

Victor Valley College Course Outline

1. Changes Being Made

2. Course Number and Title

AUTO 89.6 Advanced Hybrid, Electric Vehicle, and Alternative Propulsion Technology

3. Discipline

AUTO - Automotive

4. Title 5 Category

AA/AS Degree

5. Certificate Applicable

6. Number of Units (Zero units for non-credit courses)

4

7. Contact hours per term

48 – 54 Lecture

48 – 54 Lab

Activity

Out-of-Class Hours

Independent Study

48 – 54 Individualized Instruction

Maximum class size 25

☒ Safety Issues

Based on Laboratory supervision requirements.

Enrollment Justification: Based on Laboratory supervision requirements must not exceed 25 without IA present and an IA is not always available in the evenings.

TOP Code 094800 - Automotive Technology

8. Special Topics

No

9. Grading GRD - Letter Grade Only

10. Repeatability

0

11. Catalog Description

This course explores advanced level theory, operation, diagnosis and repair of Hybrid, EV (electric vehicle), HEV (hydrogen electric vehicle), and Alternative propulsion systems in the modern automobile. This course is suitable for experienced students and technicians who intend to perform diagnosis and repair of high voltage battery and management systems, electric propulsion systems, onboard computer systems, and gaseous fuel delivery systems.

12. Schedule Description

This course explores advanced level theory, operation, diagnosis and repair of Hybrid, EV (electric vehicle), HEV (hydrogen electric vehicle), and Alternative propulsion systems.

13. Entrance Skills

Requisite Skill: AUTO 89.3, AUTO 89.4, AUTO 89.5 - Sequential Course
Prerequisites

14. Requisites

and Prerequisite

Standard

none

AUTO 89.3

Lee Bennett VVC Auto

Keith Shaner VVC Auto

A minimum grade of C

Validated Date: 07/01/2017

Entry level course in Alternative Propulsion series for AS degree

and Prerequisite

Standard

none

AUTO 89.4

Lee Bennett VVC Auto

Keith Shaner VVC Auto

A minimum grade of C

Validated Date: 07/01/2017

Intermediate level course in Alternative Propulsion series for AS degree

and Prerequisite

Standard

none

AUTO 89.5

Lee Bennett VVC Auto

Keith Shaner VVC Auto

A minimum grade of C

Validated Date: 07/01/2017

Intermediate level course in Alternative Propulsion series for AS degree

15. **A. Instructional Objectives**

Upon completion of the course the student should be able to:

1. Recognize and identify the personal and shop precautions needed to safely work with High voltage storage and control systems and gaseous fuel storage and delivery systems.
 - a. Exams/Tests/Quizzes
 - b. Simulation
 - c. Class Participation
 - d. Lab Activities
 - e. Competency based written and practical tests which demonstrate the students ability to apply skills and concepts learned to minimum standards established by the instructor
2. Identify and evaluate acquired knowledge related to advanced level component and system operations on Hybrid, EV, HEV, and Alternative propulsion vehicles.
 - a. Exams/Tests/Quizzes
 - b. Simulation
 - c. Class Participation
 - d. Lab Activities
 - e. Competency based written and practical tests which demonstrate the students ability to apply skills and concepts learned to minimum standards established by the instructor
3. Identify and evaluate proficient use of reference materials including schematics, flow charts, logic trees, workshop manuals, Technical service bulletins, and electronic information databases to aid in Hybrid, EV, HEV, and Alternative propulsion vehicle troubleshooting.
 - a. Class Participation
 - b. Lab Activities
 - c. Competency based written and practical tests which demonstrate the students ability to apply skills and concepts learned to minimum standards established by the instructor
4. Identify and evaluate advanced level skills in electrical theory and testing procedures, computer control system diagnosis, and the use of Alternative propulsion specific diagnostic equipment including Lab Scope, Scanner, Milliohmmeter ,Megaohmmeter, and Impedance tester.
 - a. Exams/Tests/Quizzes
 - b. Lab Activities
 - c. Competency based written and practical tests which demonstrate the students ability to apply skills and concepts learned to minimum standards established by the instructor

B. Student Learning Outcomes

Upon completion of the course the student can:

1. Demonstrate the personal and shop precautions needed to safely

work with High voltage storage and control systems and gaseous fuel storage and delivery systems.

2. Demonstrate acquired knowledge related to advanced level component and system operations on Hybrid, EV, HEV, and Alternative propulsion vehicles.
3. Demonstrate proficient use of reference materials including schematics, flow charts, logic trees, workshop manuals, Technical service bulletins, and electronic information databases to aid in Hybrid, EV, HEV, and Alternative propulsion vehicle troubleshooting.
4. Demonstrate advanced level skills in electrical theory and testing procedures, computer control system diagnosis, and the use of Alternative propulsion specific diagnostic equipment including Lab Scope, Scanner, Milliohmmeter ,Megaohmmeter, and Impedance tester.

C. Course Content

- I. Hybrid, EV, and HEV Drive Systems
 - A. Motor
 - B. Controller
 - C. Wiring
 - D. Ultra-capacitors
 - E. Maintenance and service
- I. Regenerative Braking (electrical energy recovery)
 - A. Principles of Operation
 - B. Charging / Recharging Characteristics
 - C. Maintenance and Service Requirements
 - D. Safety and Emergency Considerations
- II. Hybrid, EV, and HEV Battery
 - A. Construction
 - B. Lead Ni-cad, Hi-Metal Nickel, Lithium ion
 - C. Charging/discharging Characteristics
 - D. Maintenance and Service Requirements
 - E. Safety and Emergency Considerations
- III. Power Management Systems
 - A. Signals and Telemetry Principles
 - B. General construction and fabrication
 - C. Power and Dissipation Ratios
 - D. Testing and Basic Troubleshooting
- IV. HEV Fuel cels
 - A. Hydrogen Storage and Fueling
 - B. PEM Fuel Cels
 - C. Hydrogen Production and Fueling Infrastructure
- V. On Board Computer Systems
 - A. Types and Operating Characteristics
 - B. Power and Backup systems
 - C. Input and Monitoring Functions
 - D. Output and Monitoring Functions

- E. Data Acquisition and transfer
 - F. Testing and diagnosis
- VI. System Monitoring Sensors
 - A. Current
 - B. Voltage
 - C. Frequency
 - D. Battery Charge / Discharge
- VII. Alternative Fuel Vehicles
 - A. Transportation usage of Compressed fuels
 - B. Shop safety using Compressed Fuels
 - C. Shop safety using Cryogenic Fuels
- VIII. Alternative fuel vehicle standards
 - A. Clean Air Act of 1996
 - B. California Energy Act
 - C. DOT Regulations
 - D. NFPA 52
 - E. NFPA 59
 - F. CGA C-6.4
- IX. Pressure, Temperature, and Density
 - A. Gas controls and temperature stability
 - B. Hands-on practice of fuel leak detection
- X. Properties of Gaseous Fuels
 - A. Chemical and Physical properties
 - B. CNG/LNG/LPG/CH₄
 - C. Hydrogen fuel properties
- XI. Fuel System Components
 - A. CNG delivery system testing
 - B. On-board storage and current fuel cell construction
 - C. Pressure Relief Devices, relief piping and safety venting
- XII. Electronic Control Systems
 - A. ECM system, sensors, monitor diagnosis and repair
 - B. Drive and control system diagnosis and repair
 - C. Battery and temperature management diagnosis and repair
- XIII. Diagnostic Techniques
 - A. Alternative Propulsion specific tools and testing equipment required for diagnosis and repair
 - B. Manufacture TSBs

D. Course Lab Content

These topics will be covered in lab demonstrations and hands-on exercises:

- I. Hybrid, EV, and HEV Drive Systems
 - A. Motor
 - B. Controller
 - C. Wiring

- D. Ultra-capacitors
 - E. Maintenance and service
- I. Regenerative Braking (electrical energy recovery)
 - A. Principles of Operation
 - B. Charging / Recharging Characteristics
 - C. Maintenance and Service Requirements
 - D. Safety and Emergency Considerations
- II. Hybrid, EV, and HEV Battery
 - A. Construction
 - B. Lead Ni-cad, Hi-Metal Nickel, Lithium ion
 - C. Charging/discharging Characteristics
 - D. Maintenance and Service Requirements
 - E. Safety and Emergency Considerations
- III. Power Management Systems
 - A. Signals and Telemetry Principles
 - B. General construction and fabrication
 - C. Power and Dissipation Ratios
 - D. Testing and Basic Troubleshooting
- IV. HEV Fuel cells
 - A. Hydrogen Storage and Fueling
 - B. PEM Fuel Cells
 - C. Hydrogen Production and Fueling Infrastructure
- V. On Board Computer Systems
 - A. Types and Operating Characteristics
 - B. Power and Backup systems
 - C. Input and Monitoring Functions
 - D. Output and Monitoring Functions
 - E. Data Acquisition and transfer
 - F. Testing and diagnosis
- VI. System Monitoring Sensors
 - A. Current
 - B. Voltage
 - C. Frequency
 - D. Battery Charge / Discharge
- VII. Alternative Fuel Vehicles
 - A. Transportation usage of Compressed fuels
 - B. Shop safety using Compressed Fuels
 - C. Shop safety using Cryogenic Fuel
- VIII. Pressure, Temperature, and Density
 - A. Gas controls and temperature stability
 - B. Hands-on practice of fuel leak detection
- IX. Fuel System Components
 - A. CNG delivery system testing
 - B. On-board storage and current fuel cell construction
 - C. Pressure Relief Devices, relief piping and safety venting
- X. Electronic Control Systems
 - A. ECM system, sensors, monitor diagnosis and repair
 - B. Drive and control system diagnosis and repair

- C. Battery and temperature management diagnosis and repair
- XI. Diagnostic Techniques
 - A. Alternative Propulsion specific tools and testing equipment required for diagnosis and repair
 - B. Manufacture TSBs

E. Activity Content

none

F. Assignments

1. *Required Assignment - Describe in detail one specific example of a writing or problem solving or performance assignment. MATCH INSTRUCTIONAL OBJECTIVES TO THIS ASSIGNMENT BY USING THE BLUE LINK BELOW*

Perform Diagnosis and repair of a MIL (Malfunction Indicator Light) on a Hybrid, EV, or HEV.

1. Identify and evaluate advanced level skills in electrical theory and testing procedures, computer control system diagnosis, and the use of Alternative propulsion specific diagnostic equipment including Lab Scope, Scanner, Milliohmmeter, Megaohmmeter, and Impedance tester.

2. *Required Out of Class Assignment - Describe in detail one specific homework/out of class assignment. MATCH INSTRUCTIONAL OBJECTIVES TO THIS ASSIGNMENT BY USING THE BLUE LINK BELOW.*

Research and identify applicable factory Technical Service Bulletin for assigned Vehicle.

1. Identify and evaluate proficient use of reference materials including schematics, flow charts, logic trees, workshop manuals, Technical service bulletins, and electronic information databases to aid in Hybrid, EV, HEV, and Alternative propulsion vehicle troubleshooting.

3. *Required Reading Assignment - Describe in detail the chapter or article being read and the purpose for this assignment. MATCH THE INSTRUCTNL OBJECTVES FOR THIS ASSGNMNT BY USING THE BLUE LINK BELOW*

Chapter 6 Energy Managememnt systems

1. Identify and evaluate acquired knowledge related to advanced level component and system operations on Hybrid, EV, HEV,

and Alternative propulsion vehicles.

G. Methods of Instruction

1. Laboratory/Studio/Activity
2. Lecture

H. Methods of Evaluation

1. Exams/Tests/Quizzes
2. Simulation
3. Class Participation
4. Class Work
5. Home Work
6. Lab Activities
7. Competency based written and practical tests which demonstrate the students ability to apply skills and concepts learned to minimum standards established by the instructor

16. Text and Other Materials

Textbooks:

Yangsheng, Yu. *Hybrid Electric Vehicle Design and Control: Intelligent Omnidirectional Hybrids*, first ed. New York: McGraw-Hill, 2014, ISBN: 0071826831.

Manuals:

and NAFTC. Hydrogen Booklet, NAFTC, 01-01-2016

and NAFTC. Electric Drive Booklet, NAFTC, 01-01-2016

17. Distance Education: Regular Effective Contact

18. Learning Resources

19. Library Resources

Part A:

The Library has sufficient resources presently available to support this course.

The Library resources are sufficient to offer this course but new materials should be added to improve and update the holdings in this subject area.

The Library?s resources are not presently adequate to support the teaching of this course. Accordingly, it is recommended that the items listed below be purchased prior to the first offering of this course.

20. Academic Accommodation

- A. A course syllabus or other explanation with due dates for course materials and assignments is available for students in alternative formats (e.g., electronic format).
- B. Auxiliary aids can be used in classroom or lab setting (e.g., Tape recorder, interpreters, and mobility devices).
- C. If this course requires field trips, there will be alternatives for field trips.
- D. Material is available in more than one modality or methodology (e.g., visual, oral, tactile).
- E. Students have access to the instructor to discuss accommodations.
- F. Technology used to deliver Distance Education components of this course meet standards for accessibility to persons with disabilities.
- G. Video or audiotapes are available in accessible formats.

21. Dates

Board of Trustees Date 11/14/17
Effective Date 08/27/18
Last Outline Revision Date 10/12/17
CC Approval Date 10/12/17
Content Review Date 10/12/17

22. Proposed Start Date

Fall of 2018

23. Cross Listed Courses

24. Need for Course

Automotive repair trade necessity due to new vehicle technology advancements.

25. Attached Files