

# Course Outline

Transportation

July/2023

**Job Title**

Automotive Service Technician

**Career Pathway:**

Systems Diagnostics and Service

**Industry Sector:**

Transportation

**O\*NET-SOC CODE:**

49-3023.00

**CBEDS Title:**

Automotive Service

**CBEDS No.:**

5668

**79-70-42**

## Hybrid & Electric Vehicles/1: Introduction

**Credits:** 5

**Hours:** 75

**Course Description:**

This competency-based course is the first in a sequence of two designed to introduce hybrid and electric vehicles. It provides students with project-based experiences in alternative fuel vehicles. Instruction includes introduction, general and high voltage safety, basic automotive electricity, tools and equipment, hybrid introduction, internal combustion engine overview, low-voltage batteries, preventative maintenance, regenerative brakes, electric power steering, electric motors/generators, inverters/converters, battery construction, employability, and resume preparation. The competencies in this course are aligned with the California High School Academic Content Standards and the California Career Technical Educational Model Curriculum Standards.

**Prerequisites:**

Enrollment requires successful completion of the Technology/1: Automotive Systems (79-90-83), Technology/2: Automotive Systems (79-90-85), Auto Tech: Engine Performance/1 (79-90-69), and Auto Tech: Electrical and Electronics/1 (79-90-61) courses.

**NOTE:** For Perkins purposes this course has been designated as an **introductory/concentrator** course.

This course **cannot** be repeated once a student receives a Certificate of Completion.



## **COURSE OUTLINE COMPETENCY-BASED COMPONENTS**

A course outline reflects the essential intent and content of the course described. Acceptable course outlines have six components. (Education Code Section 52506). Course outlines for all apportionment classes, including those in jails, state hospitals, and convalescent hospitals, contain the six required elements:

(EC 52504; 5CCR 10508 [b]; Adult Education Handbook for California [1977], Section 100)

### **COURSE OUTLINE COMPONENTS**

### **LOCATION**

#### **GOALS AND PURPOSES**

Cover

The educational goals or purposes of every course are clearly stated, and the class periods are devoted to instruction. The course should be broad enough in scope and should have sufficient educational worth to justify the expenditure of public funds.

The goals and purpose of a course are stated in the COURSE DESCRIPTION. Course descriptions state the major emphasis and content of a course and are written to be understandable by a prospective student.

#### **PERFORMANCE OBJECTIVES OR COMPETENCIES**

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Objectives should be delineated and described in terms of measurable results for the student and include the possible ways in which the objectives contribute to the student's acquisition of skills and competencies.

Performance Objectives are sequentially listed in the COMPETENCY-BASED COMPONENTS section of the course outline. Competency Areas are units of instruction based on related competencies. Competency Statements are competency area goals that together define the framework and purpose of a course. Competencies fall on a continuum between goals and performance objectives and denote the outcome of instruction.

Competency-based instruction tells a student before instruction what skills or knowledge they will demonstrate after instruction. Competency-based education provides instruction which enables each student to attain individual goals as measured against pre-stated standards.

Competency-based instruction provides immediate and continual repetition. In competency-based education the curriculum, instruction, and assessment share common characteristics based on clearly stated competencies. Curriculum, instruction, and assessment in competency-based education are explicit, known, agreed upon, integrated, performance oriented, and adaptive.

**COURSE OUTLINE COMPETENCY-BASED COMPONENTS**  
**(continued)**

**COURSE OUTLINE COMPONENTS**

**LOCATION**

**INSTRUCTIONAL STRATEGIES**

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Instructional techniques or methods could include laboratory techniques, lecture method, small-group discussion, grouping plans, and other strategies used in the classroom.

Instructional strategies for this course are listed in the TEACHING STRATEGIES AND EVALUATION section of the course outline. Instructional strategies and activities for a course should be selected so that the overall teaching approach considers the instructional standards of a particular program, i.e., English as a Second Language, Programs for Adults with Disabilities.

**UNITS OF STUDY, WITH APPROXIMATE HOURS ALLOTTED FOR EACH UNIT**

Cover

The approximate time devoted to each instructional unit within the course, as well as the total hours for the course, is indicated. The time in class is consistent with the needs of the student, and the length of the class should be that it ensures the student will learn at an optimum level.

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Units of study, with approximate hours allotted for each unit are listed in the COMPETENCY AREA STATEMENT(S) of the course outline. The total hours of the course, including work-based learning hours (community classroom and cooperative vocational education) is listed on the cover of every CBE course outline. Each Competency Area listed within a CBE outline is assigned hours of instruction per unit.

**EVALUATION PROCEDURES**

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The evaluation describes measurable evaluation criteria clearly within the reach of the student. The evaluation indicates anticipated improvement in performances as well as anticipated skills and competencies to be achieved.

Evaluation procedures are detailed in the TEACHING STRATEGIES AND EVALUATION section of the course outline. Instructors monitor students' progress on a continuing basis, assessing students on attainment of objectives identified in the course outline through a variety of formal and informal tests (applied performance procedures, observations, and simulations), paper and pencil exams, and standardized tests.

**REPETITION POLICY THAT PREVENTS PERPETUATION OF STUDENT ENROLLMENT**

Cover

After a student has completed all the objectives of the course, he or she should not be allowed to reenroll in the course. There is, therefore, a need for a statement about the conditions for possible repetition of a course to prevent perpetuation of students in a particular program for an indefinite period of time.

## **ACKNOWLEDGMENTS**

Thanks to JUAN SOLTERO for developing and editing this curriculum. Acknowledgment is also given to ERICA ROSARIO for designing the original artwork for the course covers.

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# **CALIFORNIA CAREER TECHNICAL EDUCATION MODEL CURRICULUM STANDARDS**

## **Transportation Industry Sector Knowledge and Performance Anchor Standards**

### **1.0 Academics**

Analyze and apply appropriate academic standards required for successful industry sector pathway completion leading to postsecondary education and employment. Refer to the Transportation academic alignment matrix for identification of standards.

### **2.0 Communications**

Acquire and accurately use Transportation sector terminology and protocols at the career and college readiness level for communicating effectively in oral, written, and multimedia formats.

### **3.0 Career Planning and Management**

Integrate multiple sources of career information from diverse formats to make informed career decisions, solve problems, and manage personal career plans.

### **4.0 Technology**

Use existing and emerging technology to investigate, research, and produce products and services, including new information, as required in the Transportation sector workplace environment.

### **5.0 Problem Solving and Critical Thinking**

Conduct short, as well as more sustained, research to create alternative solutions to answer a question or solve a problem unique to the Transportation sector using critical and creative thinking, logical reasoning, analysis, inquiry, and problem-solving techniques.

### **6.0 Health and Safety**

Demonstrate health and safety procedures, regulations, and personal health practices and determine the meaning of symbols, key terms, and domain-specific words and phrases as related to the Transportation sector workplace environment.

### **7.0 Responsibility and Flexibility**

Initiate, and participate in, a range of collaborations demonstrating behaviors that reflect personal and professional responsibility, flexibility, and respect in the Transportation sector workplace environment and community settings.

### **8.0 Ethics and Legal Responsibilities**

Practice professional, ethical, and legal behavior, responding thoughtfully to diverse perspectives and resolving contradictions, when possible, consistent with applicable laws, regulations, and organizational norms.

### **9.0 Leadership and Teamwork**

Work with peers to promote divergent and creative perspectives, effective leadership, group dynamics, team and individual decision making, benefits of workforce diversity, and conflict resolution as practiced in the SkillsUSA career technical student organization

### **10.0 Technical Knowledge and Skills**

Apply essential technical knowledge and skills common to all pathways in the Transportation sector, following procedures when carrying out experiments or performing technical tasks.

### **11.0 Demonstration and Application**

Demonstrate and apply the knowledge and skills contained in the Transportation anchor standards, pathway standards, and performance indicators in classroom, laboratory, and workplace settings, and through the SkillsUSA career technical student organization.

## **Transportation Pathway Standards**

### **C. Systems Diagnostics and Service Pathway**

The Systems Diagnostics and Service pathway prepares students for postsecondary education and employment in the transportation industry, which includes but is not limited to motor vehicles, rail systems, marine applications, and small-engine and specialty equipment.

Sample occupations associated with this pathway:

- ◆ Service Technician/Maintenance Worker/Shop Foreman
- ◆ Technical Writer
- ◆ Dispatcher
- ◆ Engineer
- ◆ Investigator/Inspector

- C1.0 Demonstrate the practice of personal and occupational safety and protecting the environment by using materials and processes in accordance with manufacturer and industry standards.
- C2.0 Practice the safe and appropriate use of tools, equipment, and work processes.
- C3.0 Use scientific principles in relation to chemical, mechanical, and physical functions for various engine and vehicle systems.
- C4.0 Perform and document maintenance procedures in accordance with the recommendations of the manufacturer.
- C5.0 Apply and understand appropriate business practices.
- C6.0 Demonstrate the application, operation, maintenance, and diagnosis of engines, including but not limited to two- and four-stroke and supporting subsystems.
- C7.0 Demonstrate the function, principles, and operation of electrical and electronic systems using manufacturer and industry standards.
- C8.0 Demonstrate the function and principles of automotive drivetrain, steering and suspension, brake, and tire and wheel components and systems in accordance with national industry standards.

**CBE**  
**Competency-Based Education**

**COMPETENCY-BASED COMPONENTS**  
**for the Hybrid & Electric Vehicles/1: Introduction Course**

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p><b>A. INTRODUCTION</b></p> <p>Review, apply, and evaluate classroom and workplace policies and procedures.</p> <p>(2 hours)</p>	<ol style="list-style-type: none"> <li>1. Discuss the scope and purpose of the course.</li> <li>2. Discuss classroom policies and procedures.</li> <li>3. Discuss and demonstrate Zoom, Schoology, and basic computer skills.</li> <li>4. Assess students’ basic knowledge in electrical principles and engine performance.</li> <li>5. Discuss, identify, research, and draw conclusions on the different career paths, occupations, employment outlook, career advancements in the transportation industry sector, which have an impact on hybrid/electric vehicles.</li> <li>6. Discuss the opportunities available for promoting gender equity and the representation of non-traditional populations in automotive industry.</li> <li>7. Explain and recognize the importance of ethics, teamwork, respecting individual and cultural differences and diversity in the workplace.</li> <li>8. Describe the role of the Automotive Service Education (ASE) Foundation as it applies to the automotive industry.</li> </ol>	<p><b>Career Ready Practice:</b> 1, 2, 3, 4, 5, 8, 9, 10, 11</p> <p><b>CTE Anchor:</b> Anchor 1.0 Communications: 2.1, 2.5 Career Planning and Management: 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.9 Technology: 4.1, 4.3, 4.5 Problem Solving and Critical Thinking Skills: 5.1, 5.4 Ethics and Legal Responsibilities: 8.3, 8.4, 8.5 Leadership and Teamwork: 9.3, 9.4, 9.6 Technical Knowledge and Skills: 10.4 Demonstration and Application: 11.1</p> <p><b>CTE Pathway:</b> C5.1, C5.4</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p><b>B. SAFETY - GENERAL</b></p> <p>Understand safety procedures and techniques in the auto repair and maintenance sector.</p> <p>(3 hours)</p>	<ol style="list-style-type: none"> <li>1. Discuss classroom and workplace first aid and emergency procedures.</li> <li>2. Discuss the California Occupational Safety and Health Administration (Cal/OSHA) workplace requirements for auto technicians.</li> <li>3. Discuss the impact of Environmental Protection Agency (EPA) legislation on Transportation Industry Sector practices in protecting and preserving the environment.</li> <li>4. Discuss the impact of California Air Resources Board (ARB) legislation on Transportation Industry Sector.</li> <li>5. Discuss the Bureau of Automotive Repair (BAR) standards for consumer and environmental protection.</li> <li>6. Discuss the use of the Safety Data Sheet (SDS) as it applies to the automotive industry.</li> <li>7. Discuss the safety items required by the federal, state, and local regulations.</li> <li>8. Discuss how each of the following insures a safe workplace: <ol style="list-style-type: none"> <li>a. employees' rights as they apply to job safety</li> <li>b. employees' obligations as they apply to safety</li> <li>c. safety laws applying to tools and equipment</li> </ol> </li> <li>9. Describe and demonstrate the standards regarding proper use of protective: <ol style="list-style-type: none"> <li>a. clothing and gloves in an auto shop</li> <li>b. respiratory gear in an auto shop</li> <li>c. eye gear in an auto shop</li> <li>d. ventilation in an auto shop</li> <li>e. handling, storage, and disposal of chemicals and hazardous materials used in an auto shop</li> </ol> </li> <li>10. Pass the safety test with 100%.</li> </ol>	<p><b>Career Ready Practice:</b> 1, 2, 10, 12</p> <p><b>CTE Anchor:</b> Academics: 1.0 Communications: 2.1 Health and Safety: 6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7 Technical Knowledge and Skills: 10.2, 10.4 Demonstration and Application: 11.1</p> <p><b>CTE Pathway:</b> C1.1, C1.2, C1.3, C1.4, C4.2, C5.2</p>
<p><b>C. HIGH VOLTAGE SAFETY</b></p> <p>Explain the principles involved in high voltage safety precautions with hybrid components.</p>	<ol style="list-style-type: none"> <li>1. Discuss general high voltage warnings and labels.</li> <li>2. Define and discuss high voltage cables: <ol style="list-style-type: none"> <li>a. blue cables</li> <li>b. yellow cables</li> <li>c. orange cables</li> </ol> </li> <li>3. Discuss and describe electrical shop potential hazards.</li> <li>4. Discuss and demonstrate high voltage safety equipment: <ol style="list-style-type: none"> <li>a. gloves</li> <li>b. glove testing</li> <li>c. safety glasses and face shields</li> <li>d. safety cones</li> <li>e. fiber glass pole and hook</li> <li>f. fire extinguishers</li> <li>g. isolating mats</li> <li>h. sheets and clothing</li> </ol> </li> <li>5. Discuss and describe procedures for depowering the high voltage system.</li> <li>6. Discuss collision and industry repair issues.</li> </ol>	<p><b>Career Ready Practice:</b> 1, 2, 5, 10</p> <p><b>CTE Anchor:</b> Academics: 1.0 Communications: 2.1 Problem Solving and Critical Thinking: 5.1, 5.2, 5.4 Health and Safety: 6.2, 6.4, 6.5, 6.6 Technical Knowledge and Skills: 10.1, 10.2</p>





COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p>maintenance, and storage techniques for automotive tools and equipment.</p> <p>(5 hours)</p>	<ol style="list-style-type: none"> <li>2. Describe and demonstrate the following:               <ol style="list-style-type: none"> <li>a. selection of the appropriate hand, power tools, and equipment for each job</li> <li>b. procedures for checking out hand, power tools, and equipment from the tool room</li> <li>c. safe use of the most common hand, power tools and equipment in the auto shop</li> <li>d. practice personal safety when lifting, bending, or moving equipment and supplies</li> </ol> </li> <li>3. Identify and describe the features and functions of the most common high voltage tools and equipment:               <ol style="list-style-type: none"> <li>a. hybrid multimeter</li> <li>b. power tools and equipment</li> <li>c. selection of the appropriate insulated hand tools</li> <li>d. Megaohmmeter</li> <li>e. Milliohmmeter/Micro</li> <li>f. Battery chargers/maintainers/conditioners</li> <li>g. Hybrid Engines</li> <li>h. hybrid CVT/Transaxles</li> <li>i. hybrid inverters/converters</li> <li>j. high voltage battery packs</li> </ol> </li> <li>4. Pass a tools and equipment assessment with an 80% score or higher.</li> </ol>	<p><b>CTE Anchor:</b>            Academics:            1.0            Communications:            2.1            Problem Solving and Critical Thinking:            5.1, 5.2, 5.4            Health and Safety:            6.3, 6.4            Technical Knowledge and Skills:            10.1            Demonstration and Application:            11.1</p> <p><b>CTE Pathway:</b>            C2.1, C2.2, C2.3, C2.4, C2.5</p>
<p><b>F. HYBRID INTRODUCTION</b></p> <p>Understand, apply, and evaluate the principles of the hybrid electric vehicles.</p> <p>(5 hours)</p>	<ol style="list-style-type: none"> <li>1. Explain the definition of a hybrid electric vehicle.</li> <li>2. Describe the unique characteristics of owning or driving a hybrid or electric vehicle.</li> <li>3. Explain the differences in the levels of hybrid vehicles.</li> <li>4. Describe the different powertrain configurations in a hybrid vehicle.</li> <li>5. Explain the differences between one-, two-, and three-motor systems to make informed decisions.</li> <li>6. Describe and demonstrate the difference between series and parallel hybrid configurations.</li> <li>7. Pass a hybrid introduction assessment with an 80% score or higher.</li> </ol>	<p><b>Career Ready Practice:</b>            1, 2, 5, 10, 11</p> <p><b>CTE Anchor:</b>            Academics:            1.0            Communications:            2.1            Problem Solving and Critical Thinking:            5.1, 5.4            Technical Knowledge and Skills:            10.1            Demonstration and Application:            11.1</p> <p><b>CTE Pathway:</b>            C3.1, C3.4, C3.5, C3.6</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p><b>G. INTERNAL COMBUSTION ENGINE</b></p> <p>Understand, apply, and evaluate the principles of the internal combustion engine design.</p> <p>(8 hours)</p>	<ol style="list-style-type: none"> <li>1. Identify and discuss the features and functions of the following:               <ol style="list-style-type: none"> <li>a. major parts of an automobile engine</li> <li>b. different types of cylinder configurations</li> <li>c. valve arrangements:                   <ol style="list-style-type: none"> <li>i. overhead valve</li> <li>ii. single overhead cam</li> <li>iii. double overhead cam</li> </ol> </li> </ol> </li> <li>2. Define and explain the four-stroke cycle.</li> <li>3. Explain the key differences between Atkinson cycle &amp; Otto cycle engine operation.</li> <li>4. Identify and discuss proper operation of the Exhaust Gas Recirculation (EGR) System.</li> <li>5. Identify and discuss operation of the Exhaust Heat Recirculation (EHR) System.</li> <li>6. Perform engine compression test using testing device.</li> <li>7. Define and explain the key differences in the catalyst system.</li> <li>8. Identify and discuss electric water pump operation and perform inverter coolant exchange and bleeding procedures using specialized tools to make informed decisions.</li> <li>9. Pass an internal combustion engine assessment with an 80% score or higher.</li> </ol>	<p><b>Career Ready Practice:</b> 1, 2, 5, 10</p> <p><b>CTE Anchor:</b> Academics: 1.0 Communications: 2.1 Problem Solving and Critical Thinking: 5.1, 5.2, 5.3, 5.4 Technical Knowledge and Skills: 10.1 Demonstration and Application: 11.1</p> <p><b>CTE Pathway:</b> C2.1, C3.1, C3.2, C3.3, C3.4, C3.5, C3.7 C6.4</p>
<p><b>H. LOW-VOLTAGE BATTERIES</b></p> <p>Understand, apply, and evaluate the principles and procedure used for low-voltage batteries.</p> <p>(5 hours)</p>	<ol style="list-style-type: none"> <li>1. Describe the purpose of the 12-volt battery.</li> <li>2. Explain the 12-volt battery rating systems.</li> <li>3. Describe the 12-volt test procedures.</li> <li>4. List the battery ratings.</li> <li>5. Describe deep cycling.</li> <li>6. Explain and demonstrate how to safely charge a battery and draw conclusions.</li> <li>7. Describe and demonstrate how to perform a battery load test.</li> <li>8. Explain how to perform a conductance test and draw conclusions.</li> <li>9. Pass a low-voltage batteries assessment with an 80% score or higher.</li> </ol>	<p><b>Career Ready Practice:</b> 1, 2, 5, 10</p> <p><b>CTE Anchor:</b> Academics: 1.0 Communications: 2.1 Problem Solving and Critical Thinking: 5.1, 5.2, 5.4 Demonstration and Application: 11.1</p> <p><b>CTE Pathway:</b> C2.1, C2.3, C3.5, C3.6, C7.2</p>
<p><b>I. PREVENTATIVE MAINTENANCE</b></p> <p>Understand, apply, and</p>	<ol style="list-style-type: none"> <li>1. Describe and identify the major considerations for servicing a hybrid, compared with a conventional vehicle.</li> <li>2. Explain and demonstrate how to place a hybrid electric vehicle in maintenance mode.</li> </ol>	<p><b>Career Ready Practice:</b> 1, 2, 5, 10</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p>evaluate the principles and procedure used for preventative maintenance of hybrid and electric vehicles.</p> <p>(4 hours)</p>	<ol style="list-style-type: none"> <li>3. Describe the service precautions when changing the oil and filter on a hybrid vehicle.</li> <li>4. Explain how to service the base brakes system on a hybrid and electric vehicle.</li> <li>5. Pass a preventative maintenance assessment with an 80% score or higher.</li> </ol>	<p><b>CTE Anchor:</b>            Academics:            1.0            Communications:            2.1            Problem Solving and Critical Thinking:            5.1, 5.2, 5.3            Demonstration and Application:            11.1</p> <p><b>CTE Pathway:</b>            C2.1, C3.4</p>
<p><b>J. REGENERATIVE BRAKES</b></p> <p>Understand, apply, and evaluate the principles and procedure used for regenerative braking systems.</p> <p>(4 hours)</p>	<ol style="list-style-type: none"> <li>1. Describe and identify how regenerative braking works.</li> <li>2. Explain the principles involved in regenerative braking.</li> <li>3. Discuss the parts and components involved in regenerative braking.</li> <li>4. Pass a regenerative brakes assessment with an 80% score or higher.</li> </ol>	<p><b>Career Ready Practice:</b>            1, 2, 5</p> <p><b>CTE Anchor:</b>            Academics:            1.0            Communications:            2.1            Problem Solving and Critical Thinking:            5.1</p> <p><b>CTE Pathway:</b>            C3.3, C3.4, C3.5, C3.6</p>
<p><b>K. ELECTRIC POWER STEERING</b></p> <p>Understand, apply, and evaluate the principles and procedures used for electric power steering systems.</p> <p>(3 hours)</p>	<ol style="list-style-type: none"> <li>1. Describe the purpose, function, and types of electric power steering systems.</li> <li>2. Explain how electric power steering systems operate.</li> <li>3. Discuss the parts and components involved with electric power steering systems.</li> <li>4. Discuss how to diagnose electric power steering system faults.</li> <li>5. Pass an electric power steering assessment with an 80% score or higher.</li> </ol>	<p><b>Career Ready Practice:</b>            1, 2</p> <p><b>CTE Anchor:</b>            Academics:            1.0            Communications:            2.1</p> <p><b>CTE Pathway:</b>            C2.1, C2.3, C3.3, C3.4, C3.5, C3.6, C3.7, C8.1</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p><b>L. ELECTRIC MOTORS / GENERATORS</b></p> <p>Understand, apply, and evaluate the principles and procedures used for electric motors and generators.</p> <p>(5 hours)</p>	<ol style="list-style-type: none"> <li>1. Describe the basic operating principles of electric motors and generators.</li> <li>2. Define the role of stators, rotors, armatures, and field windings in motors.</li> <li>3. Identify the types of electric motors in operation today and list the advantages and disadvantages of alternating current and direct current.</li> <li>4. Understand the importance of magnetic principles in the operation of a motor and generator.</li> <li>5. Explain the difference between a motor and a generator (AC and DC).</li> <li>6. Define the function and operating principles of resolvers and digital pulse encoders.</li> <li>7. Pass an electric power steering assessment with an 80% score or higher.</li> </ol>	<p><b>Career Ready Practice:</b> 1, 2, 5</p> <p><b>CTE Anchor:</b> Academics: 1.0 Communications: 2.1 Problem Solving and Critical Thinking: 5.1 Technical Knowledge and Skills: 10.1</p> <p><b>CTE Pathway:</b> C2.1, C2.3, C3.3, C3.4, C3.5, C3.6</p>
<p><b>M. INVERTERS/CONVERTERS</b></p> <p>Understand, apply, and evaluate the principles and procedures used for inverters and converters.</p> <p>(5 hours)</p>	<ol style="list-style-type: none"> <li>1. Describe how a DC-DC converter works.</li> <li>2. Describe the basic operation of a DC-AC inverter.</li> <li>3. Explain the purpose of a boost converter.</li> <li>4. Describe the purpose of the air conditioning inverter.</li> <li>5. List the components of the inverter cooling system.</li> <li>6. Pass an inverters/converters assessment with an 80% score or higher.</li> </ol>	<p><b>Career Ready Practice:</b> 1, 2</p> <p><b>CTE Anchor:</b> Academics: 1.0 Communications: 2.1</p> <p><b>CTE Pathway:</b> C2.1, C3.1, C3.2, C3.3, C3.4, C3.5, C3.6</p>
<p><b>N. BATTERY CONSTRUCTION</b></p> <p>Understand, apply, and evaluate the principles and procedures used for Hybrid High Voltage battery systems.</p>	<ol style="list-style-type: none"> <li>1. Identify and discuss low voltage batteries such as the: Absorbed Glass Matt (AGM) batteries.</li> <li>2. Discuss and determine low voltage battery faults and secondary symptoms.</li> <li>3. Describe and demonstrate charging of AGM batteries and jump-starting procedures when moving or lifting batteries.</li> <li>4. Discuss and describe High Voltage (HV) battery construction.</li> <li>5. Discuss and demonstrate HV battery health checks.</li> <li>6. Identify HV battery Bus Bars and determine possible faults.</li> <li>7. Discuss and demonstrate use of battery chargers and reconditioners.</li> <li>8. Discuss and demonstrate removal of HV Service Disconnect Plugs</li> </ol>	<p><b>Career Ready Practice:</b> 1, 2, 5, 10</p> <p><b>CTE Anchor:</b> Academics: 1.0 Communications: 2.1 Problem Solving and Critical Thinking: 5.1, 5.4</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
(10 hours)	<p>and Devices per manufacturer’s rules and regulations.</p> <ol style="list-style-type: none"> <li>9. Discuss and demonstrate enabling/disabling of HV components.</li> <li>10. Pass a battery construction assessment with an 80% score or higher.</li> </ol>	<p>Health and Safety: 6.4</p> <p>Technical Knowledge and Skills: 10.2, 10.4</p> <p>Demonstration and Application: 11.1</p> <p><b>CTE Pathway:</b> C2.2, C3.4, C3.7, C7.2, C7.3</p>
<p><b>O. EMPLOYABILITY SKILLS &amp; RESUME PREPARATION</b></p> <p>Understand, apply, and evaluate the employability skills required in auto repair and maintenance.</p> <p>(1 hour)</p>	<ol style="list-style-type: none"> <li>1. Understand employer requirements for soft skills such as: <ol style="list-style-type: none"> <li>a. attitude toward work</li> <li>b. communication and collaboration</li> <li>c. critical thinking, problem solving, decision-making</li> <li>d. customer service</li> <li>e. flexibility and adaptability</li> <li>f. interpersonal skills</li> <li>g. leadership, and responsibility</li> <li>h. punctuality and attendance</li> <li>i. quality of work</li> <li>j. respect, cultural and diversity differences</li> <li>k. teamwork</li> <li>l. time management</li> <li>m. trust and ethical behavior</li> <li>n. work ethic</li> </ol> </li> <li>2. Create/revise a resume, cover letter, and/or portfolio.</li> <li>3. Review the role of online job searching platforms and career websites.</li> <li>4. Complete and/or review an on-line job application.</li> <li>5. Understand interview skills to get the job: <ol style="list-style-type: none"> <li>a. do’s and don’ts for job interviews</li> <li>b. how to dress for the job</li> </ol> </li> <li>6. Create sample follow-up letters.</li> <li>7. Understand the importance of the continuous upgrading of job skills as it relates to: <ol style="list-style-type: none"> <li>a. certification, licensure, and/or renewal</li> <li>b. professional organizations/events</li> <li>c. industry associations and/or organized labor</li> </ol> </li> </ol>	<p><b>Career Ready Practice:</b> 1, 2, 3, 4, 5, 7, 8, 9</p> <p><b>CTE Anchor:</b> Academics: 1.0</p> <p>Communications: 2.2, 2.3, 2.4, 2.5</p> <p>Career Planning and Management: 3.2, 3.3, 3.4, 3.6, 3.8</p> <p>Technology: 4.1, 4.3</p> <p>Problem Solving &amp; Critical Thinking: 5.1</p> <p>Responsibility and Flexibility: 7.2, 7.3, 7.4, 7.7</p> <p>Ethics and Legal Responsibilities: 8.4</p> <p>Leadership and Teamwork: 9.2, 9.3, 9.4, 9.6</p> <p>Demonstration and Application: 11.5</p> <p><b>CTE Pathway:</b> C5.1, C5.2, C5.5</p>

## ***SUGGESTED INSTRUCTIONAL MATERIALS and OTHER RESOURCES***

### **TEXTBOOKS**

Bennet, Sean. Electric Vehicles: A System Approach, 1<sup>st</sup> Edition. Goodheart-Wilcox Publishing, 2023

Quarto, Dr. Mark L. and Goodnight, Dr. Nicholas. Light Duty Hybrid and Electric Vehicles, 1<sup>st</sup> Edition. Jones & Bartlett Learning, 2023.

Halderman, James and Ward, Curt. Electric and Hybrid Electric Vehicles, 1<sup>st</sup> Edition. Pearson Education, 2023.

### **SUPPLEMENTAL TEXTBOOKS**

Denton, Tom. Electric & Hybrid Vehicles, 1st Edition. Routledge, 2016.

Denton, Tom. Alternative Fuel Vehicles, 1st Edition. Routledge, 2018.

Ehsani, Mehrdad. Modern Electric, Hybrid Electric, and Fuel Cell Vehicles, 3rd Edition. CRC Press, 2019.

Husain, Iqbal. Electric & Hybrid Vehicles: Theory & Design Fundamentals, 3rd Edition. CRC Press, 2021.

### **RESOURCES**

Employer Advisory Board members

California Career Technical Education Model Curriculum Standards

<https://www.cde.ca.gov/ci/ct/sf/documents/transportation.pdf>

Automotive Service Excellence (ASE) Education Foundation 101 Blue Seal Dr. SE, Suite 101, Leesburg, VA 20175.  
Phone (703) 669-6650 Fax (703) 669-6125. <https://www.aseeducationfoundation.org/>

SkillsUSA P.O. Box 3000, Leesburg, VA 20177-0300. Phone: (703) 777-8810. Fax: (703) 777-8999. [www.skillsusa.org](http://www.skillsusa.org)

[www.freeonlineautorepair.com/automotive\\_fuel\\_system.html](http://www.freeonlineautorepair.com/automotive_fuel_system.html)

[www.fueleconomy.gov](http://www.fueleconomy.gov)

### **COMPETENCY CHECKLIST**

## **TEACHING STRATEGIES and EVALUATION**

### **METHODS AND PROCEDURES**

- A. Lecture and discussion
- B. Multimedia presentations
- C. Visual aids
- D. Projects
- E. Individualized instruction

### **EVALUATION**

SECTION A – Introduction – Pass all assignments with a minimum score of 80% or higher.

SECTION B – Safety - General – Pass the safety test with a minimum score of 100% accuracy.

SECTION C – High Voltage Safety – Pass all assignments and exams with a minimum score of 80% or higher.

SECTION D – Basic Automotive Electricity – Pass all assignments and exams with a minimum score of 80% or higher.

SECTION E – Tools and Equipment – Pass all assignments and exams with a minimum score of 80% or higher.

SECTION F – Hybrid Introduction – Pass all assignments and exams with a minimum score of 80% or higher.

SECTION G – Internal Combustion Engine – Pass all assignments and exams with a minimum score of 80% or higher.

SECTION H – Low-Voltage Batteries – Pass all assignments and exams with a minimum score of 80% or higher.

SECTION I – Preventative Maintenance – Pass all assignments and exams with a minimum score of 80% or higher.

SECTION J – Regenerative Brakes – Pass all assignments and exams with a minimum score of 80% or higher.

SECTION K – Electric Power Steering – Pass all assignments and exams with a minimum score of 80% or higher.

SECTION L – Electric Motors/Generators – Pass all assignments and exams with a minimum score of 80% or higher.

SECTION M – Inverters/Converters – Pass all assignments and exams with a minimum score of 80% or higher.

SECTION N – Battery Construction – Pass all assignments and exams with a minimum score of 80% or higher.

SECTION O – Employability Skills & Resume Preparation – Pass all assignments and exams with a minimum score of 80% or higher.



## ***Standards for Career Ready Practice***

**1. Apply appropriate technical skills and academic knowledge.**

Career-ready individuals readily access and use the knowledge and skills acquired through experience and education. They make connections between abstract concepts with real-world applications and recognize the value of academic preparation for solving problems, communicating with others, calculating measures, and performing other work-related practices.

**2. Communicate clearly, effectively, and with reason.**

Career-ready individuals communicate thoughts, ideas, and action plans with clarity, using written, verbal, electronic, and/or visual methods. They are skilled at interacting with others: they are active listeners who speak clearly and with purpose, and they are comfortable with terminology that is common to workplace environments. Career-ready individuals consider the audience for their communication and prepare accordingly to ensure the desired outcome.

**3. Develop an education and career plan aligned with personal goals.**

Career-ready individuals take personal ownership of their educational and career goals and manage their individual plan to attain these goals. They recognize the value of each step in the educational and experiential process, and they understand that nearly all career paths require ongoing education and experience to adapt to practices, procedures, and expectations of an ever-changing work environment. They seek counselors, mentors, and other experts to assist in the planning and execution of education and career plans.

**4. Apply technology to enhance productivity.**

Career-ready individuals find and maximize the productive value of existing and new technology to accomplish workplace tasks and solve workplace problems. They are flexible and adaptive in acquiring and using new technology. They understand the inherent risks—personal and organizational—of technology applications, and they take actions to prevent or mitigate these risks.

**5. Utilize critical thinking to make sense of problems and persevere in solving them.**

Career-ready individuals recognize problems in the workplace, understand the nature of the problems, and devise effective plans to solve the problems. They thoughtfully investigate the root cause of a problem prior to introducing solutions. They carefully consider options to solve a problem and, once agreed upon, follow through to ensure the problem is resolved.

**6. Practice personal health and understand financial literacy.**

Career-ready individuals understand the relationship between personal health and workplace performance. They contribute to their personal well-being through a healthy diet, regular exercise, and mental health activities. Career-ready individuals also understand that financial literacy leads to a secure future that enables career success.

**7. Act as a responsible citizen in the workplace and the community.**

Career-ready individuals understand the obligations and responsibilities of being a member of a community and demonstrate this understanding every day through their interactions with others. They are aware of the impacts of their decisions on others and the environment around them, and they think about the short-term and long-term consequences of their actions. They are reliable and consistent in going beyond minimum expectations and in participating in activities that serve the greater good.

**8. Model integrity, ethical leadership, and effective management.**

Career-ready individuals consistently act in ways that align with personal and community-held ideals and principles. They employ ethical behaviors and actions that positively influence others. They have a clear understanding of integrity and act on this understanding in every decision. They use a variety of means to positively impact the direction and actions of a team or organization, and they recognize the short-term and long-term effects that management's actions and attitudes can have on productivity, morale, and organizational culture.

**9. Work productively in teams while integrating cultural and global competence.**

Career-ready individuals contribute positively to every team, as both team leaders and team members. To avoid barriers to productive and positive interaction, they apply an awareness of cultural differences. They interact effectively and sensitively with all members of the team and find ways to increase the engagement and contribution of other members.

**10. Demonstrate creativity and innovation.**

Career-ready individuals recommend ideas that solve problems in new and different ways and contribute to the improvement of the organization. They consider unconventional ideas and suggestions by others as solutions to issues, tasks, or problems. They discern which ideas and suggestions may have the greatest value. They seek new methods, practices, and ideas from a variety of sources and apply those ideas to their own workplace practices.

**11. Employ valid and reliable research strategies.**

Career-ready individuals employ research practices to plan and carry out investigations, create solutions, and keep abreast of the most current findings related to workplace environments and practices. They use a reliable research process to search for new information and confirm the validity of sources when considering the use and adoption of external information or practices.

**12. Understand the environmental, societal, and economic impacts of decisions.**

Career-ready individuals understand the interrelated nature of their actions and regularly make decisions that positively impact other people, organizations, the workplace, and the environment. They are aware of and utilize new technologies, understandings, procedures, and materials and adhere to regulations affecting the nature of their work. They are cognizant of impacts on the social condition, environment, workplace, and profitability of the organization.

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## Statement for Civil Rights

All educational and vocational opportunities are offered without regard to race, color, national origin, gender, or physical disability.

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