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Intro Hybrid-Electric 1 A and 1B

Submitted: Sep 14, 2016
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Riverside County Office of Ed. ROP

Submission Feedback

APPROVED

Basic Course Information

Title:	Intro Hybrid-Electric 1 A and 1B
Transcript abbreviations:	
Length of course:	Full Year
Subject area:	College-Preparatory Elective ("g") / Interdisciplinary
UC honors designation?	No
Prerequisites:	CTE Automotive Technology I (Required)
Co-requisites:	Algebra I (Recommended)
Integrated (Academics / CTE)?	Yes
Grade levels:	11th, 12th
Course learning environment:	Classroom Based

Course Description

Course overview:

Intro Hybrid-Electric Vehicle is an academically challenging course that integrates science, mathematics, writing, and mechanics. 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 manufactures will be discussed. Hybrid and high voltage service and maintenance procedures. This course would be in preparation for the student to successfully complete the L-3 ASE exam. Students will learn the importance of maintaining a practice of self-monitoring for increasing and improving one's knowledge regarding new and innovative technologies and the latest tools and electronic equipment.

Course content:

Unit One: Working safety with High-Voltage

Students will use integrated academics such as reading, writing, communications, problem solving, analytical thinking, and social studies throughout the course.

Students will learn to work safety with High-Voltage, and understand NFPA and SAE high-voltage standards. Students will learn locations and functions of main service plug disconnects, Drive Systems, Hybrid/EV drive systems- design, operation Regenerative Braking (electrical energy recovery), Battery Storage, Power Management Systems, System Monitoring Sensors, Wiring, Cables and harness, Hybrid Controllers and inverters. High-voltage air conditioning compressors.
Students will review the various systems (group of related parts and assemblies that performs specific functions) as it relates to science in an automobile. As students learn about the different systems they will be asked to think about what engineers take into consideration when designing each system. Unit one will help students begin thinking about the science, math, and engineering that goes into designing and creating the hybrid automobile. This assignment will help students understand the importance of math and science in everyday life. They will compare the different levels of education each engineering field requires. Students will use the internet to visit each of the major auto manufacturer's web sites. They will discover how engineering is at the core of the automobile hybrid design. As an assignment, students will write a report describing their first experience involving a vehicle and how the automobile plays a role in their lives.

The course covers the basics of physics and chemistry concepts such as leverage and specific gravity, conservation of energy and forces that work against it, molecular structure related to octane, and air-fuel ratios related to stoichiometry. The course starts with the basics of physics, mechanics, which is the science concerned with the behavior of physical bodies when subjected to forces or displacements, and the subsequent effects of the bodies on their environment in relation to lifting equipment. The linear and angular motion, energy, momentum and special relativities will be discussed in reference to engineering and design. In addition, students will also differentiate between different engineering systems such as mechanical, electrical, fluid, and thermal.

Students will learn about the evolution of science and engineering as it applies to the automobile. They will research and write an essay on the history and evolution of transportation systems.

Auto Shop and Safety

By the end of this unit student should be able to describe the typical layout, location of safety equipment and shut-offs, work zones of an auto shop, and list the types of accidents that occur in an auto shop. Students will also explain how to prevent auto shop accidents, and practice the safe and appropriate use of tools, equipment, and work processes. They will apply and understand appropriate business practices. Practice safe handling and storage of chemicals and hazardous wastes in accordance with Material Safety Data Sheets (MSDS) and the requirements of local, state, and federal regulatory agencies.

Students will understand area, perimeter, and volume formulas for triangles, quadrilaterals, circles, and regular polygons. In “shop layout” (Lab III) students will be given tape measures and are asked to measure and recommend the safety zones around all machinery in the shop. Students will use the formulas they learned in class to calculate the dimensions of the safety zones using their measurements of length and width. Students will become familiar with units of measurements used in relation to mathematical modeling which they will implement in the Brakes module.

In a related assignment students will describe and demonstrate the use of Material Safety Data Sheets (MSDS) and hazardous and non hazardous materials as it applies to the automotive industry. They will also describe and demonstrate the NATEF (National Automotive Technicians Education Foundation) standards regarding proper use of protective clothing, gloves, respiratory gear, and eye wear in an auto shop, and hazard signs and chemical breakdown. Describe and demonstrate the NATEF standards regarding proper ventilation in an auto shop and standards regarding proper handling, storage, and disposal of chemicals and materials used in an auto shop. Students will describe how engineers must work to specific engineering standards. Safety is a major factor in every lab experiment therefore students must have completed and passed a safety test before participating in any lab.

As an introduction to chemical solutions students will learn the difference between solute and solvents. They will understand the difference between heterogeneous and homogeneous mixtures. They will use the examples they learned from the MSDS activity to identify solvents and solutes.

Students will conduct a series of small activities such as “buckle up” which relates to Newton’s first laws of motion. Buckle up allows students to learn about Newton’s first law in relation to safety restraint systems. In “constant force and changing mass” students use simple machines to investigate the effect of increasing mass on an accelerating system. Students will then view the effects of how increasing force affects the acceleration of a system in “constant mass and changing force”.

In activity “On a roll” students will hypothesize where a projectile will land. They will test their hypotheses by calculating where it will land, and then observing where the projectile actually does land. In their lab report they discuss sources of error, along with writing and detailed procedure, including a diagram of their experimental set up and all the equations and calculations. Students should observe that their math actually closely matches reality and conclude that the range of the projectile depends on its initial velocity.

High-Voltage Safety demonstration. Properly power down system and verify with meter. Service procedures associated with hybrid/high-voltage technology. Connect and observe hybrid/electric vehicle scan tool data. Inverter operation, DC/DC operation. AC to DC charging conversions. Electric power steering, electric braking and regenerative energy collection.

Math and Measurements

By the end of this unit students should be able to describe both customary (SAE) and metric measuring (SI) systems, identify basic measuring tools, describe the use of common measuring tools, use conversion charts, list safety rules relating to measurement, and summarize essential advanced mathematical concepts. Apply measurement systems and the mathematical functions necessary to perform required fabrication, maintenance, and operation procedures. Use measurement scales, devices, and systems, such as dial indicators and micrometers, to design, fabricate, and diagnose, maintain, and repair vehicles and components following recommended industry standards.

Students will understand that engineers must have good communication skills and be team players. Grouping students in teams and having them collect data will allow them to build on their communication skills and to create opportunities for hands-on, interactive learning, while teaching them the common measurement and mathematical formulas engineers use.

Work Orders and Service

By the end of this unit student should be able to describe the different types of service manuals, access and use an online service information system contents and sections, explain the different kinds of information found in a service manual, describe the three basic types of troubleshooting charts found in service manuals, and explain how to use service bulletin information. Students will be able to research and interpret manufacturer's specifications related to automotive systems. Students will use technical vocabulary, technical reports and manuals, electronic systems, and related technical data resources, as appropriate, to determine repairs and create estimates.

Students will use word problems to solve labor time standards. Students will understand that documentation is an important part of any engineering process, and they will be able to be able to provide accurate documentation for all activities and data they collect. They will accurately create, fill out, interpret, and organize all collected data on official documents. Students will set up well organized documents that enable them to discuss tasks with classmates, use problem solving techniques comparable to engineers in the field, and present their ideas to their peers in a professional manner.

Students will be able to decode their own VIN number. Students will also learn common automotive abbreviations such as ECM, ISC, and TPS so they may become familiar with technical terminology.

Once the students have learned about the common sensor abbreviations students will conduct an activity where they will learn about the various materials and signals each sensor sends to the PCM. They will discuss the scientific and engineering designs considered when engineering sensors such as temperature range tolerance, location, and natural wear concerns.

Students will study the types of ways engineers collect data and learn about the stages in the testing/analysis steps of the engineering design process. This includes different modeling methods as well as how these models are tested. They will also discuss the three types of final outputs (final project report, oral presentation, and

production documents). Students will use lead sulfation, oxidation-reduction examples found in "flooded" vehicle batteries to follow the engineering design process. They will write a report describing any design improvements they would consider. They will follow the engineering design process in all of their experiments.

Electricity

By the end of this unit student should be able to explain the principles of electricity, describe the action of basic electric circuits, compare voltage, current, and resistance, describe the principles of magnetism and magnetic fields, identify basic electric and electronic terms and components, explain different functions of automotive sensors, and perform fundamental electrical tests. They will demonstrate the function, principles, and operation of electrical and electronic systems using manufacturers' standards.

Students will be able to comprehend and calculate various forms of work, energy, and power. Students will learn scientific formulas using Ohm's Law as an example. Students will demonstrate the ability to construct a geometric proof using their knowledge of symptom to system to component to cause, electrical circuits, series and parallel networks, alternating and direct voltages, by using electrical measuring instruments (commonly used by electrical engineers) and measurements to prove their proof. Students will use proportional relationships when calculating resistance values. Electrical engineers must be able to interpret graphs from real data as will the students using digital volt-ohm meters.

Students learn about series and parallel networks, electromagnetism, alternating and direct voltages, currents, capacitors and inductors, electrical measuring instrument and measurements, electrolysis, and high and low voltage electrical systems.

Students will learn about electronic theory such as electron flow and current, voltage, direct and alternating current, circuits, resistance, and components, and electric motors. Students will be given examples in this unit for each term. Students will work with Voltage, Current, and Resistance; and understand the five basic parts of a simple circuit. (Power, ground, switch, circuit protection, and load).

Students will learn about automotive computer operations with emphasis on input, processing, and output; actuators v. sensors; CAN-bus multiplexing and networking; and analog/digital operations.

Students will be able to describe electron flow theory, magnetic induction theory, explain the operation of a storage battery, starting system, charging system, and describe the operation of lighting and accessory systems.

Students will identify schematic symbols and which electronic components are represented by each symbol. They will work in groups using the electrical trainers to build simple circuits from supplied wiring diagrams. Students will predict what will happen when power is supplied to the circuit constructed before the instructor will allow them to connect power and test the circuit. During the construction of these increasingly difficult lab projects, students will develop communication and brainstorming techniques, active listening, and time management skills. They will also learn how to allocate resources, access information, provide documentation, and written reports.

The third phase of the lab involves students working on actual vehicle electrical system. Students will be given vehicles that have been "bugged," and using online service information wiring diagrams and knowledge of circuits learned, and critical thinking skills, diagnose vehicle faults and recommend repairs to bring vehicle

back to operating parameters. Students will develop testing and problem recognition skills that they will use when diagnosing customer vehicle concerns.

Vehicle Maintenance, Fluid Service, and Recycling

By the end of the unit students should be able to check a car's hybrid electronics cooling system. Students will perform and document repair procedures in accordance with manufacturer recommendations and industry standards, while demonstrating best business practices.

Students will research the role that an environmental engineer has in waste disposal, hazardous material handling, and recycling.

Students will learn how to properly inspect a vehicle using a multi-point inspection sheet. As they check each task they will consider the engineering fields and design that created each system or part they are checking. Students will learn the importance and function of anti-freeze and how it relates to specific heat. Anti-freeze has special properties, which protect the vehicle from overheating and causing serious damage. By studying specific heat, they will learn how specific gravity affects the properties of antifreeze.

The students will calculate the average cost of a maintenance service in the local area and determine the annual cost of oil changes. They will then research the replacement cost of an engine and compare cost of oil changes to engine replacement. They will also compare the environmental impact of properly maintaining a vehicle vs. not properly maintaining a vehicle i.e. air pollution, oil leaks, draining, traffic hazards.

ASE (Automotive Service Excellence) Certification and Careers

By the end of this unit students should be able to list the most common automotive careers, describe the type of skills needed to be an auto technician, and explain the tasks completed by each type of auto technician specialist. Use reference books and materials, technical service bulletins, and other related documents to determine repairs and rate of pay. Throughout the course students will refer back to their research to connect each engineering field to the topics discussed in class. For example, when covering unit eight (electrical) students will review their notes on the education and training needed to become an electrical engineer.

Students will discuss time management, shop materials, and personnel. They will gain a better understanding of an automotive shop layout and management. Students will construct mathematical functions and equations to calculate wages and cost of supplies. Students will study various engineering careers and the role they play in everyday life such as: mechanical engineer's role in engineering new technology, civil engineer's role in designing structurally sound buildings and construction projects, chemical engineer's role in proper handling of hazardous materials. They will understand the connection between the engineering design and field service engineering aspects of the automotive industry.

Students define and research resources, management, and sustainability and the effect on business management. They will describe the management of time, materials, and human resources in the auto repair and maintenance business.

In Lab I students will be asked to compare and contrast four of the following engineering branches; aerospace, chemical, civil, electrical, mechanical, industrial, and computer science. They will then give a PowerPoint presentation of their findings. Students will utilize this project to develop critical thinking and problem solving skills by conducting research of the application of tools employed by engineers in the solution of problems, gain an understanding of the various fields of engineering, and how they relate to each other and the automobile. Students will write a report on their research. Students will also include information on a career of their choice including a description of the career; type of education needed, and average salary. This assignment will also include a guest lecturer from a local engineering firm and/or local college.

Portfolio

Students will also compose and create a portfolio with five sections (cover page, cover letter, resume, letters of recommendation, and samples of student work). The portfolio will help students apply for an internship or future job and they can continuously update their information for a future career. Students will also prepare their engineering notebooks which will include the projects, labs and research for the class for future use or study. It will include a summary of all major assignments.

Course Materials

Textbooks

Title	Author	Publisher	Edition	Website	Primary
Hybrid, Electric & Fuel-Cell Vehicles	Jack Erjavec	Delmar Cengage	2013	[empty]	Yes
Math For the Automotive Trade	John C. Peterson William deKryger	Thomson-Delmar	2014	[empty]	No

Websites

Title	Author(s)/Editor(s)/Compiler(s)	Affiliated Institution or Organization	URL

AYES	Automotive Youth Educational Systems	Automotive Youth Educational Systems	http://www.ayes.org
NATEF	[empty]	California Department of Education	http://www.natef.org
CTE-Auto	[empty]	Career and Technical Education Automotive Technology	http://www.cte-auto.net
California Career Zone	[empty]	California Career Resource Network	http://www.cacareerzone.org/index

Additional Information

Course Author:

Claire Spence
Administrator
cspence@rcoe.us
9518266827 ext.