEC 1 - Service, test, and evaluate a liquid cooling system.</p> <p>ATEC 1 - Perform an engine oil and filter change.</p> <p>Demonstrate basic maintenance procedures for fuel engines and subsystems.</p> <p>ATEC 1 - Service, test and evaluate a lead-acid battery.</p> <p>ATEC 1 - Inspect, test and evaluate the ignition system.</p> <p>ATEC 1 - Inspect, service, test and evaluate a braking system.</p> <p>ATEC 1 - Inspect and evaluate tire wear.</p> <p>ATEC 1 - Inspect and maintain drive line components and fluid levels.</p> <p>ATEC 1 - Perform chassis lubrication and "top off" fluid levels for steering and suspension.</p>
Requisite Skill:	or concurrent enrollment
Requisite Skill and Matching Skill(s): Bold the requisite skill(s). If applicable	If students have not completed Auto Technology 1, students can enroll in Auto Technology 1 concurrently in the same semester. Students will learn basic automotive skills to help them succeed in this course.
Requisite course:	Automotive Technology-51
Requisite and Matching skill(s):Bold the requisite skill. List the corresponding course objective under each skill(s).	<p>Utilize proper safety precautions when working with various types of storage batteries used in hybrid electric vehicles.</p> <p>ATEC 51 - Identify various system components from various types of alternative fuel vehicles.</p> <p>Discuss the operation of fuel cell hybrid electric drives.</p> <p>ATEC 51 - Chart the characteristics of different types of alternative fuels.</p>
Requisite Skill:	Eligibility for English 1A
Requisite Skill and Matching skill(s): Bold the requisite skill. List the	Ability to compose a written report.

<p>corresponding course objective under each skill(s). If applicable</p>	<p>Write a well-reasoned, well-supported expository essay that demonstrates application of the academic writing process.</p> <p>Ability to read and understand automotive-related material.</p> <p>Summarize, analyze, evaluate, and synthesize college-level texts.</p>
<p>Enrollment Limitations and Category:</p>	
<p>Enrollment Limitations Impact:</p>	
<p>Course Created by:</p>	Edward Matykiewicz
<p>Date:</p>	09/04/2017
<p>Original Board Approval Date:</p>	
<p>Last Reviewed and/or Revised by:</p>	Edward Matykiewicz
<p>Date:</p>	03/08/2022
<p>Last Board Approval Date:</p>	1/17/2023