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

79-70-44

Hybrid & Electric Vehicles/2: Advanced Diagnosis

Credits: 5 **Hours:** 75

Course Description:
This competency-based course is the second in a sequence of two designed to introduce hybrid and electric vehicles. It provides students with project-based experiences in automotive technologies including alternative and green vehicle technology. Instruction includes an introduction and general safety, high voltage safety, advanced automotive electricity, tools and equipment, plug-in hybrid and battery electric vehicle introduction, internal combustion engine diagnosis, onboard charging, fuel cell electric vehicles, advanced driver assistance systems (ADAS), heating, ventilation, and air conditioning (HVAC), electric motor/generator diagnosis, inverter/converter diagnosis, high-voltage battery diagnosis, and employability skills and resume preparation. The competencies in this course are aligned with the California High School Academic Content Standards and the California Career Technical Education Model Curriculum Standards.

Prerequisites:
Enrollment requires successful completion of the Hybrid & Electric Vehicles/1: Introduction (79-70-42) course.

NOTE: For Perkins purposes this course has been designated as a **capstone** course.

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

Los Angeles Unified School District
Division of Adult and Career Education
Instructional and Couseling Services Unit
Adult Curriculum Office
www.wearedace.org

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	pp. 7-15

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	p. 17
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. 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.	pp. 7-15
EVALUATION PROCEDURES	p. 17
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

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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.

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/2: Advanced Diagnosis Course

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
A. INTRODUCTION Review, apply, and evaluate classroom and workplace policies and procedures. (1 hour)	1. Review the scope and purpose of the course. 2. Review classroom policies and procedures. 3. Review and demonstrate Zoom, Schoology, and basic computer skills. 4. Review students' basic knowledge in electrical principles and engine performance. 5. Review, 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. 6. Review, and discuss the opportunities available for promoting gender equity and the representation of non-traditional populations in automotive industry. 7. Review and recognize the importance of ethics, teamwork, respecting individual and cultural differences and diversity in the workplace. 8. Review the role of the Automotive Service Education Foundation as it applies to the automotive industry.	**Career Ready Practice:** 1, 2, 3, 4, 5, 8, 9, 10, 11 **CTE Anchor:** 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 **CTE Pathway:** C5.1, C5.4

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
B. SAFETY - GENERAL Understand safety procedures and techniques in the auto repair and maintenance sector. (3 hours)	1. Review classroom and workplace first aid and emergency procedures. 2. Review the California Occupational Safety and Health Administration (Cal/OSHA) workplace requirements for auto technicians. 3. Review the impact of Environmental Protection Agency (EPA) legislation on Transportation Industry Sector practices in protecting and preserving the environment. 4. Review the impact of California Air Resources Board (ARB) legislation on Transportation Industry Sector. 5. Review the Bureau of Automotive Repair (BAR) standards for consumer and environmental protection. 6. Review the use of the Safety Data Sheet (SDS) as it applies to the automotive industry. 7. Review the safety items required by the federal, state, and local regulations. 8. Review how each of the following insures a safe workplace: a. employees' rights as they apply to job safety b. employees' obligations as they apply to safety c. safety laws applying to tools and equipment 9. Review and demonstrate the standards regarding proper use of protective: a. clothing and gloves in an auto shop b. respiratory gear in an auto shop c. eye gear in an auto shop d. ventilation in an auto shop e. handling, storage, and disposal of chemicals and hazardous materials used in an auto shop 10. Pass the safety test with 100%.	**Career Ready Practice:** 1, 2, 10, 12 **CTE Anchor:** 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 **CTE Pathway:** C1.1, C1.2, C1.3, C1.4, C4.2, C5.2
C. HIGH VOLTAGE SAFETY Explain the principles involved in high voltage safety precautions with hybrid components.	1. Review general high voltage warnings and labels. 2. Review high voltage cables: a. blue cables b. yellow cables c. orange cables 3. Review electrical shop potential hazards. 4. Review high voltage safety equipment: a. gloves b. glove testing c. safety glasses and face shields d. safety cones e. fiber glass pole and hook f. fire extinguishers g. isolating mats h. shoes and clothing 5. Review procedures for depowering the high voltage system. 6. Review collision and industry repair issues 7. Review first responder procedures	**Career Ready Practice:** 1, 2, 5, 10 **CTE Anchor:** Academics: 1.0 Communications: 2.1 Problem Solving and Critical Thinking: 5.1, 5.2, 5.4 Health and Safety: 6.2, 6.5, 6.6 Technical Knowledge and Skills: 10.1, 10.2

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
(5 hours)	8. Review emergency responses: a. fire b. hazardous material issues c. submerged vehicles d. alternative fuel issues 9. Review high-voltage interlock circuits and operation. 10. Review high-voltage bus discharge circuits and operation. 11. Perform the high voltage disconnect procedure 12. Reconnect/Enable high voltage system 13. Pass a high voltage safety assessment with an 80% score or higher.	Demonstration and Application: 11.1 **CTE Pathway:** C1.4, C1.5, C2.3
D. ADVANCED AUTOMOTIVE ELECTRICITY Understand, apply, and evaluate the principle of automotive electricity. (4 hours)	1. Describe DC current and its generation process: a. Direct Current b. electromotive force c. magnetic field d. armature and stator e. slip/split rings f. rotors and permanent magnets g. circuit protection devices h. relays i. transistors j. transformers 2. Describe AC current and its generation process: a. Alternating Current b. Root Mean square (RMS) c. hertz d. phase e. phase angles f. inductance g. reactance h. capacitance i. impedance 3. Describe the process to calculate the formulas: a. watts b. power c. ohms law 4. Explain capacitors and their purpose 5. Describe the difference between: a. milliohm b. ohm c. megaohm d. gigaohm 6. Explain electromagnetism and the electric motor principles. 7. Describe the operation of Controller Area Network (CAN) bus data communication networks. 8. List the elements present in electrical circuits. 9. Pass an advanced automotive electricity assessment with an 80% score or higher.	**Career Ready Practice:** 1, 2, 5, 10 **CTE Anchor:** Academics: 1.0 Communications: 2.1 Problem Solving and Critical Thinking: 5.1, 5.2, 5.4 Technical Knowledge and Skills: 10.1 Demonstration and Application: 11.1 **CTE Pathway:** C2.1, C3.4, C3.5, C3.6

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
E. TOOLS AND EQUIPMENT Understand, apply, and evaluate the use, maintenance, and storage techniques for automotive tools and equipment. (4 hours)	1. Review and demonstrate the features and functions of the most common: a. automotive hand tools b. power tools and equipment 2. Review the following: a. selection of the appropriate hand, power tools, and equipment for each job b. procedures for checking out hand, power tools, and equipment from the tool room c. safe use of the most common hand, power tools and equipment in the auto shop d. practice personal safety when lifting, bending, or moving equipment and supplies 3. Identify, describe, and demonstrate knowledge of the features and functions of the most common high voltage tools and equipment: a. insulated gloves b. high-voltage glove testing equipment c. selection of the appropriate insulated hand tools d. megaohmmeter e. milliohmmeter/Micro f. inductance meter g. alignment equipment h. tire balancer i. tire Changer j. Advanced Driver Assistance system (ADAS) equipment k. brake lathe and equipment (on-car brake lathe). l. Electric vehicle supply equipment (EVSE). m. labscopes n. hybrid and electric vehicle scan tools o. current clamps p. scissor hoist q. service information software 4. Pass a tools and equipment assessment with an 80% score or higher.	**Career Ready Practice:** 1, 2, 5, 10 **CTE Anchor:** 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 **CTE Pathway:** C2.1, C2.2, C2.3, C2.4, C2.5
F. PLUG-IN HYBRID AND BATTERY ELECTRIC VEHICLE-INTRODUCTION Understand, apply, and evaluate the principles of Plug-In Hybrid Electric Vehicles (PHEV) and Battery Electric Vehicles (BEV).	1. Explain the definition of: a. Battery Electric Vehicle (BEV) b. Plug-In Hybrid Electric Vehicle (PHEV) 2. Describe the evolution of electric vehicles over the past century. 3. Describe the different powertrain configurations in BEV and PHEV vehicles. 4. List some of the Advantages and Disadvantages of driving a Battery Electric Vehicle and Plug-in Hybrid Electric Vehicles. 5. Explain the advantages and disadvantages of having: a. AC motors b. DC motors	**Career Ready Practice:** 1, 2, 5, 10 **CTE Anchor:** Academics: 1.0 Communications: 2.1 Problem Solving and Critical Thinking: 5.4

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
(5 hours)	6. Describe the various types of emissions that result from the use of a PHEV versus a BEV. 7. Pass a PHEV and BEV assessment with an 80% score or higher.	Technical Knowledge and Skills: 10.1 **CTE Pathway:** C3.1, C3.4, C3.5, C3.6
G. INTERNAL COMBUSTION ENGINE DIAGNOSIS Understand, apply, and evaluate the principles of the internal combustion engine diagnosis. (5 hours)	1. Describe how the fuel injection and ignition systems work on Hybrid electric vehicles. 2. Explain how variable valve timing can improve engine power and reduce exhaust emissions. 3. Determine if the internal combustion engine (ICE) is in CRANK mode or RUN mode. 4. Differentiate between drivability problems caused by the internal combustion engine and/or hybrid drive system. 5. Identify engine start/stop function and diagnose any malfunctions. 6. Identify Hybrid system impact on maintenance and diagnosis: a. place the vehicle into Inspection Mode b. list the reasons for using this mode and any cautions associated with it. 7. Pass an Internal Combustion Engine Diagnosis assessment with an 80% score or higher.	**Career Ready Practice:** 1, 2, 5, 10 **CTE Anchor:** Academics: 1.0 Communications: 2.1 Problem Solving and Critical Thinking: 5.3, 5.4 Technical Knowledge and Skills: 10.1 Demonstration and Application: 11.1 **CTE Pathway:** C2.1, C3.1, C3.3, C3.4, C3.5, C3.7, C6.4
H. ONBOARD CHARGING Understand, apply, and evaluate the principles of Onboard Charging.	1. Explain how the high-voltage batteries are recharged in a (PHEV) and (BEV) vehicle. 2. Describe the levels of chargers used to charge a (PHEV) and (BEV) vehicles. 3. Explain the difference between conductive and inductive battery charging. 4. Describe charging power sources: a. AC b. DC 5. Describe the charging ports and plugs found on (PHEV) and (BEV) vehicles. 6. Describe and discuss onboard charging boxes. 7. Discuss vehicle charge time expectations and Fast Charging. 8. Explain vehicle charging indicators: a. LED's b. icons c. displays 9. Discuss the electric vehicle supply equipment (EVSE).	**Career Ready Practice:** 1, 2, 5 **CTE Anchor:** Academics: 1.0 Communications: 2.1 Problem Solving and Critical Thinking: 5.4 **CTE Pathway:** C2.1, C2.3, C3.5, C3.6, C7.2

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
(5 hours)	10. Pass an Onboard Charging assessment with an 80% score or higher.	
I. FUEL CELL ELECTRIC VEHICLES Understand, apply, and evaluate the principles and procedure used for Fuel Cell Electric Vehicles (FCEV). (5 hours)	1. Describe what hydrogen is and where it can be found. 2. Explain the various processes used to produce hydrogen. 3. Describe the different ways hydrogen can be stored. 4. Explain how a fuel cell works. 5. Describe the major components of a fuel cell vehicle. 6. Discuss the advantages and disadvantages of fuel cells. 7. Describe the hydrogen refueling process and standard (SAE) J2601. 8. Pass a Fuel Cell Electric Vehicle (FCEV) assessment with an 80% score or higher.	**Career Ready Practice:** 1, 2 **CTE Anchor:** Academics: 1.0 Communications: 2.1 **CTE Pathway:** C2.1, C3.1, C3.3, C3.4, C3.6
J. ADVANCED DRIVER ASSISTANCE SYSTEMS (ADAS) Understand, apply, and evaluate principles and procedures used for Advanced Driver Assistance systems (ADAS). (10 hours)	1. Describe the purpose and function of advanced driver assistance systems (ADAS). 2. Evaluate autonomous drive features and systems. a. ultrasonic sensors b. Light detection and Ranging (LiDAR) c. Radio Detection and Ranging (RADAR) d. cameras 3. Discuss blind spot monitors and parking assist systems. 4. Explain lane departure warning and lane keep assist systems. 5. Describe how adaptive cruise control systems work. 6. Explain automatic emergency braking and pre-collision systems. 7. Describe the diagnostic and calibration procedures for advanced driver assist systems (ADAS). 8. Pass an advanced driver assistance systems (ADAS) assessment with an 80% score or higher.	**Career Ready Practice:** 1, 2, 5 **CTE Anchor:** Academics: 1.0 Communications: 2.1 Problem Solving and Critical Thinking: 5.1 **CTE Pathway:** C3.3, C3.4, C3.5, C3.6
K. HEATING, VENTILATION, AND AIR CONDITIONING (HVAC) Understand, apply, and evaluate the principles and procedures used for Heating, Ventilation and Air conditioning.	1. Explain the operation of the Internal Combustion Engine (ICE) cooling system in a Hybrid Electric vehicle (HEV). 2. Explain the operation of the cooling system in a Hybrid and Electric vehicle: a. electric motor/generator b. electronics c. inverter/converter d. heat exchanger and electric heaters 3. Describe the function of a Hybrid and Electric vehicle's heating and Air Conditioning system. 4. Explain how a vehicles high-voltage battery is heated and cooled. 5. Diagnose and demonstrate cabin heating system performance problems.	**Career Ready Practice:** 1, 2, 5, 10 **CTE Anchor:** Academics: 1.0 Communications: 2.1 Problem Solving and Critical Thinking: 5.1, 5.3, 5.4

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
(5 hours)	6. Pass a Heating, Ventilation and Air Conditioning assessment with an 80% score or higher.	Demonstration and Application: 11.1 **CTE Pathway:** C2.1, C2.3, C3.2, C3.4, C3.5, C3.6, C3.7
L. ELECTRIC MOTOR/ GENERATOR DIAGNOSIS Understand, apply, and evaluate the principles and procedures used Electric Motor/Generator diagnosis. (5 hours)	1. Explain the difference between a permanent magnet (PM) motor and an Induction Motor (IM). 2. Diagnose drive/traction motor-generator assembly for improper operation: a. inoperative condition b. noise c. shudder d. overheating 3. Identify transmission fluid requirements and verify fluid levels. 4. Define the torque and power characteristics of the motors used in electric vehicles. 5. Explain the operation of continuously variable transmissions (CVT). 6. Test and demonstrate for proper resistance between phases of an electric motor/generator. 7. Test, demonstrate and diagnose high voltage leaks/loss of isolation. 8. Pass an Electric motor/generator diagnosis assessment with an 80% score or higher.	**Career Ready Practice:** 1, 2, 5, 10 **CTE Anchor:** Academics: 1.0 Communications: 2.1 Problem Solving and Critical Thinking: 5.1, 5.3, 5.4 Technical Knowledge and Skills: 10.1 Demonstration and Application: 11.1 **CTE Pathway:** C2.1, C2.3, C3.3, C3.4, C3.5, C3.6, C3.7
M. INVERTER/CONVERTER DIAGNOSIS Understand, apply, and evaluate the principles and procedures used for Inverter and Converter diagnosis.	1. Locate and test the voltage level of capacitors. 2. Diagnose, demonstrate, locate and safely disable/enable safety interlocks. 3. Diagnose inverter temperature values and determine faults. 4. Diagnose failed converters and determine needed repairs. 5. Test and diagnose insulation and isolation faults. 6. Pass an Inverter and Converter diagnosis assessment with an 80% score or higher.	**Career Ready Practice:** 1, 2, 5, 10 **CTE Anchor:** Academics: 1.0 Communications: 2.1 Problem Solving and Critical Thinking: 5.1, 5.3, 5.4 Demonstration and Application: 11.1

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
(5 hours)		**CTE Pathway:** C2.1, C3.1, C3.2, C3.3, C3.4, C3.5, C3.6, C3.7
N. HIGH-VOLTAGE BATTERY DIAGNOSIS Understand, apply, and evaluate the principles and procedures used for High-Voltage battery diagnosis. (12 hours)	1. Describe nickel-metal hydride batteries (NiMH) and designs used in hybrid electric vehicles. 2. Explain the operation of lithium-ion (Li-ion) high voltage batteries including the various types and designs. 3. Discuss battery capacity versus vehicle range. 4. Describe the purpose and function of the battery management system (BMS). 5. Retrieve and diagnose Diagnostic Trouble Codes (DTC's) and determine needed repairs. 6. Diagnose problems caused by damaged or failed: a. harnesses b. connectors c. terminals d. fuses 7. Perform high voltage disconnect procedure and reconnect/ enable high voltage system. 8. Remove and install a high voltage battery pack. 9. Test, demonstrate and diagnose high voltage battery pack internal components. 10. Diagnose system main relay (SMR)/contactor malfunctions. 11. Test high voltage cable integrity and loss of isolation. 12. Determine how to find the state of charge (SOC) of a high-voltage battery. 13. Pass a High-Voltage battery diagnosis assessment with an 80% score or higher.	**Career Ready Practice:** 1, 2, 5, 10 **CTE Anchor:** Academics: 1.0 Communications: 2.1 Problem Solving and Critical Thinking: 5.1, 5.2, 5.3, 5.4 Health and Safety: 6.4 Technical Knowledge and Skills: 10.1 Demonstration and Application: 11.1 **CTE Pathway:** C2.2, C3.4, C3.7, C7.2, C7.3
O. EMPLOYABILITY SKILLS & RESUME PREPARATION Understand, apply, and evaluate the employability skills required in auto repair and maintenance.	1. Review employer requirements for soft skills such as: a. attitude toward work b. communication and collaboration c. critical thinking, problem solving, decision-making d. customer service e. flexibility and adaptability f. interpersonal skills g. leadership, and responsibility h. punctuality and attendance i. quality of work j. respect, cultural and diversity differences k. teamwork l. time management m. trust and ethical behavior n. work ethic 2. Update a resume, cover letter, and/or portfolio.	**Career Ready Practice:** 1, 2, 3, 4, 5, 7, 8, 9 **CTE Anchor:** Academics: 1.0 Communications: 2.2, 2.3, 2.4, 2.5 Career Planning and Management: 3.2, 3.3, 3.4, 3.6, 3.8 Technology: 4.1, 4.3 Problem Solving & Critical Thinking: 5.1

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
(1 hour)	3. Review the role of online job searching platforms and career websites. 4. Review an on-line job application. 5. Review interview skills to get the job: a. do's and don'ts for job interviews b. how to dress for the job 6. Review sample follow-up letters. 7. Review the importance of the continuous upgrading of job skills as it relates to: a. certification, licensure, and/or renewal b. professional organizations/events c. industry associations and/or organized labor	Responsibility and Flexibility: 7.2, 7.3, 7.4, 7.7 Ethics and Legal Responsibilities: 8.4 Leadership and Teamwork: 9.2, 9.3, 9.4, 9.6 Demonstration and Application: 11.1, 11.5 **CTE Pathway:** C5.1, C5.2, C5.5

SUGGESTED INSTRUCTIONAL MATERIALS and OTHER RESOURCES

TEXTBOOKS

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

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

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

SUPPLMENTAL 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

www.freeonlineautorepair.com/automotive_fuel_system.html

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 – Advanced 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 – Plug-in Hybrid & Battery Electric Vehicle Introduction – Pass all assignments and exams with a minimum score of 80% or higher.

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

SECTION H – Onboard Charging – Pass all assignments and exams with a minimum score of 80% or higher.

SECTION I – Fuel Cell Electric Vehicles – Pass all assignments and exams with a minimum score of 80% or higher.

SECTION J – Advanced Driver Assistance Systems (ADAS) – Pass all assignments and exams with a minimum score of 80% or higher.

SECTION K – Heating, Ventilation, and Air Conditioning (HVAC) – Pass all assignments and exams with a minimum score of 80% or higher.

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

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

SECTION N – High-Voltage Battery Diagnosis – 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.

Statement for Civil Rights

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