

Course Outline

Transportation

REVISED: July/2021

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

79-90-73

Auto Tech: Engine Repair

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) Education Foundation standards. It provides students with technical instruction and practical experience in an automobile area incorporating sustainable and green vehicle technologies. Instruction includes orientation and safety, resource management, trade mathematics, tools and equipment, service manuals and coputer-based information systems, engines, fuel and induction systems, electrical, ignition system, hybrid vehicles, alternative fuel vehicles, general engine diagnosis: removal and reinstallation (R & R), cylinder head and valve train diagnosis and repair, engine block assembly diagnosis and repair, lubrication and cooling systems diagnosis and repair, employability and entrepreneurial 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.

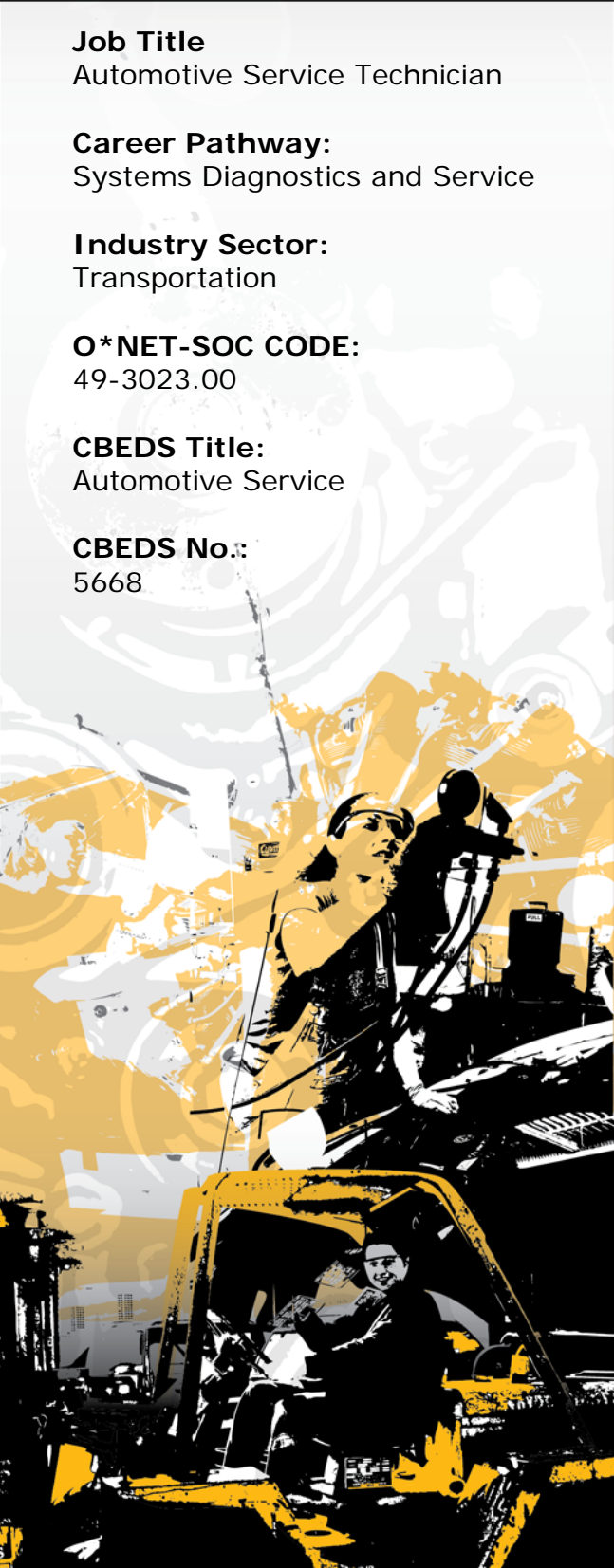
Prerequisites:

Enrollment recommends successful completion of the Technology/2: Automotive Systems (79-90-85) course.

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

MEETS ASE STANDARDS AND IDENTIFIES PRIORITY TASKS IN ENGINE REPAIR. CHECK THE ASE 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

pp. 7-16

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
<p>INSTRUCTIONAL STRATEGIES</p> <p>Instructional techniques or methods could include laboratory techniques, lecture method, small-group discussion, grouping plans, and other strategies used in the classroom.</p> <p>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 Older Adults, and Programs for Adults with Disabilities.</p>	p. 18
<p>UNITS OF STUDY, WITH APPROXIMATE HOURS ALLOTTED FOR EACH UNIT</p> <p>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.</p> <p>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.</p>	Cover pp. 7-16
<p>EVALUATION PROCEDURES</p> <p>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.</p> <p>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.</p>	pp. 18-19
<p>REPETITION POLICY THAT PREVENTS PERPETUATION OF STUDENT ENROLLMENT</p> <p>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.</p>	Cover

ACKNOWLEDGMENTS

Thanks to LUIS GARCIA, ALDO ROBLES, SEYED SAIDI and 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 Auto Tech: Engine Repair Course

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p>A. ORIENTATION AND SAFETY</p> <p>Understand, 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"> 1. Describe the scope and purpose of the course. 2. Describe the classroom policies and procedures. 3. Identify classroom and workplace first aid and emergency procedures. 4. Describe the different occupations in the Transportation Industry Sector which have an impact on the role of the auto technician. 5. Describe the California Occupational Safety and Health Administration (Cal/OSHA) workplace requirements for auto technicians. 6. Explain the impact of the Environmental Protection Agency (EPA) legislation on Transportation Industry Sector practices in protecting and preserving the environment. 7. Explain the impact of California Air Sources Board (ARB) legislation on Transportation Industry Sector practices in protecting and preserving the environment. 8. State the Bureau of Automotive Repair (BAR) standards for safety and environmental protection. 9. Describe and demonstrate the use of the Safety Data Sheet (SDS) as it applies to the automotive industry. 10. Identify the safety items required by federal, state and local regulations. 11. Describe the role of the Automotive Service Excellence (ASE) Education Foundation in auto technician training. 12. Describe and demonstrate the ASE standards regarding proper use of protective <ol style="list-style-type: none"> 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 materials used in an auto shop. 13. Pass the safety exam with 100% accuracy. 	<p>Career Ready Practice: 1, 2, 6, 12</p> <p>CTE Anchor: Communications: 2.1 Career Planning and Management: 3.4 Problem Solving and Critical Thinking: 5.1 Health and Safety: 6.1, 6.3, 6.5, 6.6, 6.7 Ethics and Legal Responsibilities: 8.2 Technical Knowledge and Skills: 10.1 Demonstration and Application: 11.2</p> <p>CTE Pathway: C1.1, C1.2, C1.3, C1.4, C5.2</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p>B. RESOURCE MANAGEMENT</p> <p>Understand, apply and evaluate the resource management principles and techniques in the auto repair and maintenance business.</p> <p>(1 hour)</p>	<ol style="list-style-type: none"> 1. Define the following: <ol style="list-style-type: none"> a. resources b. management c. sustainability 2. Describe and list specific examples of effective management of the following resources in the auto repair and maintenance business: <ol style="list-style-type: none"> a. time b. materials c. personnel 3. Describe the benefits of effective resource management in the auto repair and maintenance business: <ol style="list-style-type: none"> a. profitability b. sustainability c. company growth 4. Describe the economic benefits and liabilities of managing resources in an environmentally responsible way. 	<p>Career Ready Practice: 1, 2, 12</p> <p>CTE Anchor: Communications: 2.1 Career Planning and Management: 3.7 Problem Solving and Critical Thinking: 5.1 Responsibility and Flexibility: 7.1, 7.2, 7.4, 7.6 Technical Knowledge and Skills: 10.1, 10.2 Demonstration and Application: 11.1</p> <p>CTE Pathway: C1.1, C5.2, C5.3, C5.4</p>
<p>C. TRADE MATHEMATICS</p> <p>Understand, apply and evaluate the mathematical requirements used in auto diagnosis, maintenance and repair.</p>	<ol style="list-style-type: none"> 1. Identify the practical applications of math in auto diagnosis, maintenance and repair. 2. Describe and demonstrate problem-solving techniques involving <ol style="list-style-type: none"> a. whole number problems, using addition, subtraction, multiplication and division b. fraction problems using arithmetic operations c. decimal problems, using arithmetic operations 3. Describe and demonstrate techniques for changing: <ol style="list-style-type: none"> a. fractions to decimals b. decimals to fractions 4. Describe the English system of measuring length, weight, and volume or capacity. 5. Describe the relationships between various English units of: <ol style="list-style-type: none"> a. measurement, such as inches, feet, yards and miles b. volume or capacity, such as cups, pints, quarts and gallons c. measuring problems, using arithmetic problems 6. Describe and demonstrate measuring techniques of various objects by using the English system measuring tools common to the trade. 	<p>Career Ready Practice: 1, 2, 5</p> <p>CTE Anchor: Communications: 2.1 Problem Solving and Critical Thinking: 5.2, 5.3 Technical Knowledge and Skills: 10.1</p> <p>CTE Pathway: C2.4, C2,5, C2.7</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
(7 hours)	<ol style="list-style-type: none"> 7. Describe the metric system of measuring length, weight, and volume or capacity. 8. Describe the relationships between various metric system linear units of: <ol style="list-style-type: none"> a. measurement such as millimeters, centimeters and meters b. weight such as milligrams, grams and kilograms c. measuring problems involving addition, subtraction, multiplication and division 9. Describe and demonstrate measuring techniques of objects using metric system measuring tools common to the trade. 10. Describe and demonstrate problem-solving techniques for: <ol style="list-style-type: none"> a. geometric problems that apply to auto repair and maintenance b. algebraic problems that apply to auto repair and maintenance c. using percentages d. reading and interpreting graphs e. using calculator 	
<p>D. TOOLS AND EQUIPMENT</p> <p>Understand, apply and evaluate the policies and procedures for using drive train tools and equipment in accordance with federal, state and local safety and environment regulations.</p> <p>(7 hours)</p>	<ol style="list-style-type: none"> 1. Identify and demonstrate the proper use, maintenance and storage techniques for the general shop <ol style="list-style-type: none"> a. hand tools b. equipment c. specialty tools and equipment for engine performance: <ol style="list-style-type: none"> i. ball (small hole) gauges ii. cam bearing driver set (suggested) iii. camshaft holding tool (appropriate for units being taught) iv. cylinder de-glazer v. dial bore indicator vi. antifreeze/coolant tester vii. engine stands/benches viii. inside micrometer set of 0 – 6” and 0 – 125 mm ix. oil pressure gauge x. outside micrometer set of 0 – 6” and 0 – 125 mm xi. portable crane – ½ ton xii. ring compressor xiii. ring expander xiv. ring groove cleaner xv. straight edge xvi. telescoping gauge set xvii. torque angle gauge xviii. transaxle removal and installation equipment xix. V-Blocks xx. valve spring compressor xxi. valve spring tester 	<p>Career Ready Practice: 1, 2, 3, 11</p> <p>CTE Anchor: Communications: 2.1 Problem Solving and Critical Thinking: 5.1 Health and Safety: 6.3 Technical Knowledge and Skills: 10.1</p> <p>CTE Pathway: C2.2, C2.3</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p>E. SERVICE MANUALS AND COMPUTER-BASED INFORMATION SYSTEMS</p> <p>Understand, apply and evaluate the contents of service manuals and computer-based information systems as important sources of reference to an auto technician.</p> <p>(1 hour)</p>	<ol style="list-style-type: none"> 1. Describe the different types of service manuals. 2. Describe the different types of information that can be found in service manuals such as specifications, troubleshooting charts and repair information. 3. Describe and demonstrate the use of service manuals. 4. Describe and demonstrate the use of web-based search engines finding auto technical information. 5. Describe the advantages of using web-based search engines over service manuals in finding auto-technical information. 	<p>Career Ready Practice: 2, 4</p> <p>CTE Anchor: Communications: 2.3 Technology: 4.1, 4.2, 4.6 Problem Solving and Critical Thinking: 5.1 Technical Knowledge and Skills: 10.1</p> <p>CTE Pathway: C2.6, C4.3</p>
<p>F. ENGINES</p> <p>Understand and evaluate the function of various engine components.</p> <p>(4 hours)</p>	<ol style="list-style-type: none"> 1. Describe the internal combustion process for gas and diesel engines. 2. Explain energy and work principles of auto engines. 3. Describe the operation of the four-stroke cycle. 4. Describe the operation of the two-stroke cycle. 5. Identify various engine components such as pistons, blocks, heads, bearings and crankshafts. 6. Identify various engine designs/configurations such as in-line, V type and overhead cam. 7. Describe the function and operation of the: <ol style="list-style-type: none"> a. crankshaft b. connecting rod and piston c. crankshaft bearings d. camshaft e. cylinder head and valves f. valve timing g. lubrication system h. cooling system 8. Explain the importance of engine maintenance. 9. Perform compression tests. 	<p>Career Ready Practice: 1, 2</p> <p>CTE Anchor: Communications: 2.1 Problem Solving and Critical Thinking: 5.3, 5.4 Technical Knowledge and Skills: 10.1</p> <p>CTE Pathway: C3.1</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p>G. FUEL AND AIR INDUCTION SYSTEMS</p> <p>Understand and evaluate the function of fuel and air induction systems.</p> <p>(4 hours)</p>	<ol style="list-style-type: none"> 1. Describe atmospheric pressure and engine vacuum. 2. Describe differences in automotive fuels. 3. Explain the importance of the air-fuel ratio. 4. Describe the operation of the fuel delivery system. 5. List the components of the fuel delivery system. 6. Describe the operation of a: <ol style="list-style-type: none"> a. carburetor b. fuel injection c. intake systems d. exhaust systems 7. Explain the significance of combustion emissions. 8. Describe the principles of emission controls. 9. Describe the principles of turbochargers and superchargers. 	<p>Career Ready Practice: 1, 2</p> <p>CTE Anchor: Communications: 2.1 Problem Solving and Critical Thinking: 5.3, 5.4 Technical Knowledge and Skills: 10.1</p> <p>CTE Pathway: C3.1</p>
<p>H. ELECTRICAL</p> <p>Understand, apply and evaluate the diagnostic procedures of the automotive electrical systems.</p> <p>(4 hours)</p>	<ol style="list-style-type: none"> 1. Describe electron and conventional flow theory. 2. Describe magnetic induction theory. 3. Explain the operation of a storage battery, starting system, and charging system. 4. Describe the operation of lighting and accessory systems. 	<p>Career Ready Practice: 1, 2, 3</p> <p>CTE Anchor: Communications: 2.1 Problem Solving and Critical Thinking: 5.3 Technical Knowledge and Skills: 10.1</p> <p>CTE Pathway: C3.6, C7.1, C7.2, C7.3</p>
<p>I. IGNITION SYSTEM</p> <p>Understand and evaluate the ignition system operation.</p>	<ol style="list-style-type: none"> 1. Describe the operation of ignition systems. 2. Identify various components of an ignition system. 3. List components of the primary circuit. 4. Describe the operation of the primary circuit. 5. List components of the secondary circuit. 6. Describe the operation of the secondary circuit. 7. Describe the operation of: <ol style="list-style-type: none"> a. spark advance mechanisms b. electronic ignition operation c. electronic spark control d. computer input/output operations 	<p>Career Ready Practice: 1, 2</p> <p>CTE Anchor: Communications: 2.1 Problem Solving and Critical Thinking: 5.3 Technical</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
(4 hours)	<ul style="list-style-type: none"> e. computer sensors f. tune-up procedures 	Knowledge and Skills: 10.1 CTE Pathway: C3.1, C6.4
J. HYBRID VEHICLES Understand and evaluate the basics of hybrid vehicles.	<ol style="list-style-type: none"> 1. Describe hybrid electric vehicles (HEVs). 2. Explain and describe the importance of safety procedures and equipment. 3. Describe the three different constructions of hybrid systems: series, parallel, series/parallel. 4. Describe the relationship between the gasoline engine and the electric motor in an HEV. 5. Compare an HEV and a vehicle powered by a gasoline engine on the base of: <ul style="list-style-type: none"> a. power b. fuel economy c. emissions 6. Describe the following technologies typically used by hybrids: <ul style="list-style-type: none"> a. regenerative breaking b. electric motor drive-assist c. automatic start/shutoff 7. Describe the optimum driving environment for an HEV. 	Career Ready Practices: 1, 2, 3, 4, 12 CTE Anchor: Communications: 2.1 Career Planning and Management: 3.3 Problem Solving and Critical Thinking: 5.4 Technical Knowledge and Skills: 10.1 CTE Pathway: C1.5, C3.4, C3.6
K. ALTERNATIVE FUEL VEHICLES Understand and evaluate the basics of alternative fuel vehicles.	<ol style="list-style-type: none"> 1. Define the concept of alternative fuel vehicles. 2. Describe the following examples of alternative fuel vehicles. <ul style="list-style-type: none"> a. electric b. flex fuel c. fuel cell 3. Differentiate between an alternative fuel vehicle and a vehicle powered by a gasoline engine on the bases of bases of: <ul style="list-style-type: none"> a. engine size b. fuel economy c. emissions 	Career Ready Practices: 1, 2, 3, 4, 11, 12 CTE Anchor: Communications: 2.1, 2.2 Problem Solving and Critical Thinking: 5.1, 5.2 Technical Knowledge and Skills: 10.1 CTE Pathway: C1.5, C3.4

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p>L. GENERAL ENGINE DIAGNOSIS: REMOVAL AND REINSTALLATION (R&R)</p> <p>Understand, apply and evaluate the removal and reinstallation techniques for engines according to the manufacturer’s specifications.</p> <p>(30 hours)</p>	<ol style="list-style-type: none"> 1. Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause and correction. P-1 2. Identify and interpret engine concern; determine necessary action. P-1 3. Research applicable vehicle and service information, such as internal engine operation, vehicle service history, service precautions and technical service bulletins. P-1 4. Locate and interpret vehicle identification such as cylinder head and engine block casting numbers. P-1 5. Inspect engine assembly for fuel, oil, coolant and other leaks; determine necessary action. P-1 6. Diagnose engine noises and vibrations; determine necessary action. P-2 7. Diagnose the cause of excessive oil consumption, coolant consumption, unusual exhaust color and odor; determine necessary action. P-2 8. Perform and determine necessary action to: <ol style="list-style-type: none"> a. engine vacuum test P-1 b. cylinder power balance tests-P-2 c. cylinder cranking and running compression tests P-1 d. cylinder leakage tests P-1 9. Remove and reinstall engine in an OBDII or newer vehicle; reconnect all attaching components and restore the vehicle to running condition. P-2 10. Install engine covers using gaskets, seals and sealers as required. P-1 11. Perform common fastener and thread repair, to include: remove broken bolt, restore internal and external threads with thread insert. P-1 12. Inspect, remove and replace engine mounts. P-2 	<p>Career Ready Practices: 1, 2, 3, 5, 11</p> <p>CTE Anchor: Communications: 2.1, 2.2, 2.3 Technology: 4.1, 4.2 Problem Solving and Critical Thinking: 5.1, 5.2, 5.3, 5.4 Health and Safety: 6.4, 6.6 Ethics and Legal Responsibilities: 8.1 Technical Knowledge and Skills: 10.1, 10.3</p> <p>CTE Pathway: C1.4, C2.2, C2.3, C2.5, C2.6, C3.7, C4.4, C5.6, C6.1</p>
<p>M. CYLINDER HEAD AND VALVE TRAIN DIAGNOSIS AND REPAIR</p> <p>Understand, apply and evaluate the diagnostic and repair techniques for the cylinder head and valve train according to the manufacturer’s specifications.</p>	<ol style="list-style-type: none"> 1. Remove cylinder head; inspect gasket condition; install cylinder head and gasket; tighten according to the manufacturer’s specifications and procedures. P-1 2. Clean and visually inspect a cylinder head for cracks; check gasket surface areas for warpage and surface finish; check passage condition. P-1 3. Inspect valve springs for squareness and free height comparison; determine necessary action. P-3 4. Replace the valve stem seals on an assembled engine; inspect valve spring retainers, locks/keepers and valve lock/keeper grooves; determine necessary action. P-3 5. Inspect valve guides for wear; check valve stem-to-guide clearance; determine necessary action. P-3 6. Inspect valve and valve seats; determine necessary actions. P-3 	<p>Career Ready Practices: 1, 2, 3, 5, 10, 11</p> <p>CTE Anchor: Communications: 2.1, 2.2 Technology: 4.1, 4.2 Problem Solving and Critical Thinking: 5.1, 5.2, 5.3, 5.4 Health and Safety: 6.4, 6.6</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
(35 hours)	<ol style="list-style-type: none"> 7. Check valve spring assembled height and valve stem height; determine necessary action. P-3 8. Inspect pushrods, rocker arms, rocker arm pivots and shafts for wear, bending, cracks, looseness and blocked oil passages (orifices); determine necessary action. P-2 9. Inspect valve lifters; determine necessary action. P-2 10. Adjust valves (mechanical or hydraulic lifters). P-1 11. Inspect and replace camshaft and drive belt/chain (includes checking drive gear wear and backlash, end play, sprocket and chain wear, overhead cam drive sprockets(s), drive belt(s), belt tension, tensioners, camshaft reluctor ring/tone-wheel, and variable valve timing components). P-1 12. Inspect and/or measure camshaft for runout, journal wear and lobe wear. P-2 13. Inspect camshaft bearing surface for wear, damage, out-of-round and alignment; determine necessary action. P-2 14. Establish camshaft position sensor indexing. P-1 	<p>Ethics and Legal Responsibilities: 8.1</p> <p>Technical Knowledge and Skills: 10.1, 10.3</p> <p>CTE Pathway: C1.4, C2.1, C2.2, C2.3, C2.4, C2.5, C2.6, C2.7, C3.7, C4.2, C4.3, C5.6</p>
<p>N. ENGINE BLOCK ASSEMBLY DIAGNOSIS REPAIR</p> <p>Understand, apply and evaluate the diagnostic repair techniques for the engine block assembly components according to the manufacturer's specifications.</p> <p>(35 hours)</p>	<ol style="list-style-type: none"> 1. Disassemble engine block; clean and prepare components for inspection and reassembly. P-1 2. Inspect engine block for visible cracks, passage condition, core and gallery plug condition, surface and warpage; determine necessary action. P-2 3. Inspect and measure cylinder walls/sleeves for damage, wear and ridges; determine necessary action. P-2 4. Deglaze and clean cylinder walls. P-2 5. Inspect and measure camshaft bearings for wear, damage, out-of-round and alignment; determine necessary action. P-3 6. Inspect crankshaft for straightness, journal damage, keyway damage, thrust flange and sealing surface condition, and visual surface cracks; check oil passage condition; measure end play and journal wear; check crankshaft position sensor reluctor ring (where applicable); determine necessary action. P-1 7. Inspect main and connecting rod bearing for damage and wear; determine necessary action. P-2 8. Identify piston and bearing wear patterns that indicate connecting rod alignment and main bearing bore problems; determine necessary action. P-3 9. Inspect and measure piston skirts and ring lands; determine necessary action. P-2 10. Remove and replace piston pin. P-3 11. Determine piston-to-bore clearance. P-2 12. Inspect, measure and install piston rings. P-2 13. Inspect auxiliary shaft(s) (balance, intermediate, idler, counterbalance or silencer); inspect shaft(s) and support bearings for damage and wear; determine necessary action; reinstall and time. P-2 14. Remove, inspect or replace crankshaft vibration damper (harmonic balancer). P-2 15. Assemble engine block. P-1 	<p>Career Ready Practices: 1, 2, 3, 5, 10, 11</p> <p>CTE Anchor: Communications: 2.1, 2.2 Technology: 4.1, 4.2 Problem Solving and Critical Thinking: 5.1, 5.2, 5.3, 5.4 Health and Safety: 6.4, 6.6 Ethics and Legal Responsibilities: 8.1 Technical Knowledge and Skills: 10.1, 10.3</p> <p>CTE Pathway: C1.4, C2.1, C2.2, C2.3, C2.4, C2.5, C2.6, C2.7, C4.3, C5.6</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p>O. LUBRICATION AND COOLING SYSTEMS DIAGNOSIS AND REPAIR</p> <p>Understand, apply and evaluate the diagnostic and repair techniques for the lubrication and cooling systems according to the manufacturer's specifications.</p> <p>(35 hours)</p>	<ol style="list-style-type: none"> 1. Perform oil pressure tests; determine necessary action. P-1 2. Inspect oil pump gears or rotors, housing, pressure relief devices and pump drive; perform necessary action. P-2 3. Perform cooling system pressure tests; check coolant condition; inspect and test radiator, pressure cap, coolant recovery tank and hoses; determine necessary action. P-1 4. Inspect, replace and adjust drive belts, tensioners and pulleys; check pulley and belt alignment. P-1 5. Inspect and replace engine cooling and heater system hoses. P-1 6. Inspect, test and replace thermostat and gasket/seal. P-1 7. Test coolant; drain and recover coolant; flush and refill cooling system with recommended coolant; bleed air as required. P-1 8. Inspect, remove and replace water pump. P-2 9. Remove and replace radiator. P-2 10. Inspect, test fan(s) (electrical or mechanical), fan clutch, fan shroud and air dams. P-1 11. Inspect auxiliary coolers; determine necessary action. P-3 12. Inspect, test and replace oil temperature and pressure switches and sensors. P-2 13. Perform oil and filter change. P-1 14. Identify causes of engine overheating. P-1 	<p>Career Ready Practices: 1, 2, 3, 5, 10, 11</p> <p>CTE Anchor: Communications: 2.1, 2.2 Technology: 4.1 Problem Solving and Critical Thinking: 5.1, 5.2, 5.3, 5.4 Health and Safety: 6.4, 6.6 Technical Knowledge and Skills: 10.1, 10.3</p> <p>CTE Pathway: C1.4, C2.1, C2.2, C2.3, C2.6, C3.7, C4.3, C6.2</p>
<p>P. EMPLOYABILITY SKILLS</p> <p>Understand, apply and evaluate the employability skills required in auto diagnosis, maintenance and repair.</p>	<ol style="list-style-type: none"> 1. Summarize employer requirements for the following: <ol style="list-style-type: none"> a. punctuality b. attendance c. proper attire d. attitude toward work e. quality of work f. teamwork g. responsibility h. timeliness i. communication skills 2. Explain the importance of the continuous upgrading of job skills through lifelong learning. 3. Identify pre-professional and professional industry organizations and discuss the employability benefits of belonging. 4. State the need to adapt to varied roles and responsibilities in the workplace. 5. Describe the importance of personal integrity and ethical behavior in the workplace. 6. Describe customer service as a method of building permanent relationships between the organization and the client. 7. Identify conflict resolution strategies for a variety of workplace situations. 8. Describe ways to demonstrate respect for individual and cultural differences and for the attitudes and feelings of others. 	<p>Career Ready Practices: 1, 2, 3, 4, 5, 7, 8, 9, 10, 11</p> <p>CTE Anchor: Communications: 2.1, 2.2, 2.3, 2.4 Career Planning and Management: 3.1, 3.2, 3.4, 3.9 Problem Solving and Critical Thinking: 5.1 Responsibility and Flexibility: 7.2, 7.4, 7.5, 7.7 Leadership and Teamwork: 9.2 Technical Knowledge and Skills 10.1</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
(3 hours)	<ol style="list-style-type: none"> 9. Identify potential employers through traditional and internet sources. 10. Describe the role of electronic social networking in job search. 11. Design sample résumés and cover letters. 12. Explain the importance of filling out a job application legibly, with accurate and complete information. 13. Describe the common mistakes made on job applications. 14. Complete sample job application forms correctly. 15. State the importance of <ol style="list-style-type: none"> a. enthusiasm in the interview and on a job b. appropriate appearance on the job c. continuous upgrading of job skills d. clean driver's record e. background check 16. Create a career plan that builds on existing interests, skills, and abilities. 17. Identify the informational materials, resources, and test knowledge needed to be successful in an interview. 18. Describe and demonstrate appropriate interviewing techniques. 	<p>Demonstration and Application: 11.5</p> <p>CTE Pathway: C5.3, C5.4, C5.5</p>
<p>Q. ENTREPRENURIAL SKILLS</p> <p>Understand, apply and evaluate the process involved in becoming an entrepreneur in the auto repair maintenance industry.</p> <p>(1 hour)</p>	<ol style="list-style-type: none"> 1. Define entrepreneurship. 2. Identify the necessary characteristics of successful entrepreneurs. 3. Describe the contributions of entrepreneurs to the auto repair and maintenance industry. 4. Explain the purpose and components of a business plan. 5. Examine personal goals prior to starting a business. 6. Evaluate sources of monetary investment in a business opportunity. 7. Describe the various licensing requirements in the auto repair and maintenance business. 8. Develop a scenario depicting the student as the auto repair and maintenance business owner. 9. Differentiate between sustainable and green business practices and standard business practices. 	<p>Career Ready Practices: 1, 2, 3, 4, 5, 7, 8, 9, 10, 11</p> <p>CTE Anchor: 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>CTE Pathway: C1.1, C5.3, C5.4, C5.5</p>

SUGGESTED INSTRUCTIONAL MATERIALS and OTHER RESOURCES

TEXTS AND SUPPLEMENTAL BOOKS

Duffy, James E. Auto Engine Repair, Training Series for ASE Certification, 7th Edition. Goodheart-Willcox Publishing, 2021.

Duffy, James E. Modern Automotive Technology, 9th Edition. Goodheart-Willcox Publishing, 2017.

Giles, Tim. Automotive Engines: Diagnosis, Repair, Rebuilding 8th Edition. Cengage Learning, 2019.

Halderman, James. Automotive Engines: Theory and Servicing 9th Edition. Pearson, 2018.

Hadfield, Chris and Witthauer, John. Basic Automotive Service & Systems, 6th Edition. Cengage Learning, 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 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.

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/>

http://www.ed-foundation.org/html_pages/products_programs_services/natef_tools/non-structural_analysis/non-structural_analysis.shtml

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

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 – Orientation and Safety – Pass the safety test with 100% accuracy.

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

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

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

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

SECTION F – Engines – Pass all assignments and exams on engines with a minimum score of 80% or higher.

SECTION G – Fuel and Induction Systems – Pass all assignments and exams on fuel and induction systems with a minimum score of 80% or higher.

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

SECTION I – Ignition System – Pass all assignments and exams on ignition system with a minimum score of 80% or higher.

SECTION J – Hybrid Vehicles – Pass all assignments and exams on hybrid vehicles with a minimum score of 80% or higher.

SECTION K – Alternative Fuel Vehicles – Pass all assignments and exams on alternative fuel vehicles with a minimum score of 80% or higher.

SECTION L – General Engine Diagnosis: Removal and Reinstallation (R & R) – Pass all assignments and exams on general engine diagnosis: removal and reinstallation (r & r) with a minimum score of 80% or higher.

SECTION M – Cylinder Head and Valve Train Diagnosis and Repair – Pass all assignments and exams on cylinder head and valve train diagnosis and repair with a minimum score of 80% or higher.

SECTION N – Engine Block Assembly Diagnosis and Repair – Pass all assignments and exams on engine block assembly diagnosis and repair with a minimum score of 80% or higher.

SECTION O – Lubrication and Cooling Systems Diagnosis and Repair – Pass all assignments and exams on lubrication and cooling systems diagnosis and repair with a minimum score of 80% or higher.

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

SECTION Q – 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.

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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