

# Course Outline

## Transportation

REVISED: August/2017

### Job Title

Auto Technician

### Career Pathway:

Systems Diagnostics and Service

### Industry Sector:

Transportation

### O\*NET-SOC CODE:

49-3023.02

### CBEDS Title:

Advanced Automotive

### CBEDS No.:

5669

**79-90-63**

## Auto Tech: Electrical and Electronics/2

**Credits:** 15

**Hours:** 180

### Course Description:

This competency-based course is one in a sequence of courses designed to meet the Automotive Service Excellence (ASE) Program Certification Standards set by the National Automotive Technicians Education Foundation (NATEF). It provides students with technical instruction and practical experience in an automobile area incorporating sustainable and green vehicle technologies. Instruction includes a review of classroom and workplace policies and procedures in accordance with federal, state, and local safety and environmental regulations. Emphasis is placed on the techniques in the following areas of electrical and electronic diagnosis and repair: lighting systems, gauges, warning devices, driver information systems, horn and wiper/washer, and accessories. It also offers entrepreneurial skills and reviews of the proper use, maintenance, and storage of auto repair tools and equipment, the effective use of service manuals and computer-based information systems, trade mathematics, resource management, and employability skills. 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 Auto Tech: Electrical and Electronics/1 (79-90-61) course.

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

Meets NATEF standards and identifies priority tasks in electrical/electronics systems. Check the NATEF Manual for explanation of priority 1, 2, or 3 tasks.

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 and 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 takes into account 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 PAUL PIDOUX and MARCELA BAKER 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 Auto Tech: Electrical and Electronics/2 Course**

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p>A. INTRODUCTION AND SAFETY</p> <p>Review, apply and evaluate classroom and workplace policies and procedures used in accordance with federal, state and local safety and environmental regulations.</p> <p>(5 hours)</p>	<ol style="list-style-type: none"> <li>1. Review the scope and purpose of the course.</li> <li>2. Review classroom policies and procedures.</li> <li>3. Review classroom and workplace first aid and emergency procedures.</li> <li>4. Review the different occupations in the Transportation Industry Sector which have an impact on the role of the auto technician.</li> <li>5. Review the California Occupational Safety and Health Administration (Cal/OSHA) workplace requirements for auto technicians.</li> <li>6. Review the impact of Environmental Protection Agency (EPA) legislation on Transportation Industry Sector practices in protecting and preserving the environment.</li> <li>7. Review the impact of California Air Resources Board (ARB) legislation on Transportation Industry Sector practices in protecting and preserving the environment.</li> <li>8. Review the Bureau of Automotive Repair (BAR) standards for safety and environmental protection.</li> <li>9. Review and demonstrate the use of the Material Safety Data Sheet (MSDS) as it applies to the automotive industry.</li> <li>10. Review the safety items required by federal, state and local regulations.</li> <li>11. Review the role of the National Automotive Technicians Education Foundation (NATEF) in auto technician training.</li> <li>12. Review and demonstrate the NATEF standards regarding proper use of protective clothing and gloves in an auto shop.</li> <li>13. Review and demonstrate the NATEF standards regarding the proper use of protective respiratory gear in an auto shop.</li> <li>14. Review and demonstrate the NATEF standards regarding the proper use of protective eye gear in an auto shop.</li> <li>15. Review and demonstrate the NATEF standards regarding proper ventilation in an auto shop.</li> <li>16. Review and demonstrate NATEF standards regarding proper handling, storage and disposal of chemicals and materials used in an auto shop.</li> <li>17. Pass the safety exam with 100% accuracy.</li> </ol>	<p><b>Career Ready Practice:</b> 1, 2, 6, 12</p> <p><b>CTE Anchor:</b> Career Planning and Management: 3.4 Technology: 4.2 Health and Safety: 6.1, 6.3, 6.5, 6.6, 6.7 Ethics and Legal Responsibilities: 8.2</p> <p><b>CTE Pathway:</b> C1.1, C1.2, C1.3, C1.4, C5.2</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p><b>B. RESOURCE MANAGEMENT REVIEW</b></p> <p>Review, apply and evaluate the resource management principles and techniques in the auto repair and maintenance business.</p> <p>(3 Hours)</p>	<ol style="list-style-type: none"> <li>Review the following definitions: <ol style="list-style-type: none"> <li>resources</li> <li>management</li> <li>sustainability</li> </ol> </li> <li>Review the management of the following resources in the auto repair and maintenance business: <ol style="list-style-type: none"> <li>time</li> <li>materials</li> <li>personnel</li> </ol> </li> <li>Review specific examples of effective management of the following in the auto repair and maintenance business: <ol style="list-style-type: none"> <li>time</li> <li>materials</li> <li>personnel</li> </ol> </li> <li>Review the benefits of the effective resource management in the auto repair and maintenance business: <ol style="list-style-type: none"> <li>profitability</li> <li>sustainability</li> <li>company growth</li> </ol> </li> <li>Review the economic benefits and liabilities of managing resources in an environmentally responsible way.</li> </ol>	<p><b>Career Ready Practice:</b> 2, 3, 8</p> <p><b>CTE Anchor:</b> Responsibility and Flexibility: 7.1, 7.4, 7.6</p> <p><b>CTE Pathway:</b> C5.3</p>
<p><b>C. TRADE MATHEMATICS REVIEW</b></p> <p>Review, apply and evaluate the mathematical requirements used in auto repair and maintenance.</p>	<ol style="list-style-type: none"> <li>Review the practical applications of math in auto repair and maintenance.</li> <li>Review and demonstrate problem-solving techniques involving whole number problems using addition, subtraction, multiplication and division.</li> <li>Review and demonstrate problem-solving techniques involving various fraction problems using arithmetic operations (addition, subtraction, multiplication and division).</li> <li>Review and demonstrate problem-solving techniques involving various decimal problems using arithmetic operations.</li> <li>Review and demonstrate techniques for changing fractions to decimals.</li> <li>Review and demonstrate techniques for changing decimals to fractions.</li> <li>Review the English system of measuring length.</li> <li>Review the English system of measuring weight.</li> <li>Review the English system of measuring volume or capacity.</li> <li>Review the relationships between various English system linear units of measurement such as inches, feet, yards and miles.</li> <li>Review the relationships between various English system units of volume or capacity such as cups, pints, quarts and gallons.</li> </ol>	<p><b>Career Ready Practice:</b> 1, 2, 4, 5</p> <p><b>CTE Anchor:</b> Problem Solving and Critical Thinking: 5.2</p> <p><b>CTE Pathway:</b> C2.4, C2.7</p>



COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
(10 Hours)	<ol style="list-style-type: none"> <li>12. Review and demonstrate problem-solving techniques for various English system measuring problems using arithmetic operations.</li> <li>13. Review and demonstrate measuring techniques of various objects by using the English system measuring tools common to the trade.</li> <li>14. Review the metric system of measuring length.</li> <li>15. Review the metric system of measuring weight.</li> <li>16. Review the metric system of measuring volume or capacity.</li> <li>17. Review the relationships between various metric system linear units of measurement such as millimeters, centimeters and meters.</li> <li>18. Review the relationships between various metric system units of weight such as milligrams, grams and kilograms.</li> <li>19. Review and demonstrate problem-solving techniques for various metric system measuring problems involving addition, subtraction, multiplication and division.</li> <li>20. Review and demonstrate measuring techniques of objects using metric system measuring tools common to the trade.</li> <li>21. Review and demonstrate problem-solving techniques for geometric problems that apply to auto repair and maintenance.</li> <li>22. Review and demonstrate problem-solving techniques for algebraic problems that apply to auto repair and maintenance.</li> <li>23. Review and demonstrate problem-solving techniques using percentages.</li> <li>24. Review and demonstrate techniques for reading and interpreting graphs.</li> <li>25. Review and demonstrate techniques for using a calculator.</li> </ol>	
<p>D. TOOLS AND EQUIPMENT REVIEW</p> <p>Review, apply and evaluate the policies and procedures for using electrical and electronic repair and maintenance tools and equipment in accordance with federal, state and local safety and environment regulations.</p> <p>(5 Hours)</p>	<ol style="list-style-type: none"> <li>1. Review and demonstrate the proper use, maintenance and storage techniques for the general shop hand tools.</li> <li>2. Review and demonstrate the proper use, maintenance and storage techniques for the general shop equipment.</li> <li>3. Review and demonstrate the proper use, maintenance and storage techniques for the following specialty tools and equipment for electrical and electronic repair and maintenance.             <ol style="list-style-type: none"> <li>a. connector pick tool set</li> <li>b. door panel trim tool(s)</li> <li>c. headlight aimer or screen</li> <li>d. heat gun (or equivalent for heat shrinking operations)</li> <li>e. wire and terminal repair kit</li> </ol> </li> </ol>	<p><b>Career Ready Practice:</b> 1</p> <p><b>CTE Anchor:</b> Problem Solving and Critical Thinking: 5.2 Health and Safety: 6.3</p> <p><b>CTE Pathway:</b> C2.2, C2.3</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p>E. SERVICE MANUALS AND COMPUTER-BASED INFORMATION SYSTEMS REVIEW</p> <p>Review, apply and evaluate the contents of service manuals and computer-based information systems as important sources of reference to an auto technician.</p> <p>(2 Hours)</p>	<ol style="list-style-type: none"> <li>1. Review the different types of service manuals.</li> <li>2. Review the different types of information that can be found in service manuals such as specifications, troubleshooting charts and repair information.</li> <li>3. Review and demonstrate the use of service manuals.</li> <li>4. Review and demonstrate the use of CD-ROM (compact disc) and web-based search engines in finding automotive technical information.</li> <li>5. Review the advantages of using CD-ROM and web-based search engines over service manuals in finding automotive technical information.</li> </ol>	<p><b>Career Ready Practice:</b> 1, 4</p> <p><b>CTE Anchor:</b> Communications: 2.3 Technology: 4.1, 4.2, 4.6</p> <p><b>CTE Pathway:</b> C2.6, C4.3</p>
<p>F. ELECTRICAL THEORY</p> <p>Understand, apply and evaluate the electrical theories that are applicable to auto repair and maintenance.</p> <p>(10 Hours)</p>	<ol style="list-style-type: none"> <li>1. Describe the electron flow theory.</li> <li>2. Describe the nature of electrical resistance.</li> <li>3. Describe the magnetic induction theory.</li> <li>4. Describe the voltage drop across resistors and inductors.</li> <li>5. Describe the operation of variable resistors such as thermistors and potentiometers.</li> <li>6. Describe the operation of voltage generators such as oxygen and knock sensors.</li> <li>7. Describe the operation of magnetic inductor sensors such as distributor and crankshaft sensors.</li> <li>8. Describe the transistor function.</li> <li>9. Describe semi-conductor function.</li> <li>10. Describe the computer input/output logic.</li> <li>11. Describe sensor ranges and system compensation.</li> <li>12. Describe the electronic fuel control loop.</li> <li>13. Describe oxygen feedback (open/closed loop) carburetion.</li> <li>14. Describe mixture control duty cycle.</li> <li>15. Describe electronic fuel injection theory.</li> <li>16. Describe the function of the electronic ignition module.</li> <li>17. Describe system self-diagnostics.</li> <li>18. Describe the function of various types of mixture control solenoids.</li> </ol>	<p><b>Career Ready Practice:</b> 2, 4</p> <p><b>CTE Anchor:</b> Problem Solving and Critical Thinking: 5.3 Technical Knowledge and Skills: 10.1 Demonstration and Application: 11.1</p> <p><b>CTE Pathway:</b> C2.2, C2.3, C3.5, C7.1</p>
<p>G. GENERAL MOTORS ELECTRONIC FUEL AND IGNITION CONTROL REVIEW</p> <p>Review and evaluate the features of the General Motors electronic engine control systems.</p>	<ol style="list-style-type: none"> <li>1. Review the features of the different types of General Motors (GM) electronic engine control systems.</li> <li>2. Review the measuring procedure for mixture control dwell.</li> <li>3. Review the electronic spark timing sensor input.</li> <li>4. Review the features of the following GM electronic fuel injection systems: <ol style="list-style-type: none"> <li>a. throttle body</li> <li>b. port</li> <li>c. digital fuel injection</li> </ol> </li> </ol>	<p><b>Career Ready Practice:</b> 2, 5</p> <p><b>CTE Anchor:</b> Problem Solving and Critical Thinking: 5.4</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
(5 Hours)	<ol style="list-style-type: none"> <li>Review the activation process for a GM self-diagnostic system.</li> <li>Review the different measurements of GM sensors readings.</li> <li>Review the GM system trouble codes.</li> </ol>	<b>CTE Pathway:</b> C2.3, C2.4, C2.5
<p><b>H. FORD ELECTRONIC FUEL AND IGNITION CONTROL REVIEW</b></p> <p>Review and evaluate the following features of the Ford electronic engine control systems.</p> <p>(5 Hours)</p>	<ol style="list-style-type: none"> <li>Review the features of the following Ford electronic engine control systems: <ol style="list-style-type: none"> <li>EEC I</li> <li>EEC II</li> <li>EEC III</li> <li>EECIV</li> </ol> </li> <li>Review the measuring procedures for mixture control dwell.</li> <li>Review the electronic spark timing sensor input.</li> <li>Review the features of the following Ford electronic fuel injection systems: <ol style="list-style-type: none"> <li>single point</li> <li>multi point</li> <li>central</li> <li>sequential fuel injection</li> </ol> </li> <li>Review the activation process for a Ford self-diagnostic system.</li> <li>Review the different measurements of Ford sensor readings.</li> <li>Review the Ford system trouble codes.</li> </ol>	<p><b>Career Ready Practice:</b> 1, 4</p> <p><b>CTE Anchor:</b> Problem Solving and Critical Thinking: 5.4 Technical Knowledge and Skills: 10.1</p> <p><b>CTE Pathway:</b> C6.3, C6.4, C7.1</p>
<p><b>I. CHRYSLER ELECTRONIC FUEL AND IGNITION CONTROL REVIEW</b></p> <p>Review and evaluate the features of the Chrysler electronic engine control systems.</p> <p>(5 Hours)</p>	<ol style="list-style-type: none"> <li>Review the features of the different types of Chrysler electronic engine control systems.</li> <li>Review the measuring procedures for mixture control dwell.</li> <li>Review the electronic spark timing sensor input.</li> <li>Review the features of the Chrysler electronic fuel injection systems.</li> <li>Review the activation procedure for a Chrysler self-diagnostic system.</li> <li>Review the various measurements of the Chrysler sensor readings.</li> <li>Review the Chrysler system codes.</li> </ol>	<p><b>Career Ready Practice:</b> 1, 4</p> <p><b>CTE Anchor:</b> Technical Knowledge and Skills: 10.4</p> <p><b>CTE Pathway:</b> C6.3</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p>J. IMPORT ELECTRONIC FUEL AND IGNITION CONTROL REVIEW</p> <p>Review and evaluate the features of the electronic engine control system in various imports.</p> <p>(5 Hours)</p>	<ol style="list-style-type: none"> <li>Review the features of the following import electronic engine control systems:               <ol style="list-style-type: none"> <li>Toyota TCCS</li> <li>Nissan ECCS</li> <li>Mitsubishi ECI</li> </ol> </li> <li>Review the features and function of the electronic spark timing for the different types of import systems.</li> <li>Review the features of the different types of import electronic fuel injection systems.</li> <li>Review the operation of the Continuous Injection Systems (CIS) and CIS-E injection systems.</li> <li>Review the activation procedures for the different types of import self-diagnosis systems.</li> <li>Review the different samples of import sensor readings.</li> <li>Review the trouble codes found in the different types of imports.</li> </ol>	<p><b>Career Ready Practice:</b> 1, 4</p> <p><b>CTE Anchor:</b> Problem Solving and Critical Thinking: 5.3, 5.4</p> <p><b>CTE Pathway:</b> C4.1, C5.6, C6.3</p>
<p>K. LIGHTING SYSTEMS DIAGNOSIS AND REPAIR</p> <p>Understand, apply and evaluate the diagnostic and repair techniques for auto lighting systems.</p> <p>(30 Hours)</p>	<ol style="list-style-type: none"> <li>Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause and correction. P-1</li> <li>Diagnose the cause of brighter than normal, intermittent, dim or no light operation; determine necessary action. P-1</li> <li>Inspect, replace and aim headlights and bulbs. P-2</li> <li>Inspect and diagnose incorrect turn signal or hazard light operation; perform necessary action. P-2</li> <li>Identify system voltage and safety precautions associated with high intensity discharge headlights. P-2</li> </ol>	<p><b>Career Ready Practice:</b> 1, 4, 5, 6, 8</p> <p><b>CTE Anchor:</b> Communication: 2.3 Problem Solving and Critical Thinking: 5.1, 5.3, 5.4 Health and Safety: 6.5, 6.6 Technical Knowledge and Skills: 10.1</p> <p><b>CTE Pathway:</b> C1.4, C2.1, C4.1, C4.4, C5.3, C7.1, C7.4, C7.7</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p>L. GAUGES, WARNING DEVICES AND DRIVER INFORMATION SYSTEMS DIAGNOSIS AND REPAIR</p> <p>Understand, apply and evaluate the diagnostic and repair techniques for gauges, warning devices and driver information systems.</p> <p>(30 Hours)</p>	<ol style="list-style-type: none"> <li>1. Inspect and test gauges and gauge sending units for cause of abnormal gauge readings; determine necessary action. P-1</li> <li>2. Inspect and test connectors, wires and printed circuit boards of gauge circuits; determine necessary action. P-3</li> <li>3. Diagnose the cause of incorrect operation of warning devices and other driver information systems; determine necessary action. P-1</li> <li>4. Inspect and test sensors, connectors and wires of electronic (digital) instrument circuits; determine necessary action. P-3</li> </ol>	<p><b>Career Ready Practice:</b> 1, 4, 5</p> <p><b>CTE Anchor:</b> Problem Solving and Critical Thinking: 5.1, 5.2, 5.3, 5.4 Technical Knowledge and Skills: 10.1</p> <p><b>CTE Pathway:</b> C2.2, C2.3, C2.5, C3.7</p>
<p>M. HORN AND WIPER/WASHER DIAGNOSIS AND REPAIR</p> <p>Understand, apply and evaluate the diagnostic and repair techniques for the horn and wiper/washer.</p> <p>(25 Hours)</p>	<ol style="list-style-type: none"> <li>1. Diagnose incorrect horn operation; perform necessary action. P-1</li> <li>2. Diagnose incorrect wiper operation; diagnose wiper speed control and park problems; perform necessary action. P-1</li> <li>3. Diagnose incorrect washer operation; perform necessary action. P-2</li> </ol>	<p><b>Career Ready Practice:</b> 1, 4, 5</p> <p><b>CTE Anchor:</b> Problem Solving and Critical Thinking: 5.1, 5.2, 5.3, 5.4 Technical Knowledge and Skills: 10.1</p> <p><b>CTE Pathway:</b> C2.1, C2.5, C3.7, C7.6</p>
<p>N. ACCESSORIES DIAGNOSIS AND REPAIR</p> <p>Understand, apply and evaluate the diagnostic and repair techniques for auto accessories.</p>	<ol style="list-style-type: none"> <li>1. Diagnose incorrect operation of motor-driven accessory circuits; determine necessary action. P-1</li> <li>2. Diagnose incorrect heated glass, mirror or seat operation; determine necessary action. P-3</li> <li>3. Diagnose incorrect electric lock operation (including remote keyless entry); determine necessary action. P-1</li> <li>4. Diagnose incorrect operation of cruise control system; determine necessary action. P-3</li> <li>5. Diagnose supplemental restraint system (SRS) concerns; determine necessary action. P-1</li> <li>6. Disarm and enable the airbag system for vehicle service. P-1</li> </ol>	<p><b>Career Ready Practice:</b> 1, 4, 5</p> <p><b>CTE Anchor:</b> Technology: 4.1 Problem Solving and Critical Thinking: 5.1, 5.2, 5.3, 5.4</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
(30 Hours)	<ol style="list-style-type: none"> <li>Diagnose radio static and weak, intermittent or no radio reception; determine necessary action. P-3</li> <li>Remove and reinstall door panel. P-1</li> <li>Diagnose body electronic system circuits using a scan tool; determine necessary action. P-2</li> <li>Check for module communication (including CAN/BUS systems) errors using a scan tool. P-2</li> <li>Diagnose the cause of false, intermittent or no operation of anti-theft systems. P-3</li> <li>Describe the operation of keyless entry/remote-start systems. P-3</li> <li>Perform software transfers, software updates or flash reprogramming on electronic modules. P-3</li> </ol>	<p>Technical Knowledge and Skills: 10.1</p> <p><b>CTE Pathway:</b> C2.1, C2.2, C2.3, C2.5, C3.7</p>
<p>O. EMPLOYABILITY SKILLS REVIEW</p> <p>Understand, apply and evaluate the employability skills required in the auto repair and maintenance.</p> <p>(5 Hours)</p>	<ol style="list-style-type: none"> <li>Review employer requirements for the following: <ol style="list-style-type: none"> <li>punctuality</li> <li>attendance</li> <li>attitude toward work</li> <li>quality of work</li> <li>teamwork</li> <li>responsibility</li> <li>timeliness</li> <li>communication skills</li> </ol> </li> <li>Update potential employers through traditional and internet sources.</li> <li>Update sample resumes and cover letters.</li> <li>Review the importance of filling out a job application legibly, with accurate and complete information.</li> <li>Review the common mistakes that are made on job applications.</li> <li>Complete the sample job application forms correctly.</li> <li>Review the importance of enthusiasm in the interview and on a job.</li> <li>Review the importance of appropriate appearance in the interview and on a job.</li> <li>Review the importance of the continuous upgrading of job skills.</li> <li>Review the customer service as a method of building permanent relationships between organization and the customer.</li> </ol>	<p><b>Career Ready Practice:</b> 1, 2, 4, 11</p> <p><b>CTE Anchor:</b> Communications: 2.1, 2.2, 2.3, 2.4 Career Planning and Management: 3.1, 3.2, 3.4, 3.9 Responsibility and Flexibility: 7.2, 7.4, 7.5, 7.7 Leadership and Teamwork: 9.2 Demonstration and Application: 11.5</p> <p><b>CTE Pathway:</b> C5.3, C5.4, C5.5</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p>P. ENTREPRENEURIAL SKILLS</p> <p>Understand, apply and evaluate the process involved in becoming an entrepreneur in the auto repair and maintenance industry.</p> <p>(5 Hours)</p>	<ol style="list-style-type: none"> <li>1. Define entrepreneurship.</li> <li>2. Identify the necessary characteristics of successful entrepreneurs.</li> <li>3. Describe the contributions of entrepreneurs to the auto repair and maintenance industry.</li> <li>4. Explain the purpose and components of a business plan.</li> <li>5. Examine personal goals prior to starting a business plan.</li> <li>6. Evaluate sources of monetary investment in a business opportunity.</li> <li>7. Describe the various licensing requirements in the auto repair and maintenance business.</li> <li>8. Develop a scenario depicting the student as the auto repair and maintenance business owner.</li> <li>9. Differentiate between sustainable and green business practices and standard business practices.</li> </ol>	<p><b>Career Ready Practice:</b> 2, 3, 6, 8</p> <p><b>CTE Anchor:</b> Communications: 2.3, 2.4 Career Planning and Management: 3.4, 3.5, 3.7, 3.9 Responsibility and Flexibility: 7.1, 7.6 Technical Knowledge and Skills: 10.3 Demonstration and Application: 11.5</p> <p><b>CTE Pathway:</b> C1.1, C5.3, C5.4, C5.5</p>

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

### **TEXTBOOKS**

Duffy, James E. Auto Electricity and Electronics. Goodheart-Wilcox Publisher, 2003.

Duffy, James E. Modern Automotive Technology, 7<sup>th</sup> Edition. Goodheart-Willcox Publishing, 2009.

Duffy, James E. and Nancy Henke-Konopasek. Auto Electricity and Electronics: Instructor's Guide, Goodheart-Wilcox Publisher, 2004.

Halderman, James D and Chase D. Mitchell. Diagnosis and Troubleshooting of Automotive Electric, Electronic, and Computer Systems, 4<sup>th</sup> Edition. Prentice Hall, 2006.

### **RESOURCES**

Employer Advisory Board members

Foundation Standards

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

Automotive Retailing Today (ART) 8400 Westpark Dr., MS 2, McLean, VA 22102. Phone: (703) 556-8578.

Automotive Youth Educational Systems (AYES) 50 W. Big Beaver, Suite 145, Troy, MI 48084. Phone: (248) 526-1750. Fax: (248) 526-1751.

National Automobile Dealers Association (NADA) Public Relations Dept., 8400 Westpark Dr., McLean, VA 22102-3591. Phone: (703) 821-7000.

National Automotive Technicians Education Foundation (NATEF) 101 Blue Seal Dr. SE, Suite 101, Leesburg, VA 20175. Phone: (703) 669-6650. Fax: (703) 669-6125.

[www.natef.org](http://www.natef.org)

[http://www.ed-foundation.org/html\\_pages/products\\_programs\\_services/natef\\_tools/non-structural\\_analysis/non-structural\\_analysis.shtml](http://www.ed-foundation.org/html_pages/products_programs_services/natef_tools/non-structural_analysis/non-structural_analysis.shtml)

National Institute for Automotive Service Excellence (ASE) 101 Blue Seal Dr. SE, Suite 101, Leesburg, VA 20175. Phone: (703) 669-6600.

SkillsUSA P.O. Box 3000, Leesburg, VA 20177-0300. Phone: (703) 777-8810. Fax: (703) 777-8999.

[www.skillsusa.org](http://www.skillsusa.org)

### **COMPETENCY CHECKLIST**



## ***TEACHING STRATEGIES and EVALUATION***

### **METHODS AND PROCEDURES**

- A. Lecture and discussion
- B. Demonstration
- C. Multimedia presentations

### **EVALUATION**

SECTION A – Introduction and Safety – Pass the safety test with 100% accuracy.

SECTION B – Resource Management Review – Pass all assignments and exams on resource management review with a minimum score of 80% or higher.

SECTION C – Trade Mathematics Review – Pass all assignments and exams on trade mathematics review with a minimum score of 80% or higher.

SECTION D – Tools and Equipment Review – Pass all assignments and exams on tools and equipment review with a minimum score of 80% or higher.

SECTION E – Service Manuals and Computer-Based Information Systems Review – Pass all assignments and exams on service manuals and computer-based information systems review with a minimum score of 80% or higher.

SECTION F – Electrical Theory – Pass all assignments and exams on electrical theory with a minimum score of 80% or higher.

SECTION G – General Motors Electronic Fuel and Ignition Control Review – Pass all assignments and exams on General Motors electronic fuel and ignition control review with a minimum score of 80% or higher.

SECTION H – Ford Electronic Fuel and Ignition Control – Pass all assignments and exams on Ford electronic fuel and ignition control review with a minimum score of 80% or higher.

SECTION I – Chrysler Electronic Fuel and Ignition Control Review – Pass all assignments and exams on Chrysler electronic fuel and ignition control review with a minimum score of 80% or higher.

SECTION J – Import Electronic Fuel and Ignition Control Review – Pass all assignments and exams on import electronic fuel and ignition control review with a minimum score of 80% or higher.

SECTION K – Lighting Systems Diagnosis and Repair – Pass all assignments and exams on lighting systems diagnosis and repair with a minimum score of 80% or higher.

SECTION L – Gauges, Warning Devices, and Driver Information Systems Diagnosis and Repair – Pass all assignments and exams on gauges, warning devices, and driver information systems diagnosis and repair with a minimum score of 80% or higher.

SECTION M – Horn and Wiper/Washer Diagnosis and Repair – Pass all assignments and exams on horn and wiper/washer diagnosis and repair with a minimum score of 80% or higher.

SECTION N – Accessories Diagnosis and Repair – Pass all assignments and exams on accessories diagnosis and repair with a minimum score of 80% or higher.

SECTION O – Employability Skills – Pass all assignments and exams on employability skills with a minimum score of 80% or higher.

SECTION P – Entrepreneurial Skills – Pass all assignments and exams on entrepreneurial skills with a minimum score of 80% or higher.

**NATEF TASK PRIORITY ITEM TOTALS (by area)****I. Engine Repair**

P-1 = 26 95% = 25 tasks  
P-2 = 22 80% = 18 tasks  
P-3 = 9 50% = 5 tasks

**II. Automatic Transmission and Transaxle**

P-1 = 21 95% = 20 tasks  
P-2 = 17 80% = 14 tasks  
P-3 = 4 50% = 2 tasks

**III. Manual Drive Train and Axles**

P-1 = 24 95% = 23 tasks  
P-2 = 24 80% = 19 tasks  
P-3 = 17 50% = 9 tasks

**IV. Suspension and Steering**

P-1 = 25 95% = 24 tasks  
P-2 = 25 80% = 20 tasks  
P-3 = 11 50% = 6 tasks

**V. Brakes**

P-1 = 39 95% = 37 tasks  
P-2 = 10 80% = 8 tasks  
P-3 = 11 50% = 6 tasks

**VI. Electrical/Electronic Systems**

P-1 = 39 95% = 37 tasks  
P-2 = 13 80% = 10 tasks  
P-3 = 10 50% = 5 tasks

**VII. Heating and Air Conditioning**

P-1 = 26 95% = 25 tasks  
P-2 = 14 80% = 11 tasks  
P-3 = 7 50% = 4 tasks

**VIII. Engine Performance**

P-1 = 39 95% = 37 tasks  
P-2 = 12 80% = 10 tasks  
P-3 = 7 50% = 4 tasks

## DEFINITIONS OF TECHNICAL TERMS

ADJUST - to bring components to specified operational settings.

ALIGN - to restore the proper position of components.

ANALYZE - to assess the condition of a component or system.

ASSEMBLE (REASSEMBLE) - to fit together the components of a device or system.

BALANCE - to establish correct linear, rotational or weight relationship.

BLEED - to remove air from a closed system.

CAN – Controller Area Network. CAN is a network protocol (SAE J2284/ISO 15765-4) used to interconnect a network of electronic control modules

CHARGE - to bring to a specified state, e.g., battery or air conditioning system.

CHECK - to verify condition by performing an operational or comparative examination.

CLEAN - to rid component of foreign matter for the purpose of reconditioning, repairing, measuring or reassembling.

DEGLAZE – to remove a smooth glossy surface.

DETERMINE - to establish the procedure to be used to perform the necessary repair.

DETERMINE NECESSARY ACTION – indicates that the diagnostic routine(s) is the primary emphasis of a task. The student is required to perform the diagnostic steps and communicate the diagnostic outcomes and corrective actions required addressing the concern or problem. The training program determines the communication method (worksheet, test, verbal communication, or other means deemed appropriate) and whether the corrective procedures for these tasks are actually performed.

DIAGNOSE - to identify the cause of a problem.

DISASSEMBLE - to separate a component's parts as a preparation for cleaning, inspection or service.

DISCHARGE - to empty a storage device or system.

EVACUATE - to remove air, fluid or vapor from a closed system by use of a vacuum pump.

FLUSH - to internally clean a component or system.

HIGH VOLTAGE – voltages of 50 volts and higher.

HONE - to restore or resize a bore by using rotating cutting stones.

JUMP START - to use an auxiliary power supply to assist a battery to crank an engine.

LOCATE – to determine or establish a specific spot or area.

MEASURE - to determine existing dimensions/values for comparison to specifications.

NETWORK - a system of interconnected electrical modules or devices.

ON-BOARD DIAGNOSTICS (OBD) - diagnostic protocol which monitors computer inputs and outputs for failures.

PARASITIC DRAW - electrical loads which are still present when the ignition circuit is OFF.

PERFORM - to accomplish a procedure in accordance with established methods and standards.

PERFORM NECESSARY ACTION – indicates that the student is to perform the diagnostic routine(s) and perform the corrective action item. Where various scenarios (conditions or situations) are presented in a single task, at least one of the scenarios must be accomplished.

PURGE - to remove air or fluid from a closed system.

REMOVE - to disconnect and separate a component from a system.

REPAIR - to restore a malfunctioning component or system to operating condition.

REPLACE - to exchange a component; to reinstall a component.

RESURFACE – to restore correct finish.

SERVICE - to perform a procedure as specified in the owner's or service manual.

TEST - to verify condition through the use of meters, gauges or instruments.

TORQUE - to tighten a fastener to specified degree or tightness (in a given order or pattern if multiple fasteners are involved on a single component).

VERIFY - to confirm that a problem exists after hearing the customer's concern; or, to confirm the effectiveness of a repair.

VOLTAGE DROP - a reduction in voltage (electrical pressure) caused by the resistance in a component or circuit.

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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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