

RARITAN VALLEY COMMUNITY COLLEGE ACADEMIC COURSE OUTLINE

AUTC 220 Hybrid/Electric Vehicles

I. Basic Course Information

- A. Course Number and Title: AUTC 220 Hybrid/Electric Vehicles
- B. New or Modified Course: Modified
- C. Date of Proposal: Semester: Fall 2022
- D. Effective Term: Fall 2023**
- E. Sponsoring Department: Science & Engineering Department
- F. Semester Credit Hours: 2
- G. Weekly Contact Hours: 4 Lecture: 1
Laboratory: 3
Out of class student work per week: 3.5
- H. Prerequisite (s) ☐ Corequisite (s) ☐ **OR** Prerequisite (s) and Corequisite (s) ☒:
Prerequisite: AUTC 101 – Automotive Introduction, Fundamentals, and Safety.
Corequisites: AUTC 204 – Automotive Electrical Systems II
AUTC 208 – Engine Performance and Diagnosis II
AUTC 221 – Engine Systems & Emission Control II
AUTC 290-Automotive Cooperative Education I
(Students must be registered in the same section for each course)
- I. Additional Fees: None
- J. Name and Telephone Number or E-Mail Address of Department Chair and Divisional Dean at time of approval:
Department Chair: Marianne Baricevic, Marianne.baricevic@raritanval.edu
Divisional Dean: Sarah Imbriglio, sarah.imbriglio@raritanval.edu

II. Catalog Description

Prerequisite: AUTC 101 – Automotive Introduction, Fundamentals, and Safety.
Corequisites: AUTC 204 – Automotive Electrical Systems II
AUTC 208 – Engine Performance and Diagnosis II
AUTC 221 – Engine Systems & Emission Control II
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(Students must be registered in the same section for each course)

This course provides an overview of the hybrid (HEV) & electric (EV) vehicles and prepares students for the ASE L3 exam. Training will cover multiple types and operation of hybrid and electric vehicles, motor/generator operation with experiments and animations, battery management systems, drive systems, power electronics including inverters, DC to AC conversion and safe handling of HV systems, internal combustion engines, and instructor fault insertion included for trouble shooting the system.

In the lab, students will learn a hands-on strategy to perform diagnosis, maintenance, and repair of the (H)EV. Tasks include isolation procedure and voltage measurement, measurements of real high voltage to understand electric motors, fault finding and diagnostics with real world faults such as insulation resistance measurement, resolver/motor positioner, energy flows in series, parallel, series-parallel, fuel cell and pure electric vehicles, high voltage capacitors found in EVs, & charging connections. Students will be required to wear clothing appropriate for auto shop safety at all classes. Safety glasses will also be required at all classes.

III. Statement of Course Need

- A.** Automotive technicians are vital to our mobile and transport-dependent community. HEV/EV are becoming more and more popular and it is imperative that students understand the proper maintenance, service, and repair of these systems. Efficiency, performance and compliance with EPA regulations (State and Federal) are mandatory in this field as well as customer satisfaction. This course covers the maintenance, diagnosis, and repair of the HEV/EV and is intended to enhance the student's knowledge beyond understanding.
- B.** Lab assignments for the course will introduce students to the maintenance, diagnosis, and repair of automotive HEV/EV systems while maintaining instruction that reinforces safety practices in a demonstrative environment.
- C.** Course transferability: The course transfers as one of the core fundamental courses for the Automotive Technology major and includes a laboratory component; for New Jersey schools go to the NJ Transfer website, www.njtransfer.org. For all other colleges and universities, go to their individual websites.

IV. Place of Course in College Curriculum

- A.** Free Elective
- B.** This course meets the program requirement for the Associate of Applied Science in Automotive Technology.
- C.** Course transferability; for New Jersey schools go to the NJ Transfer website, www.njtransfer.org. For all other colleges and universities go to their individual sites.

V. Outline of Course Content

- Smart grids
- Criteria for putting the test equipment into operation
- Selection and checking of the test equipment
- Drive concepts
- Drive configurations
- Drive variants
- Operating modes
- Health and safety while working
- Electrical hazards
- Passage of electricity through the human body
- Hazards due to AC
- Safety regulations
- HV battery
- Batteries made of nickel-metal hydrides
- Lithium-ion batteries • Cooling of battery systems
- Meaning of "high voltage (HV)"
- Electricity "fueling" stations
- Working with high-voltage vehicles
- On-board power networks in high-voltage vehicles
- Intrinsically safe HV vehicles
- Safety concepts for high-voltage vehicles
- Vehicle-internal safety concepts
- Switch-on current and current limiting
- Serial hybrid drive with plug-in capability
- Parallel hybrid drive with plug-in capability
- Serial-parallel hybrid with plug-in capability
- Axle-split parallel hybrid
- Power-split hybrid drive
- Other drive configurations
- Hybrid driving
- Pure electric driving
- Generator operation
- Boosting
- Regenerative braking
- Electric drive systems for hybrid vehicles
- Electric vehicles
- Hydrogen-fueled electric vehicles
- Design of electrical machines
- Asynchronous machines
- Synchronous machines
- Control units for hybrid drives
- Rectifiers
- Inverters

- Regenerative braking and energy recovery
- Fault finding in traction motor circuits
- Fault finding in inverter circuits
- Fault finding in screening circuits
- Fault finding in equipotential bonding circuits
- Fault finding in battery circuits
- Operating principle for resolvers
- Operating principle for interlock contacts
- High speed - CAN bus
- Measurement of the CP signal of type2 charge connection during active charging process
- How to handle damaged HV vehicles
 - o Safer handling by rescue services
 - o Disconnection and isolation options for rescue services
 - o Special hazards
 - o Rescue scheme for rescue services

VI. A. Course Learning Outcomes

At the completion of the course, students will be able to:

1. Perform procedures needed to work on hybrid/electric vehicles safely
2. Work directly on a real high-voltage system
3. Become familiar with the key theoretical background of the (H)EV
4. Investigate drive configurations, components of high-voltage systems, disconnection/isolation of HV systems, safe working with such systems, electrical fundamentals, charging of high-voltage batteries and diagnostics.
5. Develop various diagnostic strategies, including measurements on an actual HV system under the most stringent safety conditions.
6. Identify techniques to troubleshoot, repair, maintain, and solve problems with various automotive (H)EV systems (GE NJ 4)
7. Apply quantitative reasoning to problems with the maintenance of automotive (H)EV systems (GE NJ 2)
8. Discuss issues of automotive (H)EV systems (GE NJ 1)

ASE Standards

- a. Identify service precautions related to service of the internal combustion engine of a hybrid vehicle.
- b. Describe the operational characteristics of a hybrid vehicle drive train.
- c. Identify hybrid vehicle power steering system electrical circuits and safety precautions.
- d. Identify safety precautions for high voltage systems on electric, hybrid, hybrid-electric, and diesel vehicles.
- e. Identify hybrid vehicle auxiliary (12v) battery service, repair, and test procedures.
- f. Identify hybrid vehicle A/C system electrical circuits and service/safety precautions.

B. Assessment Instruments

1. Lectures
2. Demonstrations
3. Laboratory work
4. Instructional videos/DVDs
5. Laboratory performance
6. Examinations
7. ASE task list
8. Online modules
9. Manufacturer programs
10. Lucas-Nuelle CarTrain "Hybrid and Electric Vehicles - ASE L3 Trainer

VII. Grade Determinants

- A. Lab performance
- B. Examinations
- C. Class participation
- D. Technical writing
- E. Interactive simulations
- F. Module completion
- G. Homework assignments
- H. Lucas-Nuelle CarTrain "Hybrid and Electric Vehicles - ASE L3 Trainer completion & practical exercises

Primary formats, modes, and methods for teaching and learning that may be used in the course:

- A. Lecture/discussion
- B. Small-group work
- C. Group discussion
- D. Computer-assisted instruction
- E. Laboratory
- F. Simulation/role playing
- G. Demonstration
- H. Student collaboration
- I. Individual assignments
- J. Manufacturer training
- K. Lucas-Nuelle CarTrain "Hybrid and Electric Vehicles - ASE L3 Trainer

VIII. Texts and Materials

- A. CDX interactive textbook
- B. Students will be required to wear clothing appropriate for auto shop safety at all classes. Student are required to wear a standard industry uniform. Safety glasses will also be required at all classes.

- C. The Automotive Program utilizes online curriculum and online industry service and repair information from the following sources:
 - I. AllData
 - II. Snap On Industries
 - III. Shop Key Pro.
 - IV. Manufacturer Training
 - V. CDX
 - VI. Lucas-Nuelle CarTrain "Hybrid and Electric Vehicles - ASE L3 Trainer
- D. Various Automotive Magazines
- E. Students are provided the use of RVCC technology during the course

(Please Note: The course outline is intended only as a guide to course content and resources. Do not purchase textbooks based on this outline. The RVCC Bookstore is the sole resource for the most up-to-date information about textbooks.)

IX. Resources

- A. Reference books
- B. Text Book
- C. AllData
- D. Shop Key Pro
- E. Snap On Industries
- F. NAPA Pro-Link
- G. Published Automotive Magazines
- H. Lab/Shop Tools and Equipment
- I. Electude Interactive Courseware
- J. Safety equipment
- K. Lubricants and various automotive fluids
- L. Sample Steering and Suspension system components
- M. Instructional videos/DVDs
- N. Auto mechanics shop facility at RVCC workforce building
- O. Manufacturer Training
- P. Lucas-Nuelle CarTrain "Hybrid and Electric Vehicles - ASE L3 Trainer