

AT R100: INTRODUCTION TO HYBRID AND ELECTRIC VEHICLE TECHNOLOGY

Originator

ptrujillo

College

Oxnard College

Discipline (CB01A)

AT - Automotive Technology

Course Number (CB01B)

R100

Course Title (CB02)

Introduction to Hybrid and Electric Vehicle Technology

Banner/Short Title

Hybrid & Electric Vehicle Tech

Credit Type

Credit

Start Term

Fall 2022

Catalog Course 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 assist the student in passing the L-3 ASE exam.

Taxonomy of Programs (TOP) Code (CB03)

0948.40 - *Alternative Fuels and Advanced Transportation Technology

Course Credit Status (CB04)

D (Credit - Degree Applicable)

Course Transfer Status (CB05) (select one only)

B (Transferable to CSU only)

Course Basic Skills Status (CB08)

N - The Course is Not a Basic Skills Course

SAM Priority Code (CB09)

C - Clearly Occupational

Course Cooperative Work Experience Education Status (CB10)

N - Is Not Part of a Cooperative Work Experience Education Program

Course Classification Status (CB11)

Y - Credit Course

Educational Assistance Class Instruction (Approved Special Class) (CB13)

N - The Course is Not an Approved Special Class

Course Prior to Transfer Level (CB21)

Y - Not Applicable

Course Noncredit Category (CB22)

Y - Credit Course

Funding Agency Category (CB23)

Y - Not Applicable (Funding Not Used)

Course Program Status (CB24)

1 - Program Applicable

General Education Status (CB25)

Y - Not Applicable

Support Course Status (CB26)

N - Course is not a support course

Field trips

May be required

Grading method

(L) Letter Graded

Alternate grading methods

(E) Credit by exam, license, etc.

Does this course require an instructional materials fee?

No

Repeatable for Credit

No

Is this course part of a family?

No

Units and Hours

Carnegie Unit Override

No

In-Class

Lecture

Minimum Contact/In-Class Lecture Hours

43.75

Maximum Contact/In-Class Lecture Hours

43.75

Activity

Laboratory

Minimum Contact/In-Class Laboratory Hours

26.25

Maximum Contact/In-Class Laboratory Hours

26.25

Total in-Class

Total in-Class

Total Minimum Contact/In-Class Hours

70

Total Maximum Contact/In-Class Hours

70

Outside-of-Class**Internship/Cooperative Work Experience**

Paid

Unpaid

Total Outside-of-Class**Total Outside-of-Class****Minimum Outside-of-Class Hours**

87.5

Maximum Outside-of-Class Hours

87.5

Total Student Learning**Total Student Learning****Total Minimum Student Learning Hours**

157.5

Total Maximum Student Learning Hours

157.5

Minimum Units (CB07)

3

Maximum Units (CB06)

3

Prerequisites

AT R110 and AT R115

Entrance Skills**Entrance Skills**

Comprehensive overview of the automobile, basic operation principles and repair procedures

Prerequisite Course Objectives

AT R110-Explain the chemistry of combustion.

AT R110-Identify automotive systems and repair.

AT R110-Complete common automotive measurements.

AT R110-Complete common automotive services to industry standards.

AT R110-Understand the proper management of hazardous waste.

AT R110-Diagnose potential failures in a vehicle charging, starting, and battery system.

Entrance Skills

Automotive electrical system theory and application

Prerequisite Course Objectives

AT R115-Explain and repair the lighting accessories and body electrical wiring.

AT R115-Describe magnetism, electromagnetism as it relates to automotive motors and switches.

AT R115-Explain the differences between the conventional theory and electronic theory.

AT R115-Explain the charging and starting electrical application used in today's vehicles.

AT R115-Identify electrical circuits used in automotive systems, series circuits, parallel circuits and series parallel circuits.

AT R115-Explain Ohm's Law in the calculation of electrical circuits, voltage, resistance, amperage.

AT R115-Properly test and recharge a vehicle battery

AT R115-Recognize the safety aspects of hybrid vehicles and the orange wire color determining high voltage and potentially deadly results from handling improperly.

Requisite Justification**Requisite Type**

Prerequisite

Requisite

AT R110

Requisite Description

Course in a sequence

Level of Scrutiny/Justification

Content review

Requisite Type

Prerequisite

Requisite

AT R115

Requisite Description

Course in a sequence

Level of Scrutiny/Justification

Content review

Student Learning Outcomes (CSLOs)**Upon satisfactory completion of the course, students will be able to:**

- | | |
|---|---|
| 1 | Demonstrate understanding of basic automotive hybrid and EV information using current technology such as scan tools or computer equipment, gathering data and selecting information for diagnosis. |
| 2 | Safely isolate the hybrid battery for service and possible testing. |
| 3 | Identify both high voltage and low voltage circuits and can perform voltage tests to determine state of charge. |
| 4 | Identify the cooling system and components required to cool high voltage batteries and the testing protocols involved. |
| 5 | Locate safety and environmental regulations related to the removal and replacement of hybrid vehicle components. |
| 6 | Determine the type of alternative fuels used in alternative fuel vehicles. Become aware of the hazards each fuel source and the safety measures used to minimize fuel spills and undesired fuel releases. |

Course Objectives**Upon satisfactory completion of the course, students will be able to:**

- | | |
|---|---|
| 1 | Demonstrate the precautions personal and shop safety procedures needed to safely work with high voltage systems. |
| 2 | Demonstrate familiarity with reference materials such as schematics, flow charts, logic trees, and workshop manuals to aid in battery system troubleshooting. |
| 3 | Demonstrate familiarity with reference materials such as schematics, flow charts, logic trees, and workshop manuals to aid in battery system troubleshooting. |
| 4 | Demonstrate how to perform basic maintenance related to hybrid and electric vehicles. |
| 5 | Demonstrate how to diagnose a basic hybrid or electric vehicle fault using standard diagnostic equipment. |

Course Content**Lecture/Course Content**

1. Introduction to Hybrid Vehicles
2. Working safety with High-Voltage, NFPA and SAE high-voltage standards

3. Vehicle ICE Service Precautions
 4. Vehicle Fuel Specifications
 5. Fuel Composition
 6. Oxygenated, Propane, CNG, LNG, Diesel, and Bio-Diesel fuels
 7. Hybrid Auxiliary and High Voltage Batteries
 8. Main service plug disconnects Drive Systems
 9. Hybrid/EV drive systems – design, operation Regenerative Braking (electrical energy recovery)
 10. Battery storage
 11. Power Management Systems
 12. System Monitoring Sensors
 13. Wiring
 14. Cables and harness
 15. Hybrid Controllers and inverters
 16. High-voltage air conditioning compressors
 17. Hybrid Vehicle Transmissions and Transaxles
- Introduction to Hybrid Vehicles Hybrid Engine Systems,

Laboratory or Activity Content

1. High-Voltage Safety demonstration
2. Properly power down system and verify with meter
3. Service procedures associated with hybrid/high-voltage technology
4. Connect and observe hybrid/electric vehicle scan tool data
5. Inverter operation
6. DC/DC operation
7. AC to DC charging conversions
8. Electric power steering
9. Electric braking and regenerative energy collection
10. Hybrid Transmission and Tranaxle Service
11. Hybrid Air Conditioning Service Precautions
12. Hybrid Minor Service Procedures and precautions

Methods of Evaluation

Which of these methods will students use to demonstrate proficiency in the subject matter of this course? (Check all that apply):

Problem solving exercises
Skills demonstrations

Methods of Evaluation may include, but are not limited to, the following typical classroom assessment techniques/required assignments (check as many as are deemed appropriate):

Group projects
Laboratory activities
Laboratory reports
Objective exams
Oral presentations
Quizzes
Skills demonstrations
Written homework
Projects
Problem-Solving Assignments

Instructional Methodology

Specify the methods of instruction that may be employed in this course

Audio-visual presentations
Case studies
Class activities
Class discussions
Collaborative group work
Computer-aided presentations
Demonstrations
Distance Education

Field trips
Group discussions
Guest speakers
Instructor-guided use of technology
Internet research
Laboratory activities
Lecture
Small group activities

Describe specific examples of the methods the instructor will use:

1. Instructor will demonstrate hands on work on lab vehicles using proper safe techniques to repair hybrid automobiles.
2. Instructor will demonstrate proper use of the DVOM testing equipment.
3. Instructor will organize student groups to research and report on battery voltage and construction technology. Students will present their research during an oral presentation.
4. Instructor will demonstrate each alternative fuel system using the bio fuel mock up and the hybrid vehicle lab mock up, exposing students to easily accessible testing techniques.

Representative Course Assignments

Writing Assignments

1. Students will be required to answer questions at the end of each chapter, some questions require essay responses. Typical questions include:
 - a. What components are used in a typical evaporative emission control system?
 - b. How does a catalytic converter reduce NOx to nitrogen and oxygen?
 - c. How does the computer monitor catalytic converter performance?
2. Students will be required to write notes on diagnostic steps and conclusions made from diagnostic testing procedures.

Critical Thinking Assignments

1. Students will research how a gasoline engine will pair with an electrical motor(s).
2. Research battery construction and chemical composition.
3. Research how different hybrid drive systems operate in Hybrid and all electric vehicles.
4. Research charging station operation and terminology for each charging station type. Level 1, level 2 and level 3 operation.

Reading Assignments

1. Students will be required to do outside reading in professional journals such as Motor Service Journal and Motor Age Magazine in addition to the textbook assignments and write summaries on assigned reading topics.
2. Students will be required to do outside reading at assigned internet sites such as the California Bureau of Automotive Repair and State of California Department of Consumer Affairs and be prepared to discuss updates on rules and regulations in class.

Skills Demonstrations

1. Practical application of servicing the disconnect service connector safely.
2. Trace high-voltage wiring to determine risk.
3. Demonstrate understanding of wire color designation.

Outside Assignments

Representative Outside Assignments

1. Perform multiple online certifications
2. Review training videos and complete sequenced quizzes.
3. Complete multiple factory training on Hybrid safety and propulsion.

Articulation

C-ID Descriptor Number

ALTF 100X

Status

Approved

Equivalent Courses at other CCCs

College	Course ID	Course Title	Units
Rio Hondo College	AUTO 147	Introduction to Hybrid and Electric Vehicle Technology	3

District General Education**A. Natural Sciences****B. Social and Behavioral Sciences****C. Humanities****D. Language and Rationality****E. Health and Physical Education/Kinesiology****F. Ethnic Studies/Gender Studies****CSU GE-Breadth****Area A: English Language Communication and Critical Thinking****Area B: Scientific Inquiry and Quantitative Reasoning****Area C: Arts and Humanities****Area D: Social Sciences****Area E: Lifelong Learning and Self-Development****Area F: Ethnic Studies****CSU Graduation Requirement in U.S. History, Constitution and American Ideals:****IGETC****Area 1: English Communication****Area 2A: Mathematical Concepts & Quantitative Reasoning****Area 3: Arts and Humanities****Area 4: Social and Behavioral Sciences****Area 5: Physical and Biological Sciences****Area 6: Languages Other than English (LOTE)****Textbooks and Lab Manuals****Resource Type**

Textbook

DescriptionHalderman, James (2016). *Hybrid and Alternative Vehicles*.**Description**

Online textbook CDX reduced cost.

Library Resources

Sufficient Library Resources exist

Yes

Distance Education Addendum

Definitions

Distance Education Modalities

Hybrid (1%–50% online)

Faculty Certifications

Faculty assigned to teach Hybrid or Fully Online sections of this course will receive training in how to satisfy the Federal and state regulations governing regular effective/substantive contact for distance education. The training will include common elements in the district-supported learning management system (LMS), online teaching methods, regular effective/substantive contact, and best practices.

Yes

Faculty assigned to teach Hybrid or Fully Online sections of this course will meet with the EAC Alternate Media Specialist to ensure that the course content meets the required Federal and state accessibility standards for access by students with disabilities. Common areas for discussion include accessibility of PDF files, images, captioning of videos, Power Point presentations, math and scientific notation, and ensuring the use of style mark-up in Word documents.

Yes

Regular Effective/Substantive Contact

Hybrid (1%–50% online) Modality:

Method of Instruction	Document typical activities or assignments for each method of instruction
Asynchronous Dialog (e.g., discussion board)	Regular use of asynchronous discussion boards encourages various types of interaction and critical thinking skills among all course participants. Questions and topics posed will allow students to discuss, compare and contrast, identify, and analyze elements of the course outcomes. Other discussion boards may be used for Q&A and general class discussion by students and instructor to facilitate student success and strengthen student learning outcomes.
E-mail	E-mail, class announcements and various learning management system tools such as “Message Students Who” and “Assignment Comments”, will be used to regularly communicate with all students on matters such as clarification of class content, reminders of upcoming assignments and/or course responsibilities, to provide prompt feedback to students on coursework to facilitate student learning outcomes, or to increase the role of an individual educator in the academic lives of a student. Students will be given multiple ways to email instructor through both the learning management system inbox and faculty provided email accounts.
Face to Face (by student request; cannot be required)	Students will have direct face-to-face contact with instructor during weekly class meetings. This time will provide the opportunity for students to discuss and ask questions about the material to facilitate student learning objectives and course outcomes. The instructor will also hold weekly, scheduled office hours for students to be able to meet and discuss course materials or individual progress. Students can request additional in-person or web conferencing meetings with faculty member as needed. Faculty may encourage online students to form “study groups” in person or online. Note: For hybrid classes, face-to-face class time will provide opportunities for students to discuss amongst themselves (in groups or pairs) and ask questions about the material to facilitate SLOs and course outcomes.

Other DE (e.g., recorded lectures)

Faculty may use a variety of ADA compliant tools and media integrated within the learning management system to help students reach SLO competency. Tools may include: o Recorded Lectures, Narrated Slides, Screencasts o Instructor created content o VC Online Library Resources o Canvas Peer Review Tool o Canvas Student Groups (Assignments, Discussions) o 3rd Party (Publisher) Tools (MyOpenMath) o Websites and Blogs o Multimedia (YouTube, Films on Demand, 3CMedia, Khan Academy, etc.)

Synchronous Dialog (e.g., online chat)

Instructor may provide a set time each week where they will be available for synchronous chat and be available in the discussion board and can answer questions in live time.

Examinations

Hybrid (1%–50% online) Modality

On campus
Online

Primary Minimum Qualification

AUTOMOTIVE TECHNOLOGY

Review and Approval Dates

Department Chair

10/22/2021

Dean

10/26/2021

Technical Review

MM/DD/YYYY

Curriculum Committee

10/27/2021

DTRW-I

MM/DD/YYYY

Curriculum Committee

12/08/2021

Board

MM/DD/YYYY

CCCCO

01/14/2022

Control Number

CCC000593786

DOE/accreditation approval date

MM/DD/YYYY