ELECTRIC VEHICLE FUNDAMENTALS
COURSE CODE: TBD

COURSE DESCRIPTION: In the EV Fundamentals course, students will build on their foundational knowledge of circuits, electricity, and power from Clean Energy Systems in order to explore electric vehicles (EV), high voltage batteries, and the impact of emerging technologies on EV manufacturing and the charging infrastructure.

Students will engage in a variety of hands-on design projects to demonstrate principles using advanced technology hardware and software, including the assembly, testing, and improvement of an electric vehicle/trainer. This course will also prepare students for the ASE xEV Electrical Safety Awareness (Level 1) certification.

OBJECTIVE: Given the necessary equipment, materials, and instruction, students, on completion of the prescribed course of study, will be able to successfully accomplish the following core competencies.

CREDIT:	1 (120 hours) Carnegie unit
PREREQUISITE:	Clean Energy Systems (SREB)
GRADE:	11 - 12
COMPUTER ACCESS:	1 computer w/ internet access per student
MAXIMUM ENROLLMENT:	16 – 20 per instructor

STUDENT ORGANIZATIONS

Proficient professionals know the academic subject matter, including professional development, required for proficiency within their area. The following accountability criteria are considered essential for students in any program of study.

1. Identify the purpose and goals of a Career and Technology Student Organization (CTSO).
2. Explain how CTSOs are integral parts of specific clusters, majors, and/or courses.
3. Explain the benefits and responsibilities of being a member of a CTSO.
4. List leadership opportunities that are available to students through participation in CTSO conferences, competitions, community service, philanthropy, and other activities.
5. Explain how participation in CTSOs can promote lifelong benefits in other professional and civic organizations.

TECHNOLOGY KNOWLEDGE

Proficient professionals know the academic subject matter, including digital citizenship and the ethical use of technology. The following accountability criteria are considered essential for students in any program of study.

1. Demonstrate proficiency and skills associated with the use of technologies that are common to a specific occupation (e.g., keying speed).
2. Identify proper netiquette when using e-mail, social media, and other technologies for communication purposes.
3. Identify potential abuse and unethical uses of laptops, tablets, computers, and/or networks.
4. Explain the consequences of social, illegal, and unethical uses of technology (e.g., cyberbullying, piracy; illegal downloading; licensing infringement; inappropriate uses of software, hardware, and mobile devices in the work environment).
5. Discuss legal issues and the terms of use related to copyright laws, fair use laws, and ethics pertaining to downloading of images, photographs, documents, video, sounds, music, trademarks, Creative Commons, and other elements for personal use.
6. Describe ethical and legal practices of safeguarding the confidentiality of business- and personal-related information.
7. Describe possible threats to a laptop, tablet, computer, and/or network and methods of avoiding attacks.
8. Evaluate various solutions to common hardware and software problems.

PERSONAL QUALITIES AND EMPLOYABILITY SKILLS

Proficient professionals know the academic subject matter, including positive work practices and interpersonal skills. The following accountability criteria are considered essential for students in any program of study.

1. Demonstrate creativity and innovation.
2. Demonstrate critical thinking and problem-solving skills.
3. Demonstrate initiative and self-direction.
4. Demonstrate integrity.
5. Demonstrate work ethic.
6. Demonstrate conflict resolution skills.
7. Demonstrate listening and speaking skills.
8. Demonstrate respect for diversity.
9. Demonstrate customer service orientation.
10. Demonstrate teamwork.

PROFESSIONAL KNOWLEDGE

Proficient professionals know the academic subject matter, including positive work practices and interpersonal skills. The following accountability criteria are considered essential for students in any program of study.

1. Demonstrate global or “big picture” thinking.
2. Demonstrate career and life management skills and goal-making.
3. Demonstrate continuous learning and adaptability skills to changing job requirements.
4. Demonstrate time and resource management skills.
5. Demonstrates information literacy skills.
6. Demonstrates information security skills.

7. Demonstrates information technology skills.
8. Demonstrates knowledge and use of job-specific tools and technologies.
9. Demonstrate job-specific mathematics skills.
10. Demonstrates professionalism in the workplace.
11. Demonstrate reading and writing skills.
12. Demonstrates workplace safety.

A. ELECTRIC VEHICLES IN SOCIETY

EV engineers and technologists evaluate the impact of electric vehicles in society. The following accountability criteria are considered essential for students in the Advanced Automotive Pre-Engineering Technology program of study.

1. Analyze the evolution of electric vehicles in the automotive industry in relation to global events (e.g., energy production and decline, fossil fuel production, industrial revolution, world wars, pandemic.)
2. Differentiate between the types/classifications of electric vehicles (e.g., BEV, HEV, FCEV.)
3. Analyze the environmental impact of electric vehicles and their components.
4. Compare and contrast the life cycle of electric versus internal combustion vehicles.

B. ELECTRIC VEHICLE SAFETY AWARENESS

EV engineers and technologists demonstrate safety proficiency and risk awareness. The following accountability criteria are considered essential for students in the Advanced Automotive Pre-Engineering Technology program of study.

1. Identify risks associated with hybrid/electric vehicle (EV) manufacturing and operation.
2. List the steps needed to aid people subjected to high voltage.
3. Review basic first aid/CPR procedures.
4. Identify appropriate personal protective equipment (PPE) and inspection procedures (e.g., goggles, hard hat, gloves, shoes, face shield).
5. Demonstrate procedures for inspecting high-voltage safety gloves, insulated tools, and equipment prior to hybrid/EV service.
6. Identify different types of high-voltage components (e.g., converters, capacitors, cables, air conditioner compressor, modules/electronic control units).
7. Identify high-voltage components, circuits, and warning labeling (orange cables).
8. List the steps used in the high-voltage disconnect process.
9. Compare and contrast different types of batteries (e.g., lithium, solid-state) used in hybrid/EV vehicles.
10. Identify the associated risks created by damaged batteries (e.g., thermal runaway, stranded energy).
11. List the steps to de-energize/disable hybrid/EV vehicles.

12. Identify barriers, barricades, signs, equipment, and practices needed to prevent intrusion into the work zone.
13. Describe lockout/tagout procedures used during hybrid/EV manufacturing and operation.
14. Successfully achieve the ASE xEV Electrical Safety Awareness (Level 1) certification.

C. ANATOMY OF ELECTRIC VEHICLES

EV engineers and technologists understand the components and related functions in electric vehicle operations. The following accountability criteria are considered essential for students in the Advanced Automotive Pre-Engineering Technology program of study.

1. Identify electric vehicle components.
2. Explain the basic principles of EV propulsion systems including the function and interrelations of the major components.
3. Identify the hardware and software components that make up an EV propulsion system including battery management systems and motor controllers.
4. Identify the low-voltage human interface components needed to operate an electric vehicle.
5. Apply the concepts of electrical symbols and theories that pertain to ladder/line diagrams.
6. Select the manual controls, motor starters, and relays/timers that are used to wire a motor control circuit.
7. Read a wiring diagram to troubleshoot wiring failure.
8. Use appropriate equipment to analyze electric faults and determine the root cause of failure.

D. HIGH VOLTAGE BATTERIES AND MOTORS

EV engineers and technologists evaluate motor and battery characteristics for efficient use in an electric vehicle. The following accountability criteria are considered essential for students in the Advanced Automotive Pre-Engineering Technology program of study.

1. Calculate energy use and predict charging times of an EV battery.
2. Apply electrical and electronic theory to EV battery balancing, assembly, and maintenance.
3. Evaluate the effectiveness of EV batteries for energy density, ecology, c rating, and state of charge.
4. Monitor and evaluate EV battery status through the use of a battery management system (BMS).
5. Compare and contrast EV charging levels for time, power, and battery longevity.
6. Analyze criteria to select appropriate battery for DC/AC motors (e.g., size, speed, chemistry).

E. EMERGING TECHNOLOGIES IN AUTOMOTIVE ENGINEERING

EV engineers and technologists explore the use of emerging technologies for driver comfort, safety, and electric vehicle performance. The following accountability criteria are considered essential for students in the Advanced Automotive Pre-Engineering Technology program of study.

1. Evaluate the use of emerging technologies in electric vehicles and related charging infrastructures.
2. Evaluate data acquisition, cyber security, autonomy, sensors and control systems.
3. Evaluate the use of AI, robotics, automation in EV manufacturing.
4. Explore the use of Advanced Driver Assist Systems (ADAS) to improve safety and performance in electric vehicles.
5. Explore the use of augmented and virtual reality applications in automotive engineering diagnostics.

Additional Materials/Resources/Equipment Listing

Course Academic Standards and Indicators