

# AUTO 043A: INTRO TO HYBRID, ELECTRIC & FUEL-CELL VEHICLE TECHNOLOGY

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**Originator**

Douglas Redman

**Co-Contributor(s)****Name(s)**

Anderson, Dorothy

**Justification / Rationale**

The Automotive Faculty are reviewing and/or updating this course to assure compliance with local, State, and Federal regulations; support consistency within the curriculum; practice relevance regarding automotive industry and community; and to make improvements that will strengthen the learning environment this course creates thus benefiting the learners.

**Effective Term**

Fall 2022

**Credit Status**

Credit - Degree Applicable

**Subject**

AUTO - Automotive Technology

**Course Number**

043A

**Full Course Title**

Intro to Hybrid, Electric & Fuel-Cell Vehicle Technology

**Short Title**

INTRO HYBRID/EV/FC

**Discipline****Disciplines List**

Automotive Technology

**Modality**

Face-to-Face  
Hybrid

**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, DC/DC power transfer, and battery technology. Physics of battery storage, Hybrid generation systems, Electric vehicle applications and their integrated systems from many manufacturers will be discussed. Hybrid and high voltage service and maintenance procedures. This course will help prepare the learner to successfully complete the L-3 ASE exam.

**Schedule Description**

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**Lecture Units**

2

**Lecture Semester Hours**

36

**Lab Units**

1

**Lab Semester Hours**

54

**In-class Hours**

90

**Out-of-class Hours**

72

**Total Course Units**

3

**Total Semester Hours**

162

**Prerequisite Course(s)**

AUTO 010 or concurrent enrollment

**Required Text and Other Instructional Materials****Resource Type**

Book

**Open Educational Resource**

No

**Author**

Denton, Tom

**Title**

Electric and Hybrid Vehicles

**Edition**

2nd

**City**

New York

**Publisher**

Routledge

**Year**

2020

**College Level**

Yes

**Flesch-Kincaid Level**

13

**ISBN #**

978-0367273248

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**Resource Type**

Web/Other

**Open Educational Resource**

No

**Year**

2020

**Description**Instructor provided manufacturer materials.

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**Class Size Maximum**

21

**Entrance Skills**

Utilize proper safety precautions when working with various types of storage batteries used in hybrid electric vehicles.

**Requisite Course Objectives**

AUTO 010-Describe shop safety practices and proper procedures regarding handling hazardous material.

AUTO 010-Maintain a clean working environment.

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**Entrance Skills**

Discuss the operation of fuel cell hybrid electric drives.

**Requisite Course Objectives**AUTO 010-Properly connect a digital multimeter and read volts, amps and ohms on a basic electrical circuit.

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**Entrance Skills**

Practice basic maintenance procedures for internal combustion hybrid drives

**Requisite Course Objectives**

AUTO 010-Locate applicable vehicle service specifications and procedures using the latest online service information.

AUTO 010-Verify proper fill and type for all fluids on the automobile.

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**Entrance Skills**

Demonstrate basic maintenance procedures for fuel engines and subsystems

**Requisite Course Objectives**

AUTO 010-Perform a chassis lubrication, and change oil and filter.

AUTO 010-Identify and describe the purpose of the following components and systems: engine, transmission, suspension, braking system, fuel system, ignition system, electrical system and steering system.

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**Course Content**

1. Orientation, safety and environmental concerns
2. High-Voltage safety, NFPA and SAE high-voltage standards
3. Proper power down and verification with a DMM
4. Electrical basics
5. HV Battery, motor and generator basics
6. Intro to electric vehicles
7. Introduction to hybrid vehicles
8. Introduction to fuel-cell vehicles
9. Hybrid maintenance and service
10. Hybrid/Elec/Fuel-cell system: design, operation, regenerative braking and power management systems
11. High-voltage cables, harness, wiring, controllers and A/C compressors
12. Operation of: converters/inverter, DC/DC, AC/DC & DC/AC, fuel-cells
13. Connect and observe hybrid/elect/fuel-cell scan tool data
14. Chrysler web-based training modules

**Lab Content**

1. High-voltage safety demonstration & environmental concerns.
2. Remove and replace: HV battery, inverter, disassemble engine and transaxle with drive motors.
3. Perform basic maintenance on electric/hybrid/fuel-cell vehicle.
4. Demonstrate and perform basic safety protocols and HV battery isolation including powering down and verification with a DMM.
5. Operation and function of electric power steering, high-voltage AC compressors, electric braking, regenerative energy collection, inverter (including A/C to D/C, D/C to D/C and D/C to A/C).
6. Connect a scan tool and observe electric/hybrid/fuel-cell vehicle data.
7. Perform basic diagnostics with scan tool related to hybrid and electric vehicles.

**Course Objectives**

Objectives	
Objective 1	Comply with shop and vehicle safety practices relevant to electric, hybrid and fuel cell vehicles.
Objective 2	List principles of fuel cell operations.
Objective 3	Explain the operation of Proton Exchange Membrane (PEM) fuel cells.
Objective 4	Discuss the operation of fuel cell hybrid electric drives.
Objective 5	Explain the operation of internal combustion hybrid electric drives.
Objective 6	Utilize proper safety precautions when working with various types of storage batteries used in hybrid electric vehicles.
Objective 7	Perform basic maintenance related to hybrid/electric/fuel-cell vehicles.
Objective 8	Demonstrate the precautions, personal and shop safety procedures needed to safely work with high-voltage systems.
Objective 9	Practice basic maintenance procedures for internal combustion hybrid drives.
Objective 10	Demonstrate acquired knowledge related to the components used on modern hybrid/electric/fuel-cell vehicles.
Objective 11	Demonstrate familiarity with reference materials such as schematics, flow charts, logic trees, and workshop manuals to aid in battery system troubleshooting.
Objective 12	Demonstrate how to diagnose a basic hybrid or electric or fuel-cell vehicle fault using standard diagnostic equipment.

**Student Learning Outcomes**

Upon satisfactory completion of this course, students will be able to:	
Outcome 1	Describe safety concerns and protocols related to hybrid, electric, and hydrogen vehicles and service equipment.
Outcome 2	Perform basic maintenance related to hybrid, electric and hydrogen vehicles.
Outcome 3	Explain hybrid, electric, and fuel-cell vehicle powertrain operation including the function and operation of key systems.

**Methods of Instruction**

Method	Please provide a description or examples of how each instructional method will be used in this course.
Demonstration, Repetition/Practice	Instructor-led demonstrations to familiarize learners with proper procedures and protocols.
Collaborative/Team	Lab activities will be accomplished in groups and projects may be assigned to groups.
Technology-based instruction	Use of virtual reality for safety training and basic engine/drivetrain functions.
Lecture	Lectures will stimulate discussion and learning on theoretical and knowledge-based material.
Laboratory	Provide the learners with activities which require hands-on, a live or simulated vehicle in a live or simulated shop setting.

**Methods of Evaluation**

Method	Please provide a description or examples of how each evaluation method will be used in this course.	Type of Assignment
Student participation/contribution	Provide feedback during discussions and active involvement in assignments.	In and Out of Class

Mid-term and final evaluations	A cumulative mid-term and final exam will be given comprised of hands-on and written questions.	In and Out of Class
Tests/Quizzes/Examinations	Periodic quizzes to help the learners assess their progress after each main section.	In and Out of Class
Group activity participation/observation	Lab activities will be completed in groups.	In Class Only
Laboratory projects	Respectful, active interaction in activities.	In and Out of Class
Written homework	Complete homework assigned weekly from the required reading.	In and Out of Class
Presentations/student demonstration observations	Each learner will research an assigned topic and give a brief presentation to the class.	In and Out of Class

## Assignments

### Other In-class Assignments

1. Facilitator assigned readings each week from both classroom material and service manuals.
2. In class worksheets.
3. Instruction on safety related to hybrid tools and vehicle service.
4. Assigned readings and written summaries from selected instructor handouts.
5. Written summaries and analysis of assigned websites.
6. Must complete a course project consisting of describing, analyzing and summarizing a selected topic, including out of class research and fieldwork.
7. Research of service information related to vehicle diagnosis, troubleshooting and repair of personal, shop and other vehicles to be evaluated by the instructor during lab time.
8. Hands-on lab worksheets matching each course objective. These will be graded by the instructor throughout the semester during lab time.
9. Develop teamwork skills through group activities and assigned special projects.

### Other Out-of-class Assignments

1. Facilitator assigned readings each week from both classroom material and service manuals. (1hr per week)
2. Homework from required text: multiple-choice questions, fill in the blank and essay questions to be graded each week. (1hr per week)
3. Completion of 3 SP2 safety tests. (4hrs total)
4. Assigned readings and written summaries from selected instructor handouts. (8hrs total)
5. Must complete a course project consisting describing, analyzing and summarizing a selected topic, including out of class research and fieldwork. (8hrs total)
6. Must develop teamwork skills through lab activities and assigned special projects. (8hrs total)
7. Automotive industry web-based training modules. (8hrs total)

### Grade Methods

Letter Grade Only

## Distance Education Checklist

Include the percentage of online and on-campus instruction you anticipate.

Online %

50

On-campus %

50

## Lab Courses

**How will the lab component of your course be differentiated from the lecture component of the course?**

The lab activities will require hands-on, live or simulated vehicle in a live or simulated setting.

**From the COR list, what activities are specified as lab, and how will those be monitored by the instructor?**

The facilitator will supervise all lab content, guiding the learner in productivity and understanding.

**How will you assess the online delivery of lab activities?**

Laboratory activities will not be delivered in the online setting, only in person.

**Instructional Materials and Resources****Effective Student/Faculty Contact**

**Which of the following methods of regular, timely, and effective student/faculty contact will be used in this course?**

**Within Course Management System:**

Discussion forums with substantive instructor participation  
Online quizzes and examinations  
Regular virtual office hours  
Timely feedback and return of student work as specified in the syllabus  
Video or audio feedback  
Weekly announcements

**External to Course Management System:**

Direct e-mail  
Synchronous audio/video

**Briefly discuss how the selected strategies above will be used to maintain Regular Effective Contact in the course.**

Regular effective contact will be practiced through online lecture, discussion board postings, email communications, regular announcements, prompt grading and feedback of assignments, and virtual office hours. This contact between the facilitator and learner on a regular basis will enhance learner confidence and understanding and promote critical thinking and analyzation of subject matter.

**If interacting with students outside the LMS, explain how additional interactions with students outside the LMS will enhance student learning.**

Interaction between instructor and learner will help to enhance learning and understanding of subject material.

**Other Information**

**Provide any other relevant information that will help the Curriculum Committee assess the viability of offering this course in an online or hybrid modality.**

With the uncertainty of the teaching environment, enabling the lecture portion of this course to be delivered in an online setting, while keeping the hands-on portion face-to-face, will ensure learners can access needed training to ensure knowledge and experience is achieved to gain employment in the automotive field.

**MIS Course Data****CIP Code**

47.0614 - Alternative Fuel Vehicle Technology/Technician.

**TOP Code**

094840 - Alternative Fuels and Advanced Transportation Technology

**SAM Code**

B - Advanced Occupational

**Basic Skills Status**

Not Basic Skills

**Prior College Level**

Not applicable

**Cooperative Work Experience**

Not a Coop Course

**Course Classification Status**

Credit Course

**Approved Special Class**

Not special class

**Noncredit Category**

Not Applicable, Credit Course

**Funding Agency Category**

Not Applicable

**Program Status**

Program Applicable

**Transfer Status**

Transferable to CSU only

**General Education Status**

Y = Not applicable

**Support Course Status**

N = Course is not a support course

**Allow Audit**

Yes

**Repeatability**

No

**Materials Fee**

No

**Additional Fees?**

No

**Approvals****Curriculum Committee Approval Date**

3/17/2022

**Academic Senate Approval Date**

3/24/2022

**Board of Trustees Approval Date**

4/22/2022

**Chancellor's Office Approval Date**

5/07/2022

**Course Control Number**

CCC000631451

**Programs referencing this course**

Automotive Air Conditioning Certificate of Achievement (<http://catalog.collegeofthedesert.eduundefined/?key=104>)  
Automotive Electrical Certificate of Achievement (<http://catalog.collegeofthedesert.eduundefined/?key=105>)  
Automotive Braking Systems Certificate of Achievement (<http://catalog.collegeofthedesert.eduundefined/?key=109>)  
Automotive Light and Medium Duty Diesel Certificate of Achievement (<http://catalog.collegeofthedesert.eduundefined/?key=111>)  
Automotive Steering, Suspension, Alignment Certificate of Achievement (<http://catalog.collegeofthedesert.eduundefined/?key=112>)  
Hybrid, Fuel Cell, Electric Vehicle Certificate of Achievement (<http://catalog.collegeofthedesert.eduundefined/?key=198>)  
Automotive Introductions Certificate of Achievement (<http://catalog.collegeofthedesert.eduundefined/?key=201>)  
Advanced Transportation Technologies AS Degree (<http://catalog.collegeofthedesert.eduundefined/?key=44>)  
Advanced Transportation Technologies AS Degree (<http://catalog.collegeofthedesert.eduundefined/?key=45>)  
Automotive Technology AS Degree (<http://catalog.collegeofthedesert.eduundefined/?key=57>)  
Automotive Alternative Fuels Certificate of Achievement (<http://catalog.collegeofthedesert.eduundefined/?key=82>)

