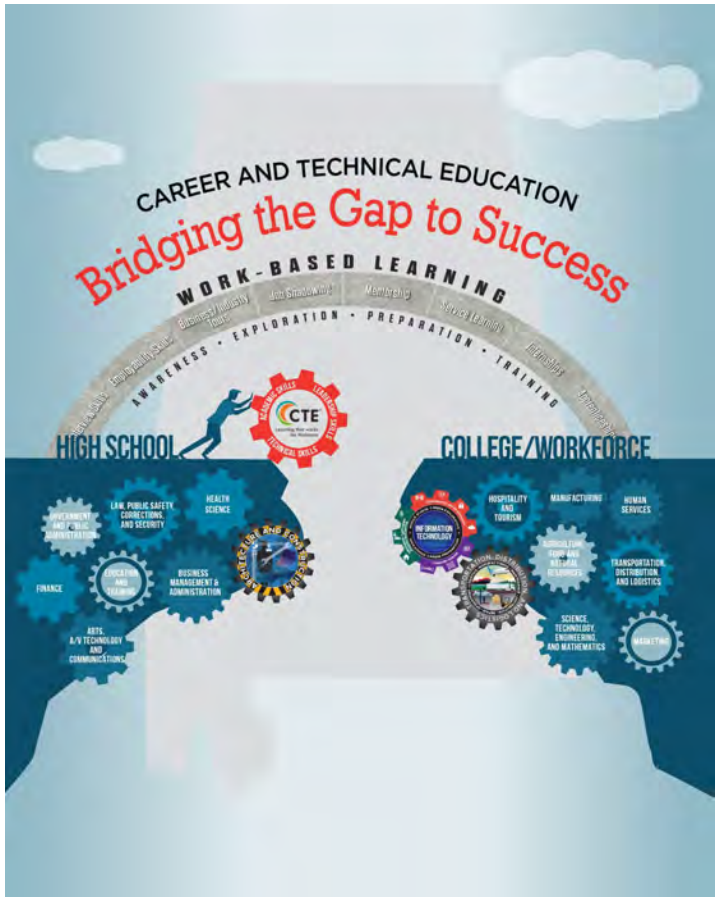
2023 Revised Alabama Course of Study
Career and Technical Education



2023

Eric G. Mackey, State Superintendent of Education
Alabama State Department of Education

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2023 Revised Alabama Course of Study
Transportation, Distribution and Logistics

Eric G. Mackey
State Superintendent of Education

STATE SUPERINTENDENT OF EDUCATION'S MESSAGE

Dear Alabama Educator:

The 2023 *Revised Alabama Course of Study: Career and Technical Education, Transportation, Distribution and Logistics* presents standards designed to prepare students for the career and technical demands of the future, both in the workplace and in the postsecondary education setting.

This document contains a challenging set of standards designed to promote students' engagement and career interests in transportation, distribution, and logistics fields. I encourage each system to use the document in developing local curriculum guides that determine how its students will achieve and even exceed these standards.

The 202*3 Revised Alabama Course of Study: Career and Technical Education, Transportation, Distribution and Logistics* was developed by educators and business and community leaders to provide a foundation for building quality Transportation, Distribution and Logistics programs across the state. Implementing the content of this document through appropriate instruction will promote students' exploration and enhance preparation for further study and careers in a variety of transportation, distribution, and logistics fields.

Eric G. Mackey
State Superintendent of Education

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2023 Revised Alabama Course of Study
Transportation, Distribution and Logistics
Table of Contents

2023 Revised Alabama Course of Study
Transportation, Distribution and Logistics

PREFACE

The 2023 *Revised Alabama Course of Study: Career and Technical Education, Transportation, Distribution and Logistics* provides the framework for Grades 9-12 Transportation, Distribution and Logistics programs in Alabama's public schools. Transportation, Distribution and Logistics education courses are organized by programs, which are aligned with national standards. Content standards in this document are minimum and required (*Code of Alabama,* 1975, §16-35-4). They are fundamental and specific, but not exhaustive. When developing local curriculum, school systems may include additional content standards to reflect local needs and philosophies. Systems are encouraged to add implementation guidelines, resources, and activities based upon the content standards in the Transportation, Distribution and Logistics Course of Study.

The 2021 Alabama Career and Technical Education Course of Study Committee and Task Force conducted extensive research during the development of the Transportation, Distribution and Logistics Course of Study, analyzing career and technical education standards and curricula from other states, previous versions of Alabama's career and technical education courses of study, and national standards. The Committee and Task Force also reviewed information from professional journals and Internet sites, listened to and read comments from interested individuals and industry groups throughout the state, considered suggestions from independent reviewers, sought input from advisory councils, and thoroughly discussed each issue and standard among themselves. The Committee and Task Force reached consensus and developed what members believe to be the best Transportation, Distribution and Logistics Course of Study for students in Alabama's public schools.

2023 Revised Alabama Course of Study
Transportation, Distribution and Logistics

ACKNOWLEDGMENTS

This document was developed by the Transportation, Distribution and Logistics Committee and Task Force of the 2021 Alabama Career and Technical Education Course of Study Committee and Task Force, composed of middle school, high school, and college educators appointed by the Alabama State Board of Education and business and professional persons appointed by the Governor (*Code of Alabama*, 1975, §16-35-1). The Committee and Task Force began work in February of 2021 and submitted the document to the Alabama State Board of Education for initial adoption at the January 2022 meeting. The revised version was approved at the Board's July 2023 meeting.

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2023 Revised Alabama Course of Study
Transportation, Distribution and Logistics

GENERAL INTRODUCTION

Alabama's Career and Technical Education programs empower students with the workplace-readiness skills necessary for success in the twenty-first century. As a result, students can become productive citizens who are prepared with the necessary knowledge and skills for postsecondary education and employment. Career and Technical Education provides opportunities for students to combine core academic content with rigorous and relevant technical knowledge and skills.

The *Alabama Course of Study: Career and Technical Education* is intended for all students in Grades 6-12. Alabama's Career and Technical Education programs promote students' career awareness through engaging career exploration and development activities. Career and Technical Education programs focus on providing students with the knowledge and skills that reinforce attainment of academic core content through hands-on experiential learning. These programs are organized into the sixteen national career clusters identified by the United States Department of Education, which arrange instruction into groups of similar occupations. Within these sixteen national career clusters, separate course content standards have been developed for more than fifty career pathways.

Because of the interconnected nature of Career and Technical Education programs, some courses will be utilized in more than one cluster. Shared courses are not reprinted in each course of study, but are indicated in the clusters' program guides, which are the definitive listings of required courses for each cluster. Program guides can be found on the Alabama State Department of Education website.

Alabama's Career and Technical Education programs are designed to keep abreast of the rapid changes in business and industry and be responsive to current and future workforce demands. Rigor in each course of study is derived from both core academic content and industry-specific knowledge and skills required for students to achieve, maintain, and advance in employment in a particular career pathway. The level of academic and workplace rigor determines the degree to which each Alabama Career and Technical Education program prepares students for high-skill, high-wage, and in-demand careers. For each Career and Technical Education program, industry-recognized credentials of value and certifications have been established that validate the rigor of the curriculum to students, parents, and members of business and industry. In addition, articulation agreements are developed in partnership with the Alabama Community College System to allow for a seamless transition for students to further their education.

Alabama’s growing economy has created the demand for more highly-skilled workers. Alabama’s Career and Technical Education programs, through the implementation of each career cluster’s course of study, equip students with the employability skills and technical knowledge necessary to meet current and future workforce demands by preparing them for lifelong learning.

2023 Revised Alabama Course of Study
Transportation, Distribution and Logistics

CONCEPTUAL FRAMEWORK

2023 Revised Alabama Course of Study
Transportation, Distribution and Logistics

CONCEPTUAL FRAMEWORK

The conceptual framework pictured on the previous page is a graphic representation of the essential and highly technical fields of Transportation, Distribution and Logistics.

Listed on the band encircling the center of the gear are the themes that connect the programs within this cluster: Manufacturing, Maintenance, Distribution, Repair, Operations, and Logistics. Intermodal transportation occurs via land, sea, and air as goods and services travel by motor vehicles, marine vessels, and aircraft.

The pictures in the center of the gear represent the range of career opportunities available in the manufacturing supply chain, the production of vehicles, the distribution of products and services, and the maintenance and repair of the modes of transportation that support commerce and industry within and beyond Alabama. Transportation, Distribution and Logistics standards are designed to equip Alabama's students with the skills and knowledge to transition to postsecondary education and training opportunities and the workforce.

POSITION STATEMENTS
Transportation, Distribution and Logistics

The Transportation, Distribution and Logistics program of Career and Technical Education focuses on preparing students for employment in careers that relate to the manufacturing, operation, maintenance, repair, and refinishing of personal and commercial modes of transportation as well as the logistics of transporting goods and services. Certain fundamental understandings which support the Transportation, Distribution and Logistics program must be embraced by schools and school districts in order to provide students with the best possible experiences in the classroom and in the field. These position statements summarize the requirements for an effective Transportation, Distribution and Logistics program.

Classroom and Laboratory Environment

The effective Transportation, Distribution and Logistics classroom should be a safe environment which is fully equipped with current and emerging technologies, supplies, and materials needed for instruction, where students can increase their skills. As in other pathways in Career and Technical Education, instruction in Transportation, Distribution and Logistics cannot be confined within the four walls of a traditional classroom. Students and teachers should have access to laboratory environments on campus and in the community where students can experience practical, real-world circumstances in the Transportation, Distribution and Logistics field.

Technology, Equipment, and Facilities

Classroom technology must be readily available, efficiently maintained, and routinely upgraded according to a regular schedule. Students and teachers utilize equipment to conduct a variety of classroom instruction and learning activities. Using up-to-date technology enhances the learning environment and prepares students for future career opportunities. In addition, students should have ready access to other classroom supplies and materials (such as textbooks, reference materials, and software) in classroom libraries, research areas, and materials centers to support instruction and credentialing. Sufficient funds must be allocated to provide and maintain the technology and materials necessary for a superior career and technical education program.

Safety

The safety of students and instructors is a prime consideration in every learning environment. Creating and implementing a written safety plan is an essential part of designing, carrying out, and evaluating each career and technical education program. An effective plan may include federal, state, local, school, and program guidelines. Care must be taken to ensure that students are in safe environments both on and off campus. Safety includes not only physical and emotional well-being but also digital and online security. The importance of safety is underscored by its position as the first foundational standard, which is to be included in every course. Teachers must tailor their safety instruction to meet the demands of each specific area.

Professional Development

Because both technology and instructional methods continue to evolve, it is essential for teachers to participate in professional development and technical training opportunities to stay abreast of innovations pertaining to their content area and to the workplaces in which their students will be employed. Teachers who continually expand their pedagogical knowledge and skills are able to adjust the learning environment to reflect current and emerging trends in teaching methods and to address their students' varied learning styles. Regular program assessment by students, administrators, business and industry personnel, and the educators themselves guides professional development, which in turn enhances the instructional program.

Administrative Support

Full support from district and local administrators is essential in providing the necessary components of a Transportation, Distribution and Logistics program. Administrators should recruit highly qualified teachers who possess appropriate credentials and secure funding for professional development activities and industry certification for those teachers. Administrators must also provide time for professional development and for planning for the integration of academic content areas into the Transportation, Distribution and Logistics Cluster. Administrators should actively promote the Transportation, Distribution and Logistics program within the school and in the community.

Instructional Model

The Transportation, Distribution and Logistics Course of Study is designed to address the challenges of a changing, technological, diverse, and global society in which students must apply knowledge, skills, and ideas to solve problems and make decisions. The Transportation, Distribution and Logistics curriculum designed by each local education agency should be project-based, process-oriented, and work-based so that students can develop their abilities to collaborate, analyze, communicate, manage, and lead.

The content standards contained in this document require students to use innovative critical-thinking skills. Teachers should utilize the course of study to identify the issue or concern addressed in a specific content standard and then use the local curriculum guide to plan appropriate learning experiences. Teachers must understand that there are differences among standards, curriculum, and resources. The Transportation, Distribution and Logistics content standards delineate what students are expected to know or be able to do at the end of each course. A curriculum is a sequence of tasks, activities, and assessments that teachers enact to support students in learning the standards while drawing on a textbook and computer resources when appropriate.

Academic core content should be integrated into the Transportation, Distribution and Logistics program. To achieve the solution to a given problem, students must have adequate foundations in reading, writing, speaking, listening, viewing, and presenting; knowledge and skills in mathematics, science, and social studies; and knowledge of current and emerging technologies.

The Transportation, Distribution and Logistics program should also integrate workplace demands and employability skills, incorporating various instructional strategies to accommodate students' learning styles and interests. A variety of assessments should be used to evaluate individual students' interests, aptitudes, and abilities.

When individual needs have been determined for students in special populations, a support service program should be planned cooperatively by Transportation, Distribution and Logistics instructors and other appropriate personnel, because Individual Education Programs are most effective when developed in conjunction with students' career and technical education instructors. Courses and equipment may be tailored to ensure equal access to the full range of learning experiences and skill development in the Transportation, Distribution and Logistics program.

Career and Technical Student Organizations (CTSOs)

Nationally affiliated Career and Technical Student Organizations (CTSOs) such as SkillsUSA are an integral part of classroom instruction in each career and technical education program and are essential for the growth and development of a career-ready workforce. In conjunction with coursework completed in each cluster, CTSOs make a positive difference in the lives of students by developing their potential for leadership, personal growth, and career success. The purpose of these organizations is to help students develop an understanding of all aspects of industry and technology while learning teamwork and leadership skills. The importance of CTSOs is indicated by their inclusion in the foundational standards to be taught in every Transportation, Distribution and Logistics course. Goals of student organizations include:

- developing individual potential;
- developing effective leadership and citizenship skills through social, economic, scholastic, and civic activities;
- increasing knowledge and understanding of an ever-changing society;

• assisting in the exploration of occupational choices and the development of essential workplace skills;
• participating in career development events; and
• serving the school and community through community service projects.

Business-Industry-School Relationships

The very nature of Transportation, Distribution and Logistics requires a close relationship between the school and the business community. Some aspects of this relationship are specified by state and federal laws and regulations, while others are determined by the desires, interests, and willingness of school personnel and business leaders in the local community. The relationship between schools and businesses can be immensely beneficial to all parties involved.

Certification

Maintaining relationships with local businesses and industries is vital to the certification process as well as to federal funding through the Carl D. Perkins legislation. Certain elements of program certification require local industries to participate in the Career and Technical Education program's adoption of industry standards (including national accreditation through the ASE Education Foundation and National Coalition of Certification Centers). Representatives from local businesses and industries interact with school programs to address the ever-changing needs of the competitive global economy. Through this interaction, the program is reviewed to ensure that needs are being met through lesson plans, instructional techniques, facilities, professional development, technical updates, equipment, and implementation of CTSOs.

Student Work Experience

As students begin to plan careers, they must have opportunities to visit, tour, and work at local industries and businesses. Real-world experiences such as cooperative education, internships, apprenticeships, and job shadowing contribute to the work-based, service-based, and project-based learning that enhances classroom instruction. An additional benefit comes from continuous feedback from students and supervisors, who evaluate the program to facilitate changes that satisfy industry needs.

Advisory Councils and Partnerships

In accordance with Alabama State Department of Education guidelines, each Career and Technical Education program has an advisory council made up of representatives of the local business community that provides professional, real-world input regarding equipment needs, curriculum emphases, technical updates, and problem-solving. This link to business and industry may also give external support by supplying equipment, resource materials, or qualified speakers. Community partners may provide program sponsors, judges for student career development events, financial support, scholarships, field trip sites, and other program needs.

Community Involvement and Service

There are many ways for Transportation, Distribution and Logistics students and teachers to become involved with community service projects, providing benefits for students and their communities. Local organizations such as civic clubs, professional educational groups, youth organizations, and community adult education programs are valuable resources for Transportation, Distribution and Logistics programs. Open houses, tours, and presentations allow families and other interested citizens to become more informed about Transportation, Distribution and Logistics and more involved in the education environment.

Postsecondary and Higher Education Credit

Postsecondary and higher education articulation is a significant element in a student's career cluster. Secondary and postsecondary instructors must communicate on a regular basis to ensure a smooth transition for students and to make certain that students are aware of articulation opportunities. Articulation may occur through program alignment with postsecondary programs, early college enrollment, or dual enrollment programs.

Students benefit in a variety of ways when cooperation exists between secondary and postsecondary institutions. One of the benefits is the earning of postsecondary credit in conjunction with work completed while the student is still in secondary school. Postsecondary teachers offer additional benefits by serving as guest speakers, donating equipment, sharing expertise through professional development activities, and addressing other needs appropriate for the school community.

Dual Enrollment for Dual Credit is an enrichment opportunity allowing eligible high school students to earn high school and college credits for courses taken through an Alabama Community College System (ACCS) institution or an Alabama college or university while still enrolled in high school. Articulated credit is awarded when a student enrolls and satisfactorily completes work in a postsecondary institution that has an articulation agreement with that student's participating school.

DIRECTIONS FOR INTERPRETING STANDARDS

The 2023 *Revised Alabama Course of Study: Career and Technical Education, Transportation, Distribution and Logistics* is organized around the following elements: foundational standards, topics, and content standards.

Foundational standards are an important part of every course. Through these standards, students learn and apply safety concepts, explore career opportunities and requirements, practice the skills needed to succeed in the workplace, learn and practice essential digital skills, and develop leadership and take advantage of the opportunities afforded by Career and Technical Student Organizations.

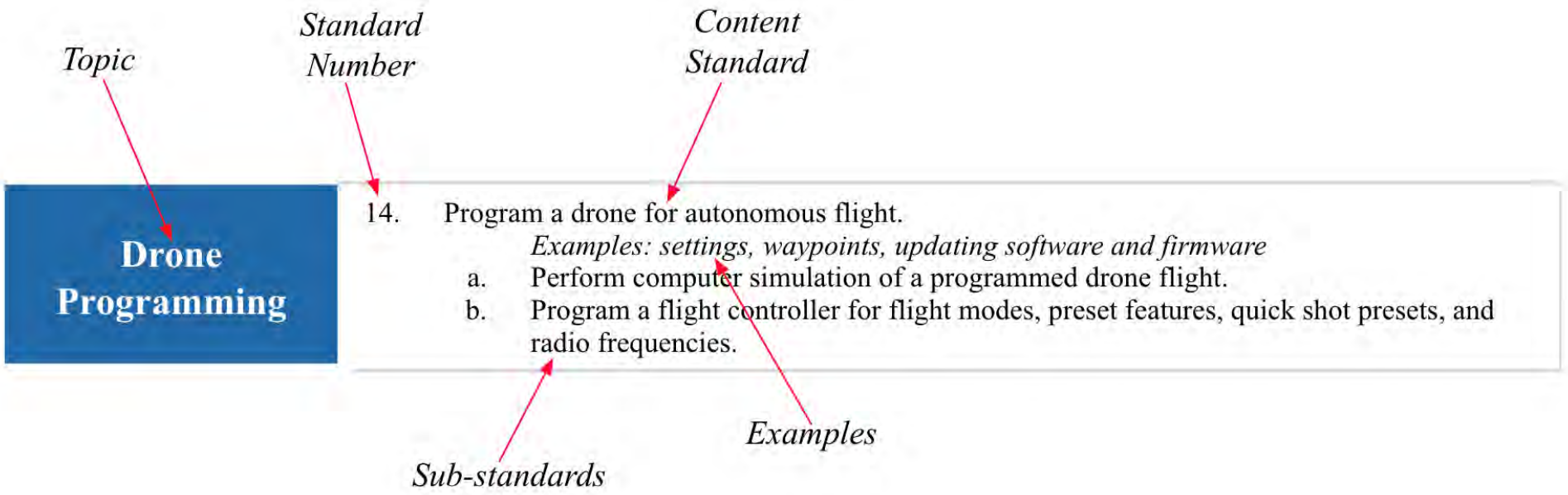
Related content standards are grouped under **Topics**. In the example below, the topic is "Drone Programming" from the Drone Technology course. Standards from different topics may be closely related.

Content Standards contain the minimum required content and define what students should know or be able to do at the conclusion of a course. Some have **sub-standards**, indicated with a, b, c, d…, which are extensions of the content standards and are also required. When "including" appears in standards, it should be construed as "including but not limited to." The items listed must be taught; others may also be included in instruction.

Some standards are followed by italicized **examples**, which present options that might prove useful in instruction of the standard. Examples are not intended to be exhaustive lists and are not required to be taught.

Local education agencies (LEAs) may add standards to meet local needs and incorporate local resources. Each content standard completes the stem *"Students will..."*

The course of study does not dictate curriculum, teaching methods, or sequence; the order in which standards are listed within a course or grade is not intended to convey the order for instruction. Even though one topic may be listed before another, the first topic does not have to be taught before the second. A teacher may choose to teach the second topic before the first, to teach both at the same time to highlight connections, or to select a different topic that leads to students reaching the standards for both topics. Each local education agency should create its own curriculum and pacing guide based on the Course of Study. The standards in each course are to be used as a minimal framework and should encourage innovation.


Topic
Standard Number
Content Standard
Drone Programming
14. Program a drone for autonomous flight.
Examples: settings, waypoints, updating software and firmware
a. Perform computer simulation of a programmed drone flight.
b. Program a flight controller for flight modes, preset features, quick shot presets, and radio frequencies.
Examples
Sub-standards

CLUSTER OVERVIEW

Transportation, Distribution and Logistics

In the Transportation, Distribution and Logistics cluster, students choose one of six programs -- Automotive Service Repair, Diesel Equipment Technology, Collision Repair Technology, Aviation Technology, Flight Technology, or Distribution and Logistics. Students select courses leading through specific programs in preparation for industry certifications and credentials.

Hands-on training is especially important in the Transportation, Distribution and Logistics cluster. Students gain knowledge and skills through an active, structured, and stimulating classroom environment which is augmented by simulated workplace learning experiences, including on-site visits and work shadowing. Transportation, Distribution and Logistics classrooms and laboratories provide safe and appropriate settings where students can learn and practice their skills. In addition, students can be assessed in meaningful ways in these simulated workplace settings.

Because of the interconnected nature of Career and Technical Education programs, some courses will be utilized in more than one cluster. Shared courses are not reprinted in each course of study, but are indicated in the clusters' program guides, which are the definitive listings of required courses for each cluster. Program guides can be found on the Alabama State Department of Education website.

Students in Transportation, Distribution and Logistics affiliate with SkillsUSA, a career and technical student organization (CTSO). This organization promotes framework skills that include personal, workplace, and technical skills grounded in academics.

Students in Grades 9-12 possess varying learning styles and levels of maturity. Their backgrounds include diverse family structures and varying social and emotional environments. Throughout these grades, students are adjusting to personal, physical, and emotional changes as well as to social changes taking place in the world around them as they tackle challenging academic requirements and opportunities. Career and Technical Education helps them navigate these personal and social changes and find their places in the world of work.

Course of Study standards represent the minimum required content and are not intended to be the course curriculum. LEAs and local schools should use these standards to create a curriculum that utilizes available resources to meet the specific needs and interests of the local community. Teachers are encouraged to incorporate the SkillsUSA framework, Career Essentials learning curriculum, and Alabama SkillsUSA District and State Leadership and Skills Conferences. All Career and Technical Education courses emphasize application of knowledge and skills to solve practical problems.

CONTENT STANDARDS

Aircraft Electrical Components

Course Credit	1.0
Grade Levels	10-12
Prerequisites	

Aircraft Electrical Components presents the basic knowledge and skills associated with aircraft electrical components. Standards are designed to equip students to select and safely utilize the proper tools for various situations as they perform aircraft maintenance and service tasks. Topics include installation, inspection, and repair of a wiring harness; electrical power sources (battery and generator); repair and overhaul of electrical components (generator, motor, actuator, and magnetos); aircraft hardware; and aircraft servicing, tools, and materials.

Career and Technical Student Organizations are integral, co-curricular components of each career and technical education course. These organizations enhance classroom instruction while helping students develop leadership abilities, expand workplace-readiness skills, and access opportunities for personal and professional growth. Students in the Transportation, Distribution and Logistics career cluster affiliate with SkillsUSA.

Foundational standards, shown in the table below, are an important part of every course. Through these standards, students learn and apply safety concepts, explore career opportunities and requirements, practice the skills needed to succeed in the workplace, develop leadership qualities and take advantage of the opportunities afforded by Career and Technical Student Organizations (CTSOs), and learn and practice essential digital literacy skills. The foundational standards are to be incorporated throughout the course.

Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork.

3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.
4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway.
5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork.
6. Apply literacy, mathematical, and scientific principles and precision measurements when diagnosing problems and making repairs.
7. Work independently, collaboratively, and in teams to explore concerns, find causes, and take appropriate action by applying principles of STEM.

AIRCRAFT ELECTRICAL COMPONENTS CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Basic Electricity	1. Explain the difference between alternating current and direct current and indicate where each is most commonly used in aircraft.
Electrical Components	2. Identify and explain the uses of various electrical components used in aviation. *Examples: AC generator, DC generator, bus bar, switches, relays* a. Explain the difference between a generator and an alternator and indicate where each is typically found in aircraft systems.

Wiring	3. Explain the relationship between wire gauge and current flow. a. Construct a wiring harness according to FAA guidelines.
Tools	4. Demonstrate how to use an electrical multimeter and its various settings. *Examples: check voltage output of generators, measure resistance in a circuit, check continuity of components and wiring harnesses*
Board Construction	5. Build a project board with an electric motor that can be reversed with a toggle switch, simulated navigation lights, bus bar, and breaker panel.

Aircraft Engine and Propeller Theory

Course Credit	1.0
Grade Levels	10-12
Prerequisites	Aircraft Theory of Flight and Operations Airframe Systems

Aircraft Engine and Propeller Theory presents the basic knowledge and skills associated with the theory and operation of aircraft engines and propellers. Standards are designed to equip students to select and safely utilize the proper tools for various situations as they perform aircraft maintenance and service tasks. Topics include engine and propeller theory, aircraft hardware, reciprocating engines, propellers, ground operations, aircraft servicing, tools, and materials.

Career and Technical Student Organizations are integral, co-curricular components of each career and technical education course. These organizations enhance classroom instruction while helping students develop leadership abilities, expand workplace-readiness skills, and access opportunities for personal and professional growth. Students in the Transportation, Distribution and Logistics career cluster affiliate with SkillsUSA.

Foundational standards, shown in the table below, are an important part of every course. Through these standards, students learn and apply safety concepts, explore career opportunities and requirements, practice the skills needed to succeed in the workplace, develop leadership qualities and take advantage of the opportunities afforded by Career and Technical Student Organizations (CTSOs), and learn and practice essential digital literacy skills. The foundational standards are to be incorporated throughout the course.

Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork. 3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.

	4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway. 5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork. 6. Apply literacy, mathematical, and scientific principles and precision measurements when diagnosing problems and making repairs. 7. Work independently, collaboratively, and in teams to explore concerns, find causes, and take appropriate action by applying principles of STEM.

AIRCRAFT ENGINE AND PROPELLER THEORY CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Aircraft Hardware	1. Install aircraft hardware, using proper tools for each task. *Example: specialized wrenches* a. Identify types, sizes, construction, finishes, and applications of aircraft hardware. *Examples: specialized fasteners, protective coatings* b. Utilize safety wire and cotter-pin torqued threaded fasteners.
Reciprocating Engines and Propellers	2. Explain how reciprocating engines work from intake to exhaust, describing engine parts and processes using industry terminology. 3. Explain the theory and operation of aircraft propellers. *Examples: propeller pitch, propeller material and construction, inspection and balancing*
Aircraft Ground Operation	4. Demonstrate procedures of ground operation to prepare for marshaling, hangaring, and flight. *Examples: ground movement, taxiing, choking, defuel, refuel*

Aircraft Servicing	5. Describe basic aircraft servicing techniques. *Examples: defuel, refuel, sample fuel, sample and check oil*
Aircraft Engine and Propeller Tools	6. Demonstrate use and proper care of tools for aircraft engine and propeller maintenance. *Examples: torque wrench, depth gauge, T and ball gauge*
Materials	7. Select the correct lubricant and liquid for each engine and propeller component. *Examples: engine oil, assembly prelube, bearing grease*
Engine Disassembly and Reassembly	8. Disassemble and reassemble an aircraft reciprocating engine, including making measurements to simulate overhaul, utilizing the engine manufacturer's overhaul manual (OHM). a. Tag and label engine parts during disassembly to account for all components. b. Clean and inspect parts according to the manufacturer's overhaul manual specifications. c. Reassemble an engine according to OHM guidelines using designated tools and techniques and replacing parts as needed. d. Assemble parts to specified torque and tolerances.

Aircraft Instruments and Avionics

Course Credit	1.0
Grade Levels	10-12
Prerequisites	Aircraft Theory of Flight and Operations Airframe Systems

Aircraft Instruments and Avionics provides an introduction to various types of instrumentation used aboard common aircraft. The course introduces electronic instruments and their uses in communication, navigation, maintenance, and operation of the aircraft.

Career and Technical Student Organizations are integral, co-curricular components of each career and technical education course. These organizations enhance classroom instruction while helping students develop leadership abilities, expand workplace-readiness skills, and access opportunities for personal and professional growth. Students in the Transportation, Distribution and Logistics career cluster affiliate with SkillsUSA.

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Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork. 3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.

4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway.
5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork.
6. Apply literacy, mathematical, and scientific principles and precision measurements when diagnosing problems and making repairs.
7. Work independently, collaboratively, and in teams to explore concerns, find causes, and take appropriate action by applying principles of STEM.

AIRCRAFT INSTRUMENTS AND AVIONICS CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Instrument and Avionics Hardware

1. Identify types, sizes, construction, and applications of aircraft hardware pertaining to avionics.
   Examples: electrical terminals, safety wire, electrical wire coating

Aircraft Instruments

2. Identify the three main instrument clusters and which instruments belong to each.
   Examples: nav-com, power, systems
   a. Explain the function of nav-com instruments and use readings to maneuver the aircraft.
      Example: Correlate readings from the turn and bank indicator, artificial horizon, and altimeter to turn the aircraft.
   b. Explain the purpose of power systems instruments and use readings to manage aircraft performance.
      Example: Correlate instrument readings to determine flight time remaining.
   c. Explain the purpose of systems cluster instruments and use readings to monitor non-standard equipment on aircraft.
      Examples: Check anti-icing system to determine power usage. Check position of retractable landing gear.

Avionics

3. Clean and inspect aircraft instruments and gauges for return to service.
    a. Test gauges for compliance with manufacturer's specifications.

4. Describe the internal working of both manual gauges and electronic gauges.

5. Build a simulated instrument panel using instruments and gauges.
    Examples: oil temp gauge, oil pressure, tachometer, fuel quantity indicator
    a. Follow FAA guidelines for placement of instruments and gauges.
    b. Connect instruments and gauges to input sources as specified in manufacturer's manual, testing for proper grounding and installing wires, clips, and ties as indicated.

Aircraft Nonmetallic Structures

Course Credit	1.0
Grade Levels	10-12
Prerequisites	Aircraft Theory of Flight and Operations Airframe Systems

Aircraft Nonmetallic Structures presents the basic knowledge and skills for inspecting and repairing aircraft nonmetallic structures. Safety and proper tool use are emphasized throughout this course. Specific topics include wood construction and repair, fabric covering, aircraft finishes, composite structures, airfoils, aircraft hardware, and tools and materials used to perform various procedures related to aircraft nonmetallic structures.

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AIRCRAFT NONMETALLIC STRUCTURES CONTENT STANDARDS

Each content standard completes the stem *"**Students will**…"*

Wood Construction and Repair	1. Describe wood aircraft structures and repair techniques.
Fabric Covering	2. Describe techniques used in preparation for covering aircraft surfaces with fabric.
Aircraft Finishes	3. Identify aircraft paint finishes and indicate when different types would be used. a. Outline procedures for inspection, removal, treatment, and application of aircraft paint finishes.
Composite Structures	4. Demonstrate techniques in aircraft composite construction and repair, including layering woven material and bonding woven materials. *Example: Install fiberglass fabric at 90-degree angles for two-layer construction.*

Tools	5. Demonstrate the proper use and care of specialized tools used with nonmetallic aircraft structures. *Examples: heat blanket, vacuum bag, heat gun, chemical atomizer*
Aircraft Hardware	6. Explain uses, care, and installation of aircraft hardware related to nonmetallic structures.
Materials	7. Select materials for given tasks in aircraft maintenance. *Examples: fasteners, safety wire; aircraft paint finish; sheet metal; rivets; threaded fasteners; aircraft fabric; aircraft dope; rib-stitching cord; wood, plywood, and molding; metal flashing; tacks*
Airfoils and Composite Panels	8. Construct a full-sized or scale model wood wing rib in accordance with industry standard applications and practices, including the proper dope and fasteners. a. Design a wood wing rib using industry standard specifications. b. Cut wing rib components from selected woods. c. Assemble wing rib components in the order specified in FAA guidelines. 9. Construct a composite panel using fiberglass cloth and resins, using FAA-approved procedures. a. Repair damage to a honeycomb panel, using FAA-approved procedures. *Example: Check to determine whether damage can be repaired according to FAA specifications, and repair or replace as indicated.* b. Repair damage to a fiberglass panel, using FAA-approved procedures. *Example: Inspect damage to determine repair or replacement options in accordance with FAA standards.*

Aircraft Sheet Metal Structures

Course Credit	1.0
Grade Levels	10-12
Prerequisites	Aircraft Theory of Flight and Operations Airframe Systems

Aircraft Sheet Metal Structures is designed to equip students with the basic knowledge and skills needed for maintaining aircraft sheet metal structures by fabricating, inspecting, and installing sheet metal components. Safety and proper tool use are emphasized throughout this course. Specific topics include aluminum alloys, materials, corrosion, aircraft hardware, and sheet metal repair. Content requires students to use computational skills, interpret technical data, follow maintenance procedures, and utilize processes, tools, and materials.

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AIRCRAFT SHEET METAL STRUCTURES CONTENT STANDARDS

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Aluminum Alloys

1. Demonstrate maintenance procedures and repair techniques for aircraft sheet metal structures.
   Examples: dent or hole repair, corrosion control
   a. Describe characteristics and uses of aluminum alloy sheet metal in aircraft.
   b. Describe characteristics of clad aluminum alloy, including refining, manufacturing, and suitable types of clad aluminum for aviation use.
   c. Describe various nondestructive testing (NDT) methods used to assess corrosion and structural damage.
2. Explain the process of selecting the correct aluminum alloy for aircraft maintenance in given scenarios.

Materials

3. Create a list of materials needed for aircraft structure maintenance in a given scenario, including fasteners, safety wire, aircraft paint finish, sheet metal, rivets, and threaded fasteners.

Corrosion	4. Identify different types and causes of corrosion on aluminum alloys. 5. Describe how to remove and treat corrosion on aluminum, using manufacturer's approved practices.
Aircraft Hardware	6. Demonstrate the use, care, and installation of specialized hardware used to fasten aircraft structures, including permanent and temporary fasteners.
Sheet Metal Repairs	7. Fabricate parts needed for various types of sheet metal repairs. a. Repair a crack in a simulated aircraft skin. b. Construct a simulated removable airframe skin panel for inspection access. 8. Complete Federal Aviation Administration (FAA) forms documenting repairs.

Aircraft Theory of Flight and Operations

Course Credit	1.0
Grade Levels	9-12
Prerequisites	

Aircraft Theory of Flight and Operations is an introductory course designed to equip students with knowledge related to the theory of flight and aircraft operation. The course presents the various aspects of aerodynamics and how lift is created and maintained. Students construct models to aid in the transition from theory to application of concepts.

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AIRCRAFT THEORY OF FLIGHT AND OPERATIONS CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Aircraft Construction	1. Describe the two basic airframe types and the materials used in the construction of aircraft structure.
Theory of Flight	2. Explain the theory of flight, including the development of airfoils utilizing Bernoulli's principles, the relationship between pressure and rate of flow of a liquid through an orifice, the relationship of air velocity and pressure, and the effects of atmospheric temperature and humidity on airfoil lift. a. Describe basic aircraft structures and aerodynamics for fixed- and rotary-wing aircraft. b. Describe control surfaces for vertical, lateral, and longitudinal axes of fixed-wing aircraft, including rudder, elevator, aileron, and secondary flight controls. c. Identify types of airfoil control surfaces and systems, including related cockpit controls. d. Describe the effects of the angle of attack, angle of incidence, and dihedral angle on aircraft stability. e. Explain the importance of instruments to aircraft operation.

Aviation History	3. Outline historical events in the development of flight. *Examples: early mythology, balloon flight, theory development and Leonardo da Vinci's helicopter and parachute, glider flights, powered flight, rocket flight, wartime aviation development, airmail and passenger development, general aviation development, space development*
Aviation Environment	4. Describe safety precautions to be followed in and around aircraft during maintenance procedures.
Tools	5. Use, inspect, and clean various types of hand tools used for applications in aviation technology. 6. Calculate measurements of airplane parts using precision measuring devices, including Vernier calipers, micrometers, depth gauges, inside micrometers, and dial indicators. a. Compare measurements of parts to manufacturer's specifications to determine serviceability. b. Use a torque wrench to tighten nuts to manufacturer's specifications.
Aircraft Hardware and Materials	7. Describe the fasteners used in aviation, including specialty fasteners, and explain where and why they are used. 8. Describe various materials used in aircraft construction and indicate where they are used on the aircraft. *Examples: Explain where titanium, stainless steel, and silver are used.* a. Provide rationale for choosing metals to be used in particular areas of the aircraft.
Aircraft Model Construction	9. Construct an aircraft model, following specifications from blueprints and using appropriate tools. *Examples: doubler project, solid rib drawing, fabrication* a. Describe how features of an aircraft model relate to the theory of flight, aviation history, aircraft construction, and wing and landing gear configurations. b. Read and interpret sketches, schematics, and blueprints.

Aircraft Turbine Engines

Course Credit	1.0
Grade Levels	10-12
Prerequisites	Aircraft Theory of Flight and Operations Airframe Systems

Aircraft Turbine Engines presents knowledge and skills related to aircraft turbine operation and to aircraft inspection. Students are introduced to various tools, hardware, and materials used to maintain turbine engines, including the safe and proper use of tools. Students construct various aircraft models to aid in the transition from theory to application of concepts.

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AIRCRAFT TURBINE ENGINES
CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Turbine Theory	1. Explain how turbine engines work and how they differ from reciprocating engines.
Turbine Hardware	2. Inspect and install aircraft hardware related to turbine engines. *Examples: specialized fasteners, safety wire, cotter-pins* 3. Explain uses, care, and installation of turbine hardware.
Turbine Engine Tools	4. Demonstrate use and proper care of tools for aviation turbine engine inspection and maintenance. a. Use precision measuring tools to determine whether a turbine part is serviceable or unserviceable. b. Use torque wrenches to tighten turbine engine fasteners to manufacturer's specifications.

Turbine Engine Servicing	5. Perform basic turbine engine servicing techniques. *Examples: oil sampling, fuel control check, checking air screens and cyclonic filters* a. Pull an oil sample and prepare it to be sent for analysis. b. Drain and replace engine oil for a turbine engine, following manufacturer's specifications. c. Remove, clean, inspect, and reinstall the cyclonic filter in accordance with manufacturer's specifications. d. Clean and inspect air vent screens and replace as needed. e. Remove and reinstall the fuel control unit, and describe the process of testing the unit.
Turbine Engine Inspection	6. Explain the steps and key items to note during turbine engine inspection. *Examples: visual inspection; deformation, discoloring* 7. Inspect turbine engine parts for return to service. *Examples: compressor blades, turbine blades, bearings*

Airframe Systems

Course Credit	1.0
Grade Levels	9-12
Prerequisites	

Airframe Systems presents basic knowledge and skills related to aircraft systems rigging, weight, and balance. Safety is emphasized throughout this course. Students are introduced to the proper use of tools required for performing tasks associated with airframe systems, the use of Type Certificate Data Sheets, and techniques for rigging and balancing aircraft for maintenance activities.

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AIRFRAME SYSTEMS CONTENT STANDARDS

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Aircraft Hardware	1. Demonstrate the use, care, and installation of aircraft hardware related to airframe systems. a. Identify types, sizes, construction and finishes, and applications of aircraft hardware.
Materials	2. Select materials used in aircraft maintenance related to airframe systems.
Weight and Balance	3. Perform weight and balance calculations and plan cargo placement utilizing the aircraft manufacturer's weight and balance manual, Type Certificate Data Sheets (TCDS), and given aircraft weight limitations.. a. Simulate weighing an aircraft to determine whether it is within allowable limits listed on TCDS. b. Perform aircraft weight and balance calculations for various simulated configuration changes.
Cable Assembly and Repair	4. Construct simple aircraft systems components for simulated installation. a. Interpret aircraft cable tension adjustment charts. b. Adjust tension on aircraft cable turnbuckles. c. Assemble safety wire turnbuckles for aircraft cables. d. Fabricate or repair rigid aircraft tubing. e. Fabricate aircraft cable using a sleeve and thimble technique.

Aircraft Rigging and Assembly	
	5. Outline in detail the procedures for removing wings from an aircraft, moving the aircraft to a shop, and reassembling the wings. a. Assess primary and secondary controls for proper rigging for aircraft according to Type Certificate Data Sheets (TCDS). b. Outline in detail the procedures for disassembling an aircraft, removing it from a shop, and reassembling it to operable condition on a ramp.

Automotive Brake, Suspension, and Steering Repair I

Course Credit	1.0
Grade Levels	9-12
Prerequisites	Automotive Technology Foundations is required as a prerequisite or a corequisite.

Automotive Brake, Suspension, and Steering Repair I is designed to equip students with foundational knowledge and skills regarding automotive suspension, steering, and brake systems. Strong emphasis is placed on system and component operations. Standards are designed to equip students to diagnose and repair engine performance related systems. This course incorporates personal and environmental safety practices associated with clothing, eye protection, hand tools, power equipment, ventilation, and material and chemical handling. Local, state, and federal safety and environmental regulations will be followed.

Content standards are written to meet Automotive Service Excellence (ASE) Education Foundation requirements, which also specify task lists, program hours, and safety standards.

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2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork.
3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.
4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway.
5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork.
6. Apply literacy, mathematical, and scientific principles and precision measurements when diagnosing problems, making repairs.
7. Work independently, collaboratively, and in teams to explore concerns, find causes, and take appropriate action by applying principles of STEM.

AUTOMOTIVE BRAKE, SUSPENSION, AND STEERING REPAIR CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Suspension and Steering Systems

1. Disable and enable supplemental restraint system (SRS) and verify indicator lamp operation.
2. Identify and inspect suspension and steering system components and configurations including rack and pinion steering gear, inner tie rod ends (sockets), and bellows boots.
3. Flush, fill, and bleed power steering system using proper fluid type per manufacturer specification.
4. Remove, inspect, replace, and adjust power steering pump drive belt, power steering hoses, and fittings.
5. Inspect steering components including pitman arm, relay (center link and intermediate) rod, idler arm, mountings, steering linkage damper, tie rod ends (sockets), tie rod sleeves, clamps, power steering fluid level and condition, and inspect for fluid leakage.
6. Inspect upper and lower control arms shafts, rebound bumpers, track bar, strut rods and radius arms, upper and lower ball joints (with or without wear indicators), suspension system coil springs, spring insulators (silencers), torsion bars, and related mounts and bushings.
7. Perform front and rear suspension system maintenance and repair including struts, shocks, sway bars, and all bushings.
8. Inspect rear suspension system lateral links and arms (track bars), control (trailing) arms, leaf spring(s), spring insulators (silencers), shackles, brackets, bushings, center pins and bolts, and mounts.
9. Identify hybrid vehicle power steering system electrical circuits and safety precautions, and inspect electric power steering assist system.
10. Describe the functions of suspension and steering control systems and components.
    Examples: active suspension, stability control

Wheel Alignment	11. Perform pre-alignment inspection, measure vehicle ride height, and describe alignment angles (camber, caster and toe).
Wheels and Tires	12. Perform tire inspection and maintenance including identification of tire wear patterns, while interpreting and applying information indicated on the placard and label. 13. Dismount, inspect, and remount tire on wheel to balance wheel and tire assembly, including wheels equipped with tire pressure monitoring system sensors. 14. Inspect tire and wheel assembly for air loss and repair tire following vehicle manufacturer's approved procedure. 15. Identify and calibrate indirect and direct tire pressure monitoring systems (TPMS) and verify operation of instrument panel lamps. a. Demonstrate removal and replacement of sensors in a tire pressure monitoring system (TPMS) including relearn procedure.
General Brakes	16. Describe procedure for performing a road test to check brake system operation, including an anti-lock brake system (ABS). 17. Install wheel and torque lug nuts. 18. Identify brake system components and configuration and describe proper brake pedal height, travel, and feel.
Hydraulic System	19. Check the master cylinder for external leaks and proper operation and inspect brake lines, flexible hoses, and fittings for leaks, dents, kinks, rust, cracks, bulging, wear, and loose fittings or supports. 20. Select, handle, store, and fill brake fluids to proper level using proper fluid type per manufacturer specification.

	21. Identify components of hydraulic brake warning light systems. 22. Bleed and flush brake system, and test brake fluid for contamination.
Drum Brakes	23. Remove, clean, and inspect brake drum; inspect shoes, springs, pins, clips, levers, adjusters and self-adjusters, other related brake hardware and backing support plates; measure brake drum diameter to determine serviceability; and refinish brake drum as needed. 24. Inspect wheel cylinders for leaks and proper operation and remove and replace as needed. 25. Pre-adjust brake shoes and parking brake; install brake drums or drum and hub assemblies and wheel bearings; make final checks and adjustments.
Disc Brakes	26. Perform disc brake maintenance and repair including removing and cleaning caliper assembly, inspecting for leaks and damage to determine needed action, and lubricating slide pins. 27. Remove and replace rotor including cleaning and inspecting rotor and mounting surface of disc brakes and measuring rotor thickness, thickness variation, and lateral runout to determine necessary action. 28. Refinish rotor on and off vehicle, measure final rotor thickness, and compare measurements with specifications. 29. Retract and re-adjust caliper piston on an integral parking brake system. 30. Check brake pad wear indicator to determine necessary action. 31. Explain the importance of operating vehicles to burnish or break in replacement brake pads according to manufacturer's recommendation.

Power-Assist Units	32. Check brake pedal travel with and without engine running to verify proper power booster operation. 33. Identify components of the brake power assist system (vacuum and hydraulic) and check vacuum supply (manifold or auxiliary pump) to vacuum-type power booster.
Related Braking Systems	34. Remove, clean, inspect, repack, and install wheel bearings, replace seals, install hubs and adjust bearings, replace wheel bearing and race as needed. 35. Evaluate parking brake system components for wear, binding, and corrosion; clean, lubricate, adjust and replace as needed. a. Check parking brake operation and parking brake indicator light system operation to determine necessary action. 36. Check operation of brake stop light system. 37. Describe the operation of a regenerative braking system.
Traction Control and Stability Control Systems	38. Identify traction control and vehicle stability control system components.

Automotive Electrical Components I

Course Credit	1.0
Grade Levels	9-12
Prerequisites	Automotive Technology Foundations is required as a prerequisite or a corequisite.

Automotive Electrical Components I is designed to equip students with foundational knowledge and skills regarding safety, electrical, and electronics systems. Standards are designed to equip students to diagnose and repair engine performance related electrical systems. This course incorporates personal and environmental safety practices associated with clothing, eye protection, hand tools, power equipment, ventilation, and the handling, storage, and disposal of chemicals and materials in accordance with local, state, and federal safety and environmental regulations.

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AUTOMOTIVE ELECTRICAL COMPONENTS CONTENT STANDARDS

Each content standard completes the stem *"**Students will**…"*

General Electrical and Electronic Systems	1. Identify electrical and electronic system components and configuration. 2. Solve for unknown values in electrical and electronic series, parallel, and series-parallel circuits using principles of electricity (Ohm's law). 3. Use wiring diagrams to trace electrical and electronic circuits. 4. Demonstrate proper use of a digital multimeter (DMM), test lights, and fused jumper wires when measuring source voltage, voltage drop (including grounds), current flow, and resistance, testing fusible links, circuit breakers, and fuses. 5. Explain causes and effects from shorts, grounds, opens, and resistance problems in electrical and electronic circuits. 6. Measure key-off battery drain (parasitic draw). 7. Repair and replace connectors, terminal ends, and wiring of electrical/electronic systems, including solder repair.
Starting and Charging System	8. Inspect and test components of starting and charging systems by making voltage and current draw and output measurements. 9. Remove and install starter/generator (alternator) in a vehicle. 10. Describe the operation of an automatic idle-stop and start-stop, keyless entry, and remote start systems.

Lighting, Instrument Cluster, Driver Information, and Body Electrical Systems	11. Inspect and replace interior and exterior lamps including sockets. 12. Aim headlights. 13. Disable and enable supplemental restraint system (SRS) and verify indicator lamp operation. 14. Remove and reinstall the door panel. 15. Verify windshield wiper and washer operation; replace wiper blades.

Automotive Engine Repair and Performance I

Course Credit	1.0
Grade Levels	9-12
Prerequisites	Automotive Technology Foundations is required as a prerequisite or a corequisite.

Automotive Engine Repair and Performance I is designed to equip students with foundational knowledge and skills regarding safety, engines, and engine performance. Standards are designed to equip students to diagnose and repair engine performance related systems. This course incorporates personal and environmental safety practices associated with clothing, eye protection, hand tools, power equipment, ventilation, and the handling, storage, and disposal of chemicals and materials in accordance with local, state, and federal safety and environmental regulations.

Content standards are written to meet Automotive Service Excellence (ASE) Education Foundation requirements, which also specify task lists, program hours, and safety standards.

Career and Technical Student Organizations are integral, co-curricular components of each career and technical education course. These organizations enhance classroom instruction while helping students develop leadership abilities, expand workplace-readiness skills, and access opportunities for personal and professional growth. Students in the Transportation, Distribution and Logistics career cluster affiliate with SkillsUSA.

Foundational standards, shown in the table below, are an important part of every course. Through these standards, students learn and apply safety concepts, explore career opportunities and requirements, practice the skills needed to succeed in the workplace, develop leadership qualities and take advantage of the opportunities afforded by Career and Technical Student Organizations (CTSOs), and learn and practice essential digital literacy skills. The foundational standards are to be incorporated throughout the course.

Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork.

	3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing. 4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway. 5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork. 6. Apply literacy, mathematical, and scientific principles and precision measurements when diagnosing problems and making repairs. 7. Work independently, collaboratively, and in teams to explore concerns, find causes, and take appropriate action by applying principles of STEM.

AUTOMOTIVE ENGINE REPAIR AND PERFORMANCE I CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

General Engine Repair	1. Inspect engine assembly for fuel, oil, coolant, and other leaks to determine necessary action. 2. Install engine covers, using gaskets, seals, and sealers as required. 3. Verify engine mechanical timing.
Cylinder Head and Valve Train	4. Identify components of the cylinder head and valve train, and adjust valves (mechanical or hydraulic lifters).

Lubrication and Cooling Systems	5. Perform cooling system pressure and dye tests to identify leaks, including checking coolant condition and level, inspecting and testing radiator, pressure cap, coolant recovery tank, heater core, and galley plugs, to determine necessary action. 6. Remove, inspect, and replace the thermostat and gasket and seal. 7. Inspect and test coolant. a. Drain and recover coolant. b. Flush and refill cooling system. c. Select proper fluid type per manufacturer specification for cooling systems. d. Bleed air from cooling systems as required. 8. Identify components of the lubrication and cooling systems.
Engine Performance	9. Perform tests for engine absolute manifold pressure (vacuum and boost), power balance, and cylinder leakage and compression (cranking and running) and document results. 10. Remove and replace spark plugs and inspect secondary ignition components for wear and damage.
Computerized Controls	11. Retrieve and record diagnostic trouble codes (DTC), on-board diagnostics monitor status, and freeze frame data, and clear codes when applicable. 12. Describe the use of on-board diagnostics monitors for repair verification.
Fuel, Air Induction, and Exhaust Systems	13. Inspect, service, or replace fuel and air filters, filter housings, and intake ductwork. 14. Inspect integrity of the exhaust manifold, exhaust pipes, muffler(s), exhaust system hangers, brackets, clamps, catalytic converter(s), resonator(s), tail pipe(s), and heat shields to determine necessary action. 15. Check and refill diesel exhaust fluid (DEF).

Emissions Control Systems	16. Inspect, test, and service positive crankcase ventilation (PCV) filter and breather, valve, tubes, orifices, and hoses and perform necessary action.

Automotive Brake, Suspension, and Steering Repair II

Course Credit	1.0
Grade Levels	10-12
Prerequisites	Automotive Brake, Suspension, and Steering Repair I

Automotive Brake, Suspension, and Steering Repair II is designed to equip students with service knowledge and skills regarding diagnosis and repair of automotive brake, steering, and suspension systems. This course incorporates standards that address personal and environmental safety practices associated with clothing, eye protection, hand tools, power equipment, ventilation, and the handling, storage, and disposal of chemicals and materials in accordance with local, state, and federal safety and environmental regulations.

Content standards are written to meet Automotive Service Excellence (ASE) Education Foundation requirements, which also specify task lists, program hours, and safety standards.

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Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork. 3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing. 4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway. 5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork. 6. Apply literacy, mathematical, and scientific principles and precision measurements when diagnosing problems and making repairs. 7. Work independently, collaboratively, and in teams to explore concerns, find causes, and take appropriate action by applying principles of STEM.

AUTOMOTIVE BRAKE, SUSPENSION, AND STEERING REPAIR II CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

General Brakes	
	1. Identify and interpret brake system concerns to determine needed action. a. Diagnose poor stopping, pulling, or dragging caused by malfunctions in the hydraulic system to determine needed action.

Hydraulic System Diagnosis and Repair	2. Diagnose pressure concerns in the brake system using hydraulic principles (Pascal's law). 3. Measure brake pedal height, travel, and free play (as applicable) to determine needed action. 4. Remove, bench bleed, and reinstall the master cylinder. 5. Replace brake lines, hoses, fittings, and supports. 6. Fabricate brake lines using approved material and flaring procedures, including double flare and ISO types. 7. Inspect, test, and replace components of the brake warning light system.
Drum Brake Diagnosis and Repair	8. Determine causes and remedial action for poor stopping, noise, vibration, pulling, grabbing, dragging, or pedal pulsation. 9. Remove, clean, and inspect brake drums, measure diameter of brake drums, and determine serviceability of brake drums.
Suspension and Steering Systems	10. Identify and interpret suspension and steering system concerns to determine needed action. 11. Remove, inspect, service, and replace front and rear wheel bearings.
Wheels and Tires Diagnosis	12. Diagnose wheel vibration, shimmy, and noise and tire pull problems to determine needed action. 13. Measure wheel, tire, axle flange, and hub runout to determine needed action.
Wheel Alignment	14. Diagnose vehicle wander, drift, pull, hard steering, bump steer, memory steer, torque steer, and steering return concerns to determine needed action.

Diagnosis, Adjustment, and Repair	15. Perform pre-alignment inspection, including measuring vehicle ride height, to determine needed action. 16. Prepare vehicle for wheel alignment on alignment machine, perform four-wheel alignment by checking and adjusting front and rear wheel caster, camber, and toe as required and center steering wheel. 17. Check toe-out on turns (turning radius), steering axis inclination (SAI) and included angle, rear wheel thrust angle, front wheel setback, and front and rear cradle (subframe) alignment to determine needed action. 18. Reset steering angle sensor.
Steering Systems Diagnosis and Repair	19. Remove and replace steering wheel and center and time supplemental restraint system (SRS) coil (clock spring). 20. Diagnose steering column noises, looseness, and binding concerns, including tilt and telescoping mechanisms, to determine needed action. 21. Diagnose power steering gear binding, uneven turning effort, looseness, hard steering, and noise concerns to determine needed action. 22. Inspect steering shaft universal joint(s), flexible coupling(s), collapsible column, lock cylinder mechanism, and steering wheel to determine needed action. 23. Remove and replace rack and pinion steering gear and inspect mounting bushings and brackets. 24. Remove and reinstall power steering pump, press fit power steering pump pulley, and check pulley and belt alignment.
Suspension Systems Diagnosis and Repair	25. Diagnose short and long arm and strut suspension system noises, body sway, and uneven ride height concerns to determine needed action. 26. Inspect, remove, and replace strut rods, bushings and steering knuckle assemblies.

Automotive Electrical Components II

Course Credit	1.0
Grade Levels	10-12
Prerequisites	Automotive Electrical Components I

Automotive Electrical Components II is designed to equip students with service knowledge and skills regarding safety, electrical, and electronics systems. Standards are designed to equip students to diagnose and repair electrical systems related to engine performance. This course incorporates personal and environmental safety practices associated with clothing and eye protection, hand tools, power equipment, ventilation, and the handling, storage, and disposal of chemicals and materials in accordance with local, state, and federal safety and environmental regulations.

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Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards

1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces.
2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork.
3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.
4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway.
5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork.
6. Apply literacy, mathematical, and scientific principles and precision measurements when diagnosing problems and making repairs.
7. Work independently, collaboratively, and in teams to explore concerns, find causes, and take appropriate action by applying principles of STEM.

AUTOMOTIVE ELECTRICAL COMPONENTS II
CONTENT STANDARDS

Each content standard completes the stem *"**Students will**…"*

Charging System Electrical Accessories	1. Diagnose charging system problems for causes of undercharge, no-charge, or overcharge condition. a. Diagnose the causes of brighter-than-normal, intermittent, dim, or no light operation. 2. Inspect and test gauges and gauge sending units for causes of abnormal readings to determine needed action. 3. Diagnose the causes of incorrect operation of warning devices and other driver information systems to determine needed action.
Advanced Electrical	4. Assess the operation of comfort and convenience accessories and related circuits to determine needed repairs. *Examples: power window, power seats, pedal height, power locks, truck locks, remote start, moonroof, sun roof, sun shade, remote keyless entry, voice activation, steering wheel controls, back-up camera, park assist, cruise control, auto-dimming headlamps* 5. Assess the operation of security and anti-theft systems and related circuits to determine needed repairs. *Examples: theft deterrent, door locks, remote keyless entry, remote start, starter or fuel disable* 6. Assess the operation of entertainment components and related circuits to determine needed repairs. *Examples: radio, DVD, remote CD changer, navigation, amplifiers, speakers, antennas, voice-activated accessories* 7. Inspect operation of safety systems and related circuits to determine needed repairs. *Examples: horn, airbags, seat belt pretensioners, occupant classification, wipers, washers, speed control and collision avoidance, heads-up display, park assist, back-up camera* 8. Assess body electronic systems circuits using a scan tool and check for module communication errors (data bus systems) to determine needed action. 9. Describe the process for software transfer, software updates, or reprogramming of electronic modules.

Automotive Engine Repair and Performance II

Course Credit	1.0
Grade Levels	10-12
Prerequisites	Automotive Engine Repair and Performance I

Automotive Engine Performance II is designed to equip students with service knowledge and skills regarding safety, engines, and engine performance. Standards are designed to equip students to diagnose and repair systems related to engine performance. This course incorporates standards that address personal and environmental safety practices associated with clothing and eye protection, hand tools, power equipment, ventilation, and the handling, storage, and disposal of chemicals and materials in accordance with local, state, and federal safety and environmental regulations.

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Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards

1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces.
2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork.
3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.
4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway.
5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork.
6. Apply literacy, mathematical, and scientific principles and precision measurements when diagnosing problems and making repairs.
7. Work independently, collaboratively, and in teams to explore concerns, find causes, and take appropriate action by applying principles of STEM.

AUTOMOTIVE ENGINE REPAIR AND PERFORMANCE II
CONTENT STANDARDS

Each content standard completes the stem *"**Students will**…"*

Engine Repair	1. Inspect, remove, and replace engine mounts. 2. Remove cylinder head, inspect gasket condition, install cylinder head and gasket, and tighten according to manufacturer's specifications and procedures. 3. Clean and visually inspect a cylinder head for cracks and check gasket surface areas for warpage and surface finish. 4. Inspect pushrods, rocker arms, rocker arm pivots, and shafts for wear, bending, cracks, looseness, and blocked oil passages (orifices). 5. Inspect and replace the camshaft and drive belt and chain. 6. Check drive gear wear and backlash, end play, sprocket and chain wear, overhead cam drive sprocket(s), drive belt(s), belt tension, tensioners, camshaft reluctor ring and tone-wheel, and valve timing components. 7. Verify correct camshaft timing (including VVT systems) using vehicle service information and establish camshaft position sensor indexing. 8. Remove, inspect, and replace crankshaft vibration damper (harmonic balancer).
Engine Cooling	9. Identify and correct causes of engine overheating including inspection and replacement of water pump and radiator as needed. 10. Inspect and correct functions of test fan(s), fan clutch (electrical or mechanical), fan shroud, and air dam issues. 11. Inspect auxiliary coolers to determine needed action. 12. Inspect, test, and replace oil temperature and pressure switches and sensors.

Engine Performance

13. Identify and interpret engine performance concerns, abnormal engine noises, or vibrations to determine needed action.

14. Diagnose the cause of excessive oil and coolant use by identifying abnormal symptoms.
    Examples: unusual exhaust color, odor, or sound

15. Perform active tests of actuators using a scan tool to determine needed action.

16. Diagnose ignition system problems to determine needed action.
    Examples: not starting, hard starting, engine misfire, poor driveability, spark knock, power loss, poor mileage, emissions concerns

17. Inspect and test crankshaft and camshaft position sensor(s) to determine needed action.

18. Inspect, test, and replace modules and reprogram and initialize as needed.

19. Check fuel for contaminants while inspecting and testing fuel pump(s).
    a. Evaluate pump control system for pressure, regulation, and volume to determine needed action.

20. Inspect throttle body, air induction system, intake manifold, and gaskets for vacuum leaks and unmetered air.

21. Inspect, test, and replace fuel injectors and verify idle control operation.

22. Perform exhaust system back-pressure test to determine needed action.

23. Diagnose oil leaks, emissions, and driveability concerns caused by the positive crankcase ventilation (PCV) system to determine needed action.

24. Inspect, test, service and replace electrical or electronic sensors, controls, wiring, tubing, exhaust passages, vacuum and pressure controls, filters, and hoses of exhaust gas recirculation (EGR) system to determine needed action.

25. Inspect and test electrical and electronically-operated components and circuits of secondary air injection systems to determine needed action.

26. Diagnose emissions and driveability concerns caused by the catalytic converter system to determine needed action.

27. Interpret diagnostic trouble codes (DTCs) and scan tool data related to the emissions control systems to determine needed action.

Automotive Technology Foundations

Course Credit	1.0
Grade Levels	9-12
Prerequisites	

Automotive Technology Foundations is designed to equip students with basic knowledge and skills regarding safety, engine repair, automatic transmissions, and manual drive trains. A major focus of this course is system and component operations. Standards are designed to equip students to diagnose and repair engine performance related systems. Because it is the foundation for all other automotive technology courses, Automotive Technology Foundations is a prerequisite or corequisite for Level I courses.

This course incorporates personal and environmental safety practices associated with clothing and eye protection, hand tools, power equipment, ventilation, and the handling, storage, and disposal of chemicals and materials in accordance with local, state, and federal safety and environmental regulations.

Content standards are written to meet Automotive Service Excellence (ASE) Education Foundation requirements, which also specify task lists, program hours, and safety standards.

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Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces.
	2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity,

positive work ethic, problem-solving, time management, and teamwork.

3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.
4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway.
5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork.
6. Apply literacy, mathematical, and scientific principles and precision measurements when diagnosing problems and making repairs.
7. Work independently, collaboratively, and in teams to explore concerns, find causes, and take appropriate action by applying principles of STEM.

AUTOMOTIVE TECHNOLOGY FOUNDATIONS CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Safety, Hand Tools, and Shop Equipment

1. Identify and demonstrate proper use of marked safety areas including vehicle traffic, fire extinguisher locations, evacuation routes, eyewash stations and material Safety Data Sheets in automotive factories and facilities.
2. Explain the safety aspects of supplemental restraint systems (SRS), electronic brake control systems, high intensity discharge (HID) lamps, ignition and fuel injection high voltage circuits for both traditional and hybrid vehicles.
3. Demonstrate safe workshop practices while using tools and equipment including floor jacks, jack stands, overhead vehicle lifts, and exhaust removal systems.

	4. Identify hand tools appropriate to the operation at hand (metric and standard) including precision measurement tools. *Examples: tape measure, vernier calipers, micrometers, diameter and pitch gauges* a. Demonstrate proper cleaning, sorting, and storage of tools.
Preparing Vehicle for Service	5. Demonstrate the use, removal, and storage or disposal of fender and steering wheel covers and floor mats. 6. Complete work order forms that include customer information; vehicle identifying information; customer concern(s), cause, and correction (3Cs); related service history; and technical service bulletins.
Transmission and Transaxle	7. Identify automatic and manual drive train components and configurations. a. Check fluid level in a transmission or a transaxle equipped with or without a dip-stick including assessment of the fluid condition, inspection for leakage at seals, gaskets, drain, refilling fluid and replacement of filters. 8. Inspect, adjust, and replace external manual valve shift linkage, transmission range sensor and switch, and park and neutral position switch. 9. Inspect, replace, and align powertrain mounts. 10. Drain and replace fluid and filter(s) according to manufacturer specifications. 11. Describe the operational characteristics of a continuously variable transmission (CVT), an electronically controlled manual transmission, and a hybrid vehicle drivetrain.
Manual Drivetrain and Axles	12. Check and adjust clutch master cylinder fluid level, using fluid type specified by the manufacturer, and inspect for leaks. 13. Inspect, remove, and replace bearings, hubs, and seals for drive shafts, universal joints, and constant-velocity joints, including front-wheel, rear-wheel, all-wheel, and four-wheel drives, locking hubs, and wheel studs.

	14. Check for leaks at drive assembly, transfer case and differential seals, check vents, fluid level, drain, and refill with manufacturer specified fluid.
Electrical Systems	15. Perform battery replacement including performance of slow and fast charge, inspection of connections, attachment of hardware, restoration of memory functions, and initializing modules.
HVAC	16. Inspect A/C and heater ducts, doors, hoses, cabin filters, and outlets to determine the cause of heating, ventilation, and air conditioning system odors.
Engine Repair	17. Verify instrument panel warning indicators and reset maintenance reminders. 18. Perform fastener and thread repair. 19. Inspect pulleys, idlers, tensioners, and belts of engine-driven accessories. 20. Change engine oil and filters.
Engine Performance	21. Retrieve and clear diagnostic trouble codes using a scan tool.

Career Pathway Project in Transportation, Distribution and Logistics

Course Credit	1.0
Grade Levels	10-12
Prerequisites	Successful completion of two or more courses in the Transportation, Distribution and Logistics career cluster

Career Pathway Project (CPP) in Transportation, Distribution and Logistics is a capstone course designed for students who have completed two or more Career and Technical Education credits in the Transportation, Distribution and Logistics career cluster. This course allows students to utilize the knowledge and skills gained through their secondary coursework in a practical, real-world experience that showcases their learning. It provides an opportunity for a student to choose an area of interest and explore it in depth while demonstrating problem-solving, decision-making, and independent-learning skills. The CPP contributes to an educational plan of challenging courses and practical experiences that prepares students for the workplace or for pursuing further education.

During the CPP, the student works with his or her coordinating teacher, academic teachers, and a product or process mentor who has expertise in the student's field of study. At the conclusion of the CPP, the student presents or demonstrates the knowledge gained to an audience consisting of the coordinating teacher, academic teachers, the mentor, peers, and community and business representatives.

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Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards

1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces.
2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork.
3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.
4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway.
5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork.
6. Apply literacy, mathematical, and scientific principles and precision measurements when diagnosing problems and making repairs.
7. Work independently, collaboratively, and in teams to explore concerns, find causes, and take appropriate action by applying principles of STEM.

CAREER PATHWAY PROJECT IN TRANSPORTATION, DISTRIBUTION AND LOGISTICS CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Project Proposal	1. Create a formal, narrative proposal that communicates a specific concept, creates a process, or develops a product related to transportation, distribution, and logistics.
Research	2. Conduct independent research related to the selected transportation, distribution, and logistics project. *Examples:"Impact of Driver Shortage on Supply Chain," "Using Predictive Networks to Accelerate Productivity," "The Importance of Technician Training in Response to Advancing Vehicle Technology,""Anticipating Repair of Telematics," "Mitigating Effects of Overcapacity and Increasing Fuel Costs," "Benefits of Water-based Paint Over Solvent-based Paint"*
Project Report	3. Write a detailed report on the chosen transportation, distribution, and logistics project, following established conventions for format, grammar, and usage.
Presentation	4. Produce an original multimedia presentation based upon transportation, distribution, and logistics project research and results. *Examples: producing a digital presentation and oral explanation, creating a documentary, presenting a project model and explanation*
Portfolio	5. Design and create a project portfolio that documents all components of the transportation, distribution, and logistics project and demonstrates the validity of the process.

Commercial Transportation

Course Credit	1.0
Grade Levels	12
Prerequisites	

Commercial Transportation presents skills and knowledge needed for entry into the commercial trucking industry. Students explore career opportunities and the requirements for becoming a professional commercial vehicle operator. Standards are designed to equip students to meet criteria for the Commercial Learner's Permit (CLP) written exam in preparation for behind-the-wheel training at a company or educational program.

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Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork. 3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.

4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway.
5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork.
6. Apply literacy, mathematical, and scientific principles and precision measurements when diagnosing problems and making repairs.
7. Work independently, collaboratively, and in teams to explore concerns, find causes, and take appropriate action by applying principles of STEM.

COMMERCIAL TRANSPORTATION CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Licensing

1. Summarize the procedures for obtaining a CDL (commercial driver's license) and explain the importance of compliance with licensing regulations.
2. Compare and contrast the classifications of commercial driving licenses.
   Examples: Class A, Class B, Class C, endorsements
3. Identify industry trends and report findings through a media presentation.
4. Describe a driver's personal and professional consequences of improper operation.

Regulations

5. Explain the importance and role of federal agencies in establishing the rules of a safe work environment in commercial transport.
   Example: U.S. Department of Transportation regulations for pre-trip inspections
6. Summarize hours of service regulations, including legal limits of operation, and complete a driver's record of duty status including electronic and paper logs.
7. Identify signs of human trafficking and explain how to respond to suspected trafficking incidents.

Safety

8. Demonstrate a systematic procedure to conduct and document pre-trip and post-trip inspections.
9. Classify hazardous materials according to Federal Motor Carrier Safety Administration regulations and summarize rules for transporting each type.
10. Determine which types of hazardous materials can be combined for shipping in given scenarios.
11. Describe the attributes of a safe driver.
12. Describe the challenges and cautions of driving at night, in extreme weather, and under hazardous conditions.
13. Summarize common practices of fire and electrical safety.
14. Summarize procedures for responding to common emergencies.
    Examples: brake failure, tire failure, skid control and recovery, fire, accident
15. Explain the importance of preventive maintenance and servicing to avoid breakdowns and accidents.
16. Demonstrate industry-specific body movements to reduce the risk of injury during operation of commercial vehicles.
    Example: Use intra-abdominal pressure while lifting.

Vehicle Operation	17. Identify the parts and systems of a commercial vehicle. 18. Describe the step-by-step procedures used to couple and uncouple a commercial combination unit, including double and triple trailers. 19. Demonstrate basic vehicle control maneuvers in a simulation. *Examples: shifting, backing, braking, approaching caution zones* 20. Demonstrate procedures for communicating intentions to other drivers. 21. Explain the importance of speed and space management when operating a commercial vehicle.
Air Brakes	22. Identify the parts of an air brake system and list the function of each part. 23. Describe the process for air brake system inspection.
Cargo	24. Demonstrate proper cargo handling and freight documentation. *Examples: gross combination weight, axle weight, gross vehicle weight* 25. Describe procedures for securing and balancing various types of cargo. 26. Summarize the major security procedures for moving goods across U.S. borders.
Route Planning	27. Plan the most effective and efficient legal route of travel in a given scenario.

CTE Lab in Transportation, Distribution and Logistics

Course Credit	1.0
Grade Levels	10-12
Prerequisites	Successful completion of any two courses in the Transportation, Distribution and Logistics career cluster

CTE Lab in Transportation, Distribution and Logistics is designed to enhance the student's general understanding and mastery of content in the cluster. This course is designed as a learning laboratory to support students' individual interests and goals. This laboratory may take place in a traditional classroom, in an industry setting, or in a virtual learning environment.

Career and Technical Student Organizations are integral, co-curricular components of each career and technical education course. These organizations enhance classroom instruction while helping students develop leadership abilities, expand workplace-readiness skills, and access opportunities for personal and professional growth. Students in the Transportation, Distribution and Logistics career cluster affiliate with SkillsUSA.

Foundational standards, shown in the table below, are an important part of every course. Through these standards, students learn and apply safety concepts, explore career opportunities and requirements, practice the skills needed to succeed in the workplace, develop leadership qualities and take advantage of the opportunities afforded by Career and Technical Student Organizations (CTSOs), and learn and practice essential digital literacy skills. The foundational standards are to be incorporated throughout the course.

Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork. 3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.

4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway.
5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork.
6. Apply literacy, mathematical, and scientific principles and precision measurements when diagnosing problems and making repairs.
7. Work independently, collaboratively, and in teams to explore concerns, find causes, and take appropriate action by applying principles of STEM.

CTE LAB IN TRANSPORTATION, DISTRIBUTION AND LOGISTICS CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Occupational Expertise

1. Demonstrate expertise in a specific occupation within the Transportation, Distribution and Logistics cluster.
    a. Meet benchmarks selected by the instructor from the appropriate curriculum frameworks, based upon the individual student's assessed needs.

Research and Investigation

2. Conduct investigative research on a selected topic related to transportation, distribution, and logistics using approved research methodology, interpreting findings and preparing a presentation to defend results.
    a. Select an investigative study based on research, interest, and prior knowledge.
    b. Collect, organize, and analyze data accurately and precisely.
    c. Design procedures to test the research.
    d. Report, display, and defend the results of investigations to audiences that may include professionals and technical experts.

	3. Demonstrate higher order critical thinking and reasoning skills appropriate for a career in transportation, distribution, and logistics. a. Use mathematical and scientific skills to solve problems encountered in the chosen occupation. b. Locate, evaluate, and interpret information related to the chosen occupation, in oral, print, and digital formats. c. Analyze and apply data and measurements to solve problems and interpret documents.
Leadership	4. Apply enhanced leadership and professional career skills needed in a transportation, distribution, and logistics career. a. Develop and deliver a professional presentation offering potential solutions to a current issue. b. Practice leadership and career skills in job placement, job shadowing, entrepreneurship, or internship or by obtaining an industry-recognized credential of value. c. Participate in leadership development opportunities available through SkillsUSA and/or professional organizations in the transportation, distribution, and logistics field. d. Demonstrate written and oral communication skills through presentations, public speaking, live or virtual interviews, and an employment portfolio.

Damage Analysis, Estimating, and Customer Service

Course Credit	1.0
Grade Levels	10-12
Prerequisites	Non-Structural Welding, Cutting, and Joining

Damage Analysis, Estimating, and Customer Service presents service knowledge and skills for analyzing collision damage to vehicles, estimating repair costs, determining repair sequences and procedures, and providing effective customer service to vehicle owners and insurance clients.

Content standards are written to meet Automotive Service Excellence (ASE) Education Foundation requirements, which also specify task lists, program hours, and safety standards.

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Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork. 3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.

4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway.
5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork.
6. Apply literacy, mathematical, and scientific principles and precision measurements when diagnosing problems and making repairs.
7. Work independently, collaboratively, and in teams to explore concerns, find causes, and take appropriate action by applying principles of STEM.

DAMAGE ANALYSIS, ESTIMATING, AND CUSTOMER SERVICE CONTENT STANDARDS

Each content standard completes the stem *"**Students will**…"*

Damage Analysis

1. Position the vehicle for inspection under proper lighting and take photos to identify the vehicle and document damage.
2. Identify and analyze damaged components to determine appropriate methods for overall repairs.
3. Gather details of the incident or accident necessary to determine the direction, point(s) of impact, and extent of direct, indirect, and inertia damage.
4. Identify and record pre-existing damage and prior repairs.
5. Identify structural damage visually and by using measuring tools and equipment.
6. Perform visual inspection of non-structural components to determine parts, components, material type(s), and procedures necessary for a proper repair.

7. Identify physical damage to suspension, electrical, and mechanical components, safety systems, and interior components.
8. Identify add-on accessories, modifications, and one-time use components.
   Example: airbags

Estimating

9. Determine and record customer and vehicle information, including VIN, make, model, mileage, trim level, and paint code.
10. Identify and inspect safety systems; determine precautions and replacement items as required per OEM.
11. Determine and apply appropriate estimating sequence, terminology, and procedure pages.
12. Apply footnotes, headnotes, and line notes to estimates as needed.
13. Identify operations requiring labor value judgment.
14. Select appropriate labor code for each operation (structural, non-structural, mechanical, and refinish).
15. Select and price OEM parts, optional OEM parts, aftermarket parts, recycled and used parts, and remanufactured, rebuilt, and reconditioned parts; verify availability, compatibility, and condition.
16. Determine necessary sublet operations, overlap, included, non-included, material, and changes, applying math skills to determine totals.
17. Compare computer-generated and manually-written estimates using different information provider systems.
18. Specify procedures to restore corrosion protection, establish labor values, and calculate material charges.
19. Compare the approximate retail and repair value and the actual cost of repair and replacement operations to determine the cost effectiveness of the repair.
20. Review damage reports and analyze damage to determine appropriate repair methods.

Vehicle Construction and Parts Identification	21. Identify type of vehicle construction (unibody, body-on-frame) and impact energy absorbing components. 22. Determine repairability or replacement procedures for different types of substrates and glass components. *Examples: steel types, aluminum, magnesium, plastic, composites* 23. Identify add-on accessories. *Examples: step bars, bug shields, vent visors, oversized wheels, brush guards*
Customer Relations and Sales Skills	24. Listen to, collect information about, and identify customer's and client's concerns, needs and expectations. 25. Resolve issues with dissatisfied customers and clients. 26. Identify the client's and customer's preferred communication methods and follow up to keep them informed about parts and the repair process. 27. Explain basic claims handling procedures to customer and client and provide and review terms and conditions of warranty, technical, and consumer protection information. 28. Estimate and communicate the expected duration of out-of-service time. 29. Interpret and explain estimates to customer and client.

Diesel Technology A

Course Credit	1.0
Grade Levels	9-12
Prerequisites	

Diesel Technology A presents content related to entry-level training for diesel brakes and cab. The course competencies include the tasks that are required to satisfy ASE Education IMMR level training for Area 3 (Brakes) and Area 7 (Cab). Content standards are written to meet Automotive Service Excellence (ASE) Education Foundation requirements, which also specify task lists, program hours, and safety standards.

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Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork. 3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing. 4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway.

	5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork. 6. Apply literacy, mathematical, and scientific principles and precision measurements when diagnosing problems and making repairs. 7. Work independently, collaboratively, and in teams to explore concerns, find causes, and take appropriate action by applying principles of STEM.

DIESEL TECHNOLOGY A
CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Vehicle Research	1. Research vehicle brakes and cab service information, including fluid type, vehicle service history, service precautions, and technical service bulletins.
General Brakes	2. Identify brake system components and configurations, including air and hydraulic systems, parking brake, power assist, and vehicle dynamic brake systems, and identify brake performance problems caused by the mechanical and foundation brake system (air and hydraulic).
Air Brakes - Air Supply and Service Systems	3. Inspect air supply system components. *Examples: compressor, governor, air drier, tanks, and lines; service system components including lines, fittings, mountings, and valves (hand brake and trailer control, brake relay, quick release, tractor protection, emergency and spring brake control and modulator, pressure relief and safety)* 4. Verify proper gauge operation and readings, verify operation of low pressure warning alarm, perform air supply system tests, drain air tanks, and check for contamination. *Example: checking air supply system for pressure build-up, governor settings, and leakage*

Air Brakes - Mechanical and Foundation Brake System	5. Inspect service brake chambers, diaphragms, clamps, springs, pushrods, clevises, mounting brackets, and rotor and mounting surface, and measure rotor thickness, thickness variation, and lateral runout to determine needed action. 6. Identify slack adjuster type and inspect slack adjusters to determine needed action. 7. Check camshafts (S-cams), tubes, rollers, bushings, seals, spacers, retainers, brake spiders, shields, anchor pins, and springs to determine needed action. 8. Inspect, clean, and adjust air disc brake caliper assemblies, inspect and measure disc brake pads, inspect mounting hardware, and perform needed action. 9. Remove, clean, and inspect brake drum and mounting surface, including measuring brake drum diameter and brake lining thickness and inspecting brake lining condition, to determine needed action.
Air Brakes - Parking Brake System	10. Inspect the parking (spring) brake chamber for leaks and determine needed action, and manually release and reset (cage and uncage) parking (spring) brakes. 11. Inspect and test parking (spring) brake and check valves, lines, hoses, fittings, application and release valve to determine needed action.
Hydraulic Brakes - Hydraulic System	12. Check master cylinder fluid level, condition, and fluid type and hydraulic brake system operation including pedal travel, pedal effort, and pedal feel. 13. Inspect hydraulic brake system components for leaks and damage.
Hydraulic Brakes - Mechanical and	14. Perform rotor and mounting surface and hardware inspection including cleaning disc brake caliper assemblies and measuring rotor thickness, thickness variation, lateral runout, and disc brake pads to determine needed action.

Foundation Brake System	15. Remove brake drum, clean and inspect brake drum and mounting surface, measure brake drum diameter, measure brake lining thickness, inspect brake lining condition, and inspect wheel cylinders to determine needed action.
Hydraulic Brakes - Parking Brake System	16. Check parking brake operation and inspect parking brake application and holding devices.
Power Assist Systems	17. Check brake assist and booster system (vacuum or hydraulic) hoses, control valves, fluid level and condition (if applicable), and operation of emergency (back-up and reserve) brake assist system.
Vehicle Dynamic Brake Systems	18. Check operation of warning lights, including automatic traction control (ATC), electronic stability control (ESC), and anti-lock brake system (ABS) (dash and trailer mounted).
Wheel Bearings	19. Clean, inspect, lubricate, and replace wheel bearings and races and cups, replace seals and wear rings, inspect spindle and tube, inspect and replace retaining hardware, adjust wheel bearings, check hub assembly fluid level and condition, and verify end play with dial indicator method. 20. Identify, inspect, and replace unitized and preset hub bearing assemblies.
Cab General	21. Use appropriate electronic service tools and procedures to check, record, and clear diagnostic codes, check and record trip and operational data, reset maintenance monitor (if applicable), and interpret digital multimeter (DMM) readings for cab systems.

Cab Instruments and Controls	22. Perform inspection of cab instruments and controls including mechanical key condition; operation of ignition switch; operation of indicator lights, warning lights, and alarms; operation of electronic power take-off (PTO) and engine idle speed controls (if applicable); operation of accessories; oil pressure; and system voltage. 23. Describe the operation of auxiliary power unit (APU) and electric power unit (EPU).
Cab Safety Equipment	24. Perform inspection of cab safety equipment including horn (electric and air) operation, warning device operation (reverse, air pressure), spare fuse condition, safety triangles, fire extinguisher, required decals, seat belts, sleeper restraints, and condition of wiper blades and arms.
Cab Hardware	25. Perform inspection of cab hardware including cab mountings, hinges, latches, linkages, ride height, quarter fender, mud flaps, brackets, wipers, washer, windshield, sun visor, seat condition, operation, and mounting, all cab glass, window operation, door and cab lock operation, steps, grab handles, and mirrors, mountings, and brackets, and record physical damage. 26. Inspect and lubricate all cab grease fittings, door and hood hinges, latches, strikers, lock cylinders, safety latches, linkages, and cables.

Diesel Technology B

Course Credit	1.0
Grade Levels	9-12
Prerequisites	

Diesel Technology B presents content related to entry-level training for diesel drive trains, suspension, and steering. The course competencies include the tasks that are required to satisfy ASE Education IMMR level training for Area 2 (Drive Train) and Area 4 (Suspension and Steering). Content standards are written to meet Automotive Service Excellence (ASE) Education Foundation requirements, which also specify task lists, program hours, and safety standards.

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Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork. 3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.

	4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway. 5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork. 6. Apply literacy, mathematical, and scientific principles and precision measurements when diagnosing problems and making repairs. 7. Work independently, collaboratively, and in teams to explore concerns, find causes, and take appropriate action by applying principles of STEM.

DIESEL TECHNOLOGY B
CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Vehicle Research	1. Research vehicle drive train, suspension, and steering service information, including fluid type, vehicle service history, service precautions, and technical service bulletins.
General Identification	2. Identify suspension, steering system, and drive train components, transmission type, and configuration.
Drive Train	3. Inspect and adjust clutch, clutch brake, linkage, cables, levers, brackets, bushings, pivots, springs, clutch safety switch (including push-type and pull-type), pedal height, pedal travel, clutch master cylinder fluid level, clutch master cylinder, slave cylinder, lines, and hoses for leaks and damage to determine needed action. 4. Inspect transmission shifter, linkage, transmission mounts, insulators, mounting bolts, transmission leakage, transmission breather, transmission oil filters, coolers, speedometer components, function of reverse light, neutral start, and warning device circuits and determine needed action.

5. Remove and replace transmission cover plates, gaskets, seals, and cap bolts and inspect seal surfaces and vents to determine needed action.
6. Check transmission fluid level and condition and determine needed action.
7. Inspect, service, and replace driveshafts, slip joints, yokes, drive flanges, support bearings, universal joints, boots, seals, and retaining and mounting hardware and check phasing of all shafts.
8. Perform drive axle inspection including fluid leaks, drive axle housing assembly, shaft, cover plates, gaskets, seals, vent and breather, magnetic plugs, drive axle fluid, and drive axle filter to determine needed action.
9. Inspect air-operated power divider (inter-axle differential) assembly including diaphragms, seals, springs, yokes, pins, lines, hoses, fittings, controls, and drive axle shafts to determine needed action.
10. Remove and replace wheel assembly, check rear wheel seal and axle flange for leaks, and determine needed action.

Suspension and Steering Systems

11. Disable and enable supplemental restraint system (SRS) and verify indicator lamp operation.
12. Check steering wheel for free play, binding, and proper centering, inspect and service steering shaft U-joint(s), slip joint(s), bearings, bushings, and seals, phase steering shaft, check operation of tilt and telescoping steering column, and check cab mounting.
13. Inspect steering pump and gear unit, including operation, mountings, lines, hoses, fluid level and condition, service filter, and inspect system for leaks.
14. Flush and refill power steering system and purge air from system.
15. Inspect steering linkage components and lubricate as needed.
    Examples: tie rod ends, ball joints, kingpins, pitman arms, idler arms

16. Inspect suspension system to determine needed action, including shock absorbers, shock bushings, shock brackets, shock mounts, leaf springs, center bolts, clips, pins, shackles, U-bolts, insulators, spring bracket, spring mounts, axle, axle aligning devices, axle bushings, axle mounts, axle shims, tandem suspension equalizer components, air suspension pressure regulator components, ride height, air springs, mounting plates, springs, suspension arms, radius rods, track bars, stabilizer bars, and torque arms.
17. Describe the aspects of alignment angles.
18. Inspect wheel and tire condition to identify tire wear patterns and tread depth.
    a. Verify and record tire matching including diameter and tread, inspect valve stem and cap, and set tire pressure.
19. Identify wheel and tire problems, including vibration, shimmy, pounding, and hop (tramp).
20. Check wheel mounting hardware including removal and installation of wheel and tire assemblies (steering and drive axle), and torque fasteners to manufacturer's specification using torque wrench.

Frame and Coupling Devices

21. Inspect, service, and adjust fifth wheel, pivot pins, bushings, locking mechanisms, mounting hardware, air lines, fittings, frame and frame members, frame hangers, brackets, and cross members for cracks, breaks, corrosion, distortion, elongated holes, looseness, or damage.
22. Check pintle hook and mounting (if applicable).

Diesel Technology C

Course Credit	1.0
Grade Levels	9-12
Prerequisites	

Diesel Technology C presents content related to entry-level training for diesel electrical and hydraulic systems. The course competencies include the tasks that are required to satisfy ASE Education IMMR level training for Area 5 (Electrical and Electronic Systems) and Area 8 (Hydraulics). Content standards are written to meet Automotive Service Excellence (ASE) Education Foundation requirements, which also specify task lists, program hours, and safety standards.

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Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork. 3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.

	4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway. 5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork. 6. Apply literacy, mathematical, and scientific principles and precision measurements when diagnosing problems and making repairs. 7. Work independently, collaboratively, and in teams to explore concerns, find causes, and take appropriate action by applying principles of STEM.

DIESEL TECHNOLOGY C
CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Vehicle Research	1. Research vehicle electrical and hydraulics service information, including vehicle service history, service precautions, fluid type, and technical service bulletins.
General Electrical and Electronic Systems	2. Demonstrate knowledge of electrical and electronic series, parallel, and series-parallel circuits using principles of electricity (Ohm's law), function, operation, and testing of fusible links, circuit breakers, relays, solenoids, diodes, and fuses. 3. Use wiring diagrams to trace electrical and electronic circuits and utilize test equipment to measure source voltage, voltage drop (including grounds), current flow, continuity, and resistance. 4. Describe causes and effects of shorts, grounds, opens, and resistance problems in electrical and electronic circuits. 5. Measure parasitic (key-off) battery drain and determine needed action.

	6. Inspect, repair (including solder repair), and replace connectors, seals, terminal ends, and wiring, and verify proper routing and securement. 7. Use appropriate electronic service tools and procedures to check, record, and clear diagnostic codes, and interpret digital multimeter (DMM) readings for electrical and electronic systems. 8. Identify malfunctions caused by faults in the data bus communications network. 9. Identify electrical and electronic system components and configuration.
Battery System	10. Identify low voltage disconnect (LVD) systems, battery types, and system configuration. 11. Confirm proper battery capacity for application, perform battery state-of-charge test, perform battery capacity test, and determine needed action. 12. Inspect battery, battery cables, connectors, battery boxes, mounts, and hold-downs and determine needed action. 13. Charge battery using appropriate method for battery type. 14. Jump-start vehicle using a booster battery and jumper cables or using an appropriate auxiliary power supply.
Starting System	15. Describe the operation of a starter system. 16. Perform starter circuit cranking voltage and voltage drop tests. 17. Inspect starter control circuit switches, relays, connectors, terminals, wires, harnesses, and over-crank protection (if applicable).

Charging System	18. Identify the generator (alternator) and explain its function. 19. Check instrument panel voltmeters and indicator lamps. 20. Inspect generator (alternator) drive belt condition, check pulleys and tensioners for wear, check fans and mounting brackets, verify proper belt alignment; inspect cables, wires, and connectors in the charging circuit; and determine needed action. 21. Perform charging system voltage and amperage output tests and AC ripple test.
Lighting Systems	22. Inspect for brighter-than-normal, intermittent, dim, or no-light operation and determine needed action; inspect cables, wires, connectors in the lighting systems, tractor-to-trailer multi-wire connectors, cables, and holders. 23. Test, replace, and aim headlights.
Instrument Cluster and Driver Information Systems	24. Check gauge and warning indicator operation. 25. Identify the sensor and sending units, gauges, switches, relays, bulbs and LEDs, wires, terminals, connectors, sockets, printed circuits, and control components and modules of the instrument cluster, driver information system, and warning systems.
General Hydraulics	26. Verify placement of safety labels and placards on equipment and components and determine needed action. 27. Identify hydraulic system components and locate filtration system components, service filters, and breathers. 28. Check fluid level and condition and take a hydraulic fluid sample for analysis. 29. Inspect hoses and connections for leaks, proper routing, and proper protection and determine needed action.

Diesel Technology D

Course Credit	1.0
Grade Levels	9-12
Prerequisites	

Diesel Technology D presents content related to entry-level training for diesel engines and HVAC. The course competencies include the tasks that are required to satisfy ASE Education IMMR level training for Area 1 (Diesel Engines) and Area 6 (Heating, Ventilation, and Air Conditioning). Content standards are written to meet Automotive Service Excellence (ASE) Education Foundation requirements, which also specify task lists, program hours, and safety standards.

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Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork. 3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.

	4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway. 5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork. 6. Apply literacy, mathematical, and scientific principles and precision measurements when diagnosing problems and making repairs. 7. Work independently, collaboratively, and in teams to explore concerns, find causes, and take appropriate action by applying principles of STEM.

DIESEL TECHNOLOGY D
CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Vehicle Research	1. Research vehicle engine and HVAC service information including fluid type, vehicle service history, service precautions, and technical service bulletins.
General Diesel Engines	2. Inspect engine assembly for condition, levels, and leakages in oil, coolant, air, and fluids, including diesel exhaust fluid (DEF). 3. Check engine operation (starting and running) for problems including noise, vibration, and smoke. 4. Use appropriate engine electronic service tools and procedures to check, record, and clear diagnostic codes, check and record trip and operational data, reset maintenance monitor (if applicable), and interpret digital multimeter (DMM) readings.

	5. Inspect electronic wiring harness and brackets for wear, bending, cracks, and looseness. 6. Inspect crankshaft vibration damper and engine mounts. 7. Identify system components, configurations, and types of cylinder head(s), valve train, engine block, engine lubrication, engine cooling, air induction, exhaust, fuel, and engine braking.
Lubrication Systems	8. Test engine oil pressure, check operation of pressure sensor, gauge, and sending unit, test engine oil temperature, and check operation of temperature sensor. 9. Check engine oil level, condition, and consumption and take an engine oil sample. 10. Determine proper lubricant and perform oil and filter service.
Cooling System	11. Check engine coolant type, level, and condition and test coolant for freeze protection and additive package concentration. 12. Verify coolant temperature and check operation of temperature and level sensors, gauge, and sending unit. 13. Inspect and pressure test engine cooling system components and replace as needed, and inspect drive belt components including alignment and replace as needed. *Examples: thermostatic cooling fan system, fan shroud, coolant conditioner and filter assembly, valves, lines, fittings, water pump, hoses, clamps, radiator, mountings, pressure cap, tank(s), recovery systems* 14. Recover coolant, flush and refill with recommended coolant and additive package, and bleed cooling system. 15. Identify engine block heater(s).

Air Induction and Exhaust Systems	16. Inspect turbocharger(s), wastegate(s), piping systems, intake manifold, gaskets, connections, engine exhaust system, exhaust gas recirculation (EGR) system, crankcase ventilation system, and exhaust aftertreatment system for leaks, mounting, proper routing, and damaged or missing components, and service as needed. 17. Check the air induction system, replace the air filter as needed, and reset the restriction indicator (if applicable). *Examples: cooler assembly, piping, hoses, clamps, mountings*
Fuel System	18. Check and report on fuel level and condition. 19. Inspect low-pressure and high-pressure fuel system components including fuel tanks, fuel pump, pump drives, screens, fuel and water separators and indicators, hold-downs, filters, heaters, coolers, ECM cooling plates, crossover system, fittings, seals, mounting hardware, vents, caps, valves, screens, hoses, lines, check valves, pressure regulator valves, and restrictive fittings. 20. Replace fuel filter and prime and bleed fuel system.
Engine Brakes	21. Inspect engine compression and exhaust brake housing, valves, seals, lines, and fittings.
HVAC	22. Identify heating, ventilation, and air conditioning (HVAC) components and configuration. 23. Use appropriate HVAC electronic service tools and procedures to check, record, and clear diagnostic codes, and interpret digital multimeter (DMM) readings.

Refrigeration System Components	24. Inspect A/C compressor drive belts, pulleys, and tensioners and verify proper belt alignment, and check A/C condenser for airflow restrictions to determine needed action. 25. Check A/C system operation including system pressures, visually inspect A/C components for signs of leaks, and check A/C monitoring system (if applicable).
HVAC Systems	26. Inspect engine cooling system and heater system hoses and pipes, HVAC system-heater ducts, doors, hoses, cabin filters, and outlets and determine needed action. 27. Identify the source of A/C system odors. *Examples: cabin air filters, restricted drains, foreign items*
Operating Systems and Related Controls	28. Verify blower motor operation, confirm proper air distribution, and confirm proper temperature control to determine needed action.

Drone Technology

Course Credit	1.0
Grade Levels	9-12 **Note:** This course may be offered to 8th grade students as an exploratory, non-credit-bearing option.
Prerequisites	

Drone Technology is designed to equip students with skills to build, repair, program, and operate drones (unmanned aerial systems) in accordance with FAA regulations. Operational knowledge of drones will be used in applications that simulate tasks and responsibilities found in associated career fields.

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Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork. 3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.

4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway.
5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork.
6. Apply literacy, mathematical, and scientific principles and precision measurements when diagnosing problems and making repairs.
7. Work independently, collaboratively, and in teams to explore concerns, find causes, and take appropriate action by applying principles of STEM.

DRONE TECHNOLOGY CONTENT STANDARDS

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Federal Regulations

1. Identify FAA regulations (FAR Part 107) and indicate where to find regulations on drones and licensing requirements.
    a. Complete an FAA license application.
2. Investigate and report on liability and insurance requirements related to drone operation.
3. Explain the characteristics of drones according to FAA regulations and industry standards.

Drone Classification and Uses

4. Classify drones according to body type.
    Examples: UAV, tricopter, quadcopter
5. Identify the roles and missions that various types of drones perform in military and civilian settings.

6. Describe industrial and commercial uses of various types of drones.
   Examples: agriculture, conservation, delivery fulfillment, disaster relief, energy exploration, tower inspections, filmmaking, law enforcement, geographic information systems, real estate, research, space exploration
   a. Describe instrument and data collection packages drones are able to take aloft.
      Examples: videography, photography, surveying, mapping, data collection, processing, remote sensing, infrared and thermal imaging, Normalized Difference Vegetation Index (NDVI), photogrammetry

Drone Hardware

7. Identify materials used in the construction of drones.

8. Identify drone components and parts of the craft.
   Examples: servos, gyros, radios, accelerometers, GPS modules, processors, cameras, batteries, rotors, motors, collision avoidance systems

9. Describe types of power systems for drones.
   Examples: engines, fuel, motors, electrical systems, lithium batteries

10. Demonstrate repair procedures on a drone.
    Examples: changing damaged blades, installing a new motor

Forces of Flight and How Drones Fly

11. Explain the aeronautical implications of air density and density altitude.

12. Explain the four forces of motion acting on a drone.
    a. Calculate vectors to determine resulting motion.

13. Explain the theories of lift and drag as they apply to airfoils and lift production.
    a. Calculate lift for a given drone.
    b. Explain the factors that result in aerodynamic stalls during drone flights.

14. Calculate aircraft weight capacities and center of gravity to balance a drone for stability and control.

Aviation Weather Theory	15. Utilize practical weather observations and micro meteorology for piloting a drone to maximize aerodynamic performance. *Example: Consult local weather radar to locate possible thunderstorms in the area.*
Drone Programming	16. Program a drone for autonomous flight. *Examples: settings, waypoints, updating software and firmware* a. Perform computer simulation of a programmed drone flight. b. Program a flight controller for flight modes, preset features, quick shot presets, and radio frequencies.
Drone Operation	17. Identify primary and secondary flight controls for a drone. 18. Perform preflight checks and demonstrate emergency procedures for a drone. 19. Plan and carry out manual and autonomous flights by a drone, collecting usable data as required. 20. Store, organize, and deliver or communicate data according to industry standards and customer requirements.
Mapping	21. Conduct environmental mapping and event-related object searching. *Examples: photograph buildings, search for a person behind a wall*

Flight Communications

Course Credit	1.0
Grade Levels	10-12
Prerequisites	Aircraft Instruments and Avionics

Flight Communications is designed to provide students with simulated flight communication experiences in accordance with Federal Aviation Agency protocols and regulations. Topics include operation of equipment, use of instruments, and content of transmissions.

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FLIGHT COMMUNICATIONS CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Communication Equipment	1. Identify and explain the operation of communication equipment in the aircraft cockpit. a. Explain the difference between local radio frequency and regional radio frequency and when each is used.
Aeronautical Charts and Airports	2. Identify notification boxes, latitude, longitude, VFR checkpoints, and maximum elevation figures on National Aerospace System sectional charts. a. Utilize National Aerospace System sectional charts to determine facilities and services available at various airports and associated airspace requirements and regulations.
Communication Conventions	3. Use appropriate etiquette and vocabulary including aircraft identification number in actual or simulated radio communication. 4. Use the FAA-approved phonetic alphabet and number system in actual or simulated radio communication.

Radio Settings	5. Set radio frequencies to the corresponding air traffic control airfield or other aircraft. a. Perform pre-flight communications with air traffic control. b. Perform emergency communications with air traffic control. 6. Demonstrate procedures for radio communications with towered and non-towered airports. 7. Explain the difference between internal and external aircraft communications and how to transition between the two.
Radio Communications	8. Simulate radio transmissions with air traffic control. *Examples: runway clearance, takeoff, landing clearance*

Flight Navigation

Course Credit	1.0
Grade Levels	10-12
Prerequisites	Aircraft Instruments and Avionics

Flight Navigation is designed to equip students to plan a course, read and interpret up-to-date weather reports, record flight paths, support flight operations, and perform calculations for fuel usage. Content application will emphasize adherence to Federal Aviation Agency guidelines.

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FLIGHT NAVIGATION CONTENT STANDARDS

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Flight Navigation	1. Explain how components of the nav and com system work together to make flight navigation possible. *Examples: artificial horizon, compass, VSI, altimeter*
Heading and Course	2. Use a magnetic compass to give heading direction in degrees. a. Differentiate between magnetic north and true north and perform calculations to find true north from magnetic north. 3. Interpret the markings and legend on a map to decipher map coordinates accurately. a. Identify longitude and latitude lines and explain how they are used in navigation. b. Identify a compass rose and explain its uses. 4. Plot an aircraft flightpath on a map and prepare a flight plan for air traffic control.
Weather	5. Explain how various weather conditions affect aircraft operations in the air and on the ground including atmosphere lift, winds, clouds, precipitation, air masses, fronts, and storms.

	6. Explain the effect weather may have on the flight plan of an aircraft depending on the aircraft rating and the pilot rating. a. Access and apply Aviation Weather Services observations, reports, forecasts, and charts.
Emergency Planning	7. Demonstrate procedures for choosing alternate airfields and making alternate flight paths for emergency situations. a. Note a secondary airfield and flightpath on a flight plan for air traffic control.
Fuel and Range Calculations	8. Perform fuel and range calculations to determine minimum fuel needed for a given flight, including the FAA standard fuel reserve.
Flight Plan	9. Simulate following a plotted flightpath with multiple course corrections and destinations.

Flight Operations

Course Credit	1.0
Grade Levels	11-12
Prerequisites	Flight Navigation Flight Communications

Flight Operations is designed to equip students with knowledge related to flight operations from preflight to post-flight procedures. Content standards are written to allow students the opportunity to demonstrate procedures in simulated aircraft experiences.

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FLIGHT OPERATIONS CONTENT STANDARDS

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Preflight Procedures	1. Check the aircraft logbook to look for any discrepancies noted by the previous pilot or maintenance personnel, to confirm the most recent annual inspection, and to determine whether the aircraft is grounded. 2. Demonstrate the procedure for plotting and filing a flight plan with air traffic control (ATC). 3. Perform an actual or simulated preflight inspection of an aircraft in accordance with the manufacturer's preflight inspection checklist. *Example: Calculate weight of pilot, passengers, luggage, and fuel to ensure compliance with TCDS.*
Taxiing and Takeoff	4. Explain the procedures for taxiing of aircraft, including planning for and avoiding ground hazards and identifying taxi and runway markings and signage. *Example: Apply brakes carefully to avoid tip-over.*

	5. Explain the runway and takeoff procedures for aircraft for IFR and VFR takeoffs. *Examples: runway etiquette, power settings, aircraft control settings*
Flight Maneuvers	6. Describe the steps and aircraft control inputs for basic flight maneuvers. *Examples: climb, descend, right turn, left turn*
Landing	7. Explain the steps for approaching the runway and landing the aircraft safely.
Post-flight Procedures	8. Perform an actual or simulated post-flight inspection of an aircraft in accordance with the manufacturer's post-flight inspection checklist. 9. Record in the aircraft logbook the flight hours, engine hours, and any mechanical issues experienced with the aircraft. *Example: Record times from the Hobbs meter(s).* 10. Explain proper parking and hangaring procedures for aircraft.

Foundations of Warehousing and Distribution

Course Credit	1.0
Grade Levels	9-12
Prerequisites	Introduction to Logistics

Foundations of Warehousing and Distribution is designed to equip students with knowledge and skills regarding the principles of warehousing and distribution. Standards are written to provide students with experiences to support warehousing functions to ensure goods and materials are processed efficiently. Students investigate various topics related to warehousing with emphasis on safety, processes, teams, cost, supply and demand, inventory, and associated terminology. Specific topics include warehouse safety, warehouse logistics, transport modes, quality control principles, teamwork and problem-solving, and procurement.

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	3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing. 4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway. 5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork. 6. Apply literacy, mathematical, and scientific principles and precision measurements when diagnosing problems and making repairs. 7. Work independently, collaboratively, and in teams to explore concerns, find causes, and take appropriate action by applying principles of STEM.

FOUNDATIONS OF WAREHOUSING AND DISTRIBUTION CONTENT STANDARDS

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Warehouse Safety	1. Identify and describe the elements of the 6S production system (sort, set in order, shine, standardize, sustain, safety).
Warehouse Logistics	2. Distinguish among types of warehouses, locations, structures, and ownership. 3. Summarize and interpret major international trade security initiatives and environmental policies governing warehousing and logistics. *Example: Customs-Trade Partnership Against Terrorism (C-TPAT)*

Transport Modes	4. Compare and contrast transportation modes to determine advantages and disadvantages of each type. 5. Construct a transportation chain by connecting the different transport modes (air, land, water). 6. Design a plan of action for purchasing a product, applying freight terms and providing documentation. *Examples: Incoterms® (International Commercial Terms), full truckload or less than truckload, calculated shipping volumes, delivery data, claims, performance history, billing, communication, competition, reputation*
Quality Control Principles	7. Illustrate how quality control processes work together to achieve the final logistics goal. 8. Compare and contrast key quality control systems within a logistics environment. *Examples: Lean, Six Sigma, shop floor management* 9. Summarize the role of Total Quality Management and continuous improvement in optimizing operational performance and customer satisfaction. 10. Apply the basic methods of continuous improvement to common logistics scenarios. 11. Gather and share information on the role of the International Organization for Standardization in quality management. 12. Identify types of quality audits and indicate the purpose of each.
Teamwork and Problem-solving	13. Differentiate among types of teams, including work teams, project teams, cross-functional teams, and departmental (functional) teams, indicating how each type may incorporate high-performance methods and characteristics. 14. Design a plan of action for solving an interpersonal issue using conflict-resolution strategies. *Examples: conflict between two team members, conflict between supervisor and team member*

15. Evaluate targets and goals to determine whether goals are SMART (Specific, Measurable, Attainable, Relevant, and Time-bound).

16. Work individually and in teams to revise vague goals into SMART goals (Specific, Measurable, Attainable, Relevant, and Time-bound).

Procurement

17. Describe the effects of supply and demand on markets, including interdependency and influencing factors.
    Examples: cost, volume, production requirements, lead time, implications of transportation and logistics

18. Compare the advantages and disadvantages of just-in-time and just-in-sequence (JIT and JIS) and maintaining stock when facing capital decisions and cost of inventory.

19. Develop a procurement process incorporating the main steps of obtaining goods or services from external sources, including researching suitable suppliers, requesting and evaluating quotes, listing legal requirements, and processing sales contracts.

20. Identify and differentiate among the basic functions of information technology applications in the procurement process.
    Examples: enterprise resource planning (ERP), material requirements planning (MRP), vendor management systems (VMS)

Global Logistics and Supply Chain Management

Course Credit	1.0
Grade Levels	10-12
Prerequisites	Industry-Specific Logistics Processes

Global Logistics and Supply Chain Management is designed to equip students with knowledge and skills regarding the process of managing the flow of goods through the supply chain from the point of origin to the final destination. Standards are written for students to investigate trends in green logistics, various aspects of international environmental laws and requirements, e-commerce applications, and innovative technologies in logistics. Specific topics include green logistics, e-commerce, key performance indicators, IT systems, and future trends in logistics.

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GLOBAL LOGISTICS AND SUPPLY CHAIN MANAGEMENT CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Green Logistics	1. Analyze the impact of logistics on the environment and discuss ways to reduce the environmental footprint. *Examples: material handling, recycling and waste management, packaging, transportation* 2. Identify and compare the provisions of international environmental laws and regulations. 3. Investigate and assess the roles and responsibilities of an environmental, health, and safety management system. 4. Research and discuss trends in green logistics. *Examples: "greening" companies, sustainability, green energy, recycling, electric vehicles*
E-Commerce	5. Compare and contrast the three types of e-commerce (business-to-business, business-to-consumer, and consumer-to-consumer) and give examples of each. 6. Research examples of e-commerce applications in logistics and evaluate their impact on globalization.

Key Performance Indicators (KPI)	7. Identify various key performance indicators and indicate how they are utilized in tracking operational and individual performance. 8. Develop a system of key performance indicators incorporating exemplars routinely utilized in logistics. 9. Calculate key performance indicators from a given sample data set and interpret the results. 10. Analyze a company's performance by benchmarking against a set of industry-wide standards.
IT Systems	11. Identify and distinguish among common information technology systems found in logistics. *Examples: K-Motion (Koerber), SAP, INCONSO, Manhattan*
Future Trends in Logistics	12. Investigate and report on innovative technologies in logistics. *Examples: automation of warehousing, electric and autonomous vehicles, drones, robots* 13. Identify and differentiate among innovative trends in logistics. *Examples: Industry 4.0, Internet of Things, digitalization, digital twin, data analytics, artificial intelligence* 14. Outline and compare characteristics of traditional, modern, and future logistics.

Industry-Specific Logistics Processes

Course Credit	1.0
Grade Levels	10-12
Prerequisites	Foundations of Warehousing and Distribution

Industry-Specific Logistics Processes is designed to equip students with knowledge and skills regarding logistics in various industry sectors in Alabama. Standards require students to investigate integrated logistics services for all sectors with emphasis on products, storage systems, equipment, picking systems, order fulfillment, and material management. Specific topics include receiving, storing, order processing and picking, packing and shipping, inventory control, dispatch and tracking operations, and industry sectors.

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INDUSTRY-SPECIFIC LOGISTICS PROCESSES CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Receiving

1. Describe the different aspects of warehousing and classify typical work areas in a warehouse according to the areas' functions.
   Examples: receiving, staging, storage, order processing, packaging, shipping
2. Gather and share information on the steps involved in the receiving process.
3. Design multiple simulations of an inbound process in warehousing, including the standard process and exceptions to that standard.
   Examples: quantity and quality deviations, improper documentation
4. Analyze the characteristics of a product, drawing accurate conclusions to devise a plan for storing the product based on that analysis.

Storage

5. Differentiate among types of warehouses according to location, structure, layout, and proprietor and operator.

6. Evaluate types of warehouse storage systems in terms of safety, cost, speed, and risk.
   Examples: racking and shelving, bulk storage, palletized storage, specialty containers, block storage, automated storage systems

7. Identify and differentiate among various types of equipment commonly used to move materials through the warehouse, both physically and in the warehouse management system.

8. Interpret product identification systems including SKUs, part and location numbers, labels, and barcodes.

9. Create an action plan for warehouse storage in a given scenario by analyzing the characteristics of materials and the facility, including any pertinent storage restrictions.
   Examples: type, condition, volume, weight, stackability, warehouse layout

10. Explain the functions of a warehouse management system.
    Examples: systematic connection of warehouse processes, tracking product movement, controlling inventory

Inventory Control

11. Compare and contrast common types of inventory, including raw materials, work-in-process, and finished goods.

12. List and differentiate among commonly used inventory control systems.
    Examples: warehouse management systems, just-in-time and just-in-sequence (JIT and JIS), First-In-First-Out (FIFO), Last-In-First-Out (LIFO), cycle counting, ABC inventory

13. Explain the financial burden associated with holding inventory, including costs associated with warehousing, capital, shrinkage, risk of loss or damage, and lost opportunity.

Order Processing and Picking	14. Assess types of picking systems, developing a logical argument for which to use in various scenarios, based on industry specifics. *Examples: just-in-time and just-in-sequence (JIT and JIS), dynamic vs.static picking, order-driven vs. sequence-driven picking, pick to light, pick by voice, pick to order vs. batch picking* 15. Compare the use of manual and technological picking methods to identify ways to increase picking productivity and accuracy. *Examples: visual inspection, hand-held bar code scanning* 16. Describe methods of product staging in preparation for shipping. *Examples: kitting, consolidation, combination of orders, preparation for dispatch, marshalling*
Packaging and Shipping	17. Identify the levels of packaging, including primary, secondary, and transport packaging, and explain how each level contributes to product protection. 18. Execute product-specific packaging requirements set forth in customer's packing instructions in a given scenario. 19. Assess how different packaging types may be combined efficiently to stow and secure loaded goods. 20. Label a package based on carrier and customer requirements. 21. Create a load list, stowage plan, and load plan, and calculate the payload for a given scenario. 22. Explain the process of utilizing reusable packaging and analyze its impact on cost, productivity, and the environment. 23. Describe how to prepare documentation and organize information flow based on types of goods and specific requirements regarding packaging, considering contractual, national, and international regulations. 24. Differentiate among loading techniques, including the use of various systems, docks, ramps, and loading equipment. 25. Simulate a loading process for a given scenario including the calculation of freight weight and volume, the identification of legal restrictions, the preparation of goods and documentation, the evaluation of different shipping methods, and the allocation of tools and loading devices.

Dispatch and Tracking Operations	26. Review modes and means of transportation and describe the benefits of intermodal transportation. 27. Identify types of standardized loading units and vehicles and explain their roles in intermodal transportation. *Examples: ISO standard containers, pallets, swap-body trailers* 28. Research how trade and customs regulations govern logistical activities. 29. Investigate aspects of route planning which influence the choice of shipping routes within the American transportation network and through major international commercial hubs, including cost-efficiency, infrastructure, environmental impact, and timing. 30. Identify methods and systems to track cargo movement throughout the entire transportation chain. *Examples: yard management systems, container tracking, RFID technology*
Hazardous Materials	31. Identify and distinguish among the nine internationally recognized classifications of hazardous materials. a. Categorize shipments according to the nine internationally recognized classifications of hazardous materials and indicate how shipments should be labeled. 32. Summarize the risks and effects of hazardous materials on humans and the environment. 33. Analyze and summarize government regulations relating to safe practices, documentation, and accident prevention for handling hazardous materials.
Industry Sectors	34. Identify local industry sectors affected by the logistics operations and the logistics options available in the area. *Examples: automotive logistics, retail logistics, health care logistics, courier logistics* 35. Research and report on how various industries in the local region apply logistics operations, including receiving, storage, inventory control, order processing and picking, packaging and shipping, dispatch and tracking operations, and handling hazardous materials.

Introduction to Logistics

Course Credit	1.0
Grade Levels	9-12
Prerequisites	

Introduction to Logistics is designed to equip students with knowledge and skills regarding the fundamental elements of logistics. Standards are designed for students to investigate various topics related to the field with emphasis on logistics affiliates, real-world scenarios, system applications, and associated terminology. Topics include the logistics environment, supply chain management, material-handling equipment, and technology.

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Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork. 3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.

4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway.
5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork.
6. Apply literacy, mathematical, and scientific principles and precision measurements when diagnosing problems and making repairs.
7. Work independently, collaboratively, and in teams to explore concerns, find causes, and take appropriate action by applying principles of STEM.

INTRODUCTION TO LOGISTICS CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

The Logistics Environment

1. Explain the importance of logistics throughout history.
   Examples: East India Trading Company, the Industrial Revolution, world wars, intermodal transportation, on-line marketplace
2. Explain how logistics affects everyday life.
   Example: purchasing a cell phone, car, groceries, or clothing
3. Describe various logistics affiliates and outline their roles.
   Examples: suppliers, manufacturers, third-party logistics providers (3PLs), limited liability partnerships (LLPs), transportation companies

	4. List and interpret the seven Rs of logistics (right product, right place, right price, right condition, right quantity, right time, and right customer). a. Design simulated workplace experiences integrating the seven Rs of logistics. *Example: lemonade stand* 5. Identify and distinguish among the fundamental elements of logistics (planning, purchasing, engineering, warehousing, shipping, receiving, distribution, quality management, transportation, and value-added services).
Supply Chain Management	6. Differentiate among the elements of a supply chain, including raw materials, information, suppliers, finances, original equipment manufacturers, returns, and recycling. 7. Describe the role of supply chain management in coordinating and integrating the elements of the supply chain. *Example: Utilize supply chain elements to build a supply chain for a product, showing the interconnections among them.*
Material-Handling Equipment	8. Identify, categorize, and compare types of material-handling equipment and describe where various kinds are commonly used. *Examples: pallet jack, forklift, automated guided vehicle (AGV)*
Technology	9. Compare and contrast technology applications used in the logistics field. *Examples: Internet, Microsoft Office applications, inventory and warehouse management systems, customer relations management (CRM), transportation management systems, radio frequency identification, cybersecurity applications* a. Compare and contrast common software systems in logistics. b. Explain how various forms of technology are used to capture and store logistics information.

Mechanical and Electrical Components I

Course Credit	1.0
Grade Levels	11-12
Prerequisites	Painting and Refinishing II

Mechanical and Electrical Components I presents knowledge and skills regarding the diagnosis and repair of collision-related mechanical damage to suspension, steering, and electrical systems. Standards are designed to equip students with the skills to diagnose and repair collision-damaged mechanical components in these systems.

Content standards are written to meet Automotive Service Excellence (ASE) Education Foundation requirements, which also specify task lists, program hours, and safety standards.

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Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork. 3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.

	4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway. 5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork. 6. Apply literacy, mathematical, and scientific principles and precision measurements when diagnosing problems and making repairs. 7. Work independently, collaboratively, and in teams to explore concerns, find causes, and take appropriate action by applying principles of STEM.

MECHANICAL AND ELECTRICAL COMPONENTS I CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Safety Precautions	1. Locate OEM procedures and precautions to identify materials and components of the vehicle being repaired. 2. Follow advanced vehicle system precautions and conduct necessary inspections, including recommended procedures before inspecting or replacing components.
Suspension and Steering	3. Perform visual inspection and measuring checks to identify collision damage to steering and suspension systems. 4. Identify one-time-use fasteners and clean, inspect, and prepare reusable fasteners. 5. Inspect, remove, replace, or adjust power steering pump, pulleys, belts, hoses, fittings, pump mounts, power steering gear, power rack and pinion steering gear, and related components.

6. Inspect, remove, and replace parallelogram steering linkage components and upper and lower control arms, steering, knuckle, spindle, hub assemblies (including bearings, races, and seals), front suspension system coil springs and spring insulators (silencers), and related components.

7. Inspect, remove, replace, and adjust suspension system torsion bars, mounts, stabilizer bar bushings, brackets, links, MacPherson strut or assembly, upper bearing, mount, rear suspension system transverse links, control arms, stabilizer bars, bushings, mounts, leaf spring(s), and related components.

8. Diagnose, inspect, adjust, repair, and replace active suspension systems and associated lines and fittings.
    a. Align front and rear frame (cradles and subframe), shock absorbers, axle assembly to correct damage and misalignment.

9. Measure vehicle ride height and wheelbase according to manufacturer specifications.

10. Inspect steering wheel, steering column, and components, including electronically controlled, hydraulic and electronically assisted steering systems, front and rear suspension system noises and body sway problems, wandering, pulling, hard steering, bump steer, memory steering, torque steering, and steering return problems; determine necessary action.

11. Describe examples of different types of wheel, suspension, and steering alignments.
    Examples: caster, camber, toe, steering axis inclination (SAI)

12. Inspect tires to identify tire wear patterns, nitrogen or air, direction of rotation and location, check tire size, check tire pressure monitoring system (TPMS), and adjust air pressure.

13. Diagnose wheel and tire vibration, shimmy, tire pull (lead), and wheel hop problems to determine needed repairs.

14. Measure wheel, tire, axle, and hub runout, determine needed repairs, reinstall wheels, and torque lug nuts.

15. Perform initialization or calibration procedures after suspension and steering system repairs and tire pressure monitoring system (TPMS) recalibration.

16. Lift the vehicle for inspection, service, and repair by properly raising and supporting the vehicle.

Electrical

17. Apply Ohm's law to troubleshoot electrical wiring circuits and components for available voltage, voltage drop and current, and resistance with a DMM (digital multimeter).
18. Inspect, test, and replace fusible links, circuit breakers, and fuses and repair wiring and connectors.
19. Identify programmable electrical and electronic components, check for malfunction indicator lamp (MIL) and fault codes, and record data for reprogramming before disconnecting the battery.
20. Inspect alignment, adjust, remove, and replace alternator (generator), drive belts, pulleys, and fans.
21. Check operation and aim headlamp assemblies and fog and driving lamps to determine needed repairs.
22. Inspect, test, repair, and replace switches, relays, bulbs, sockets, connectors,and ground wires of interior and exterior light circuits and horn(s).
23. Inspect, remove, and replace power seats, motors, linkages, cables, and components of electric door and hatch or trunk locks, keyless lock and unlock devices, alarm systems, electric sunroof, and convertible and retractable hardtop.
24. Check operation of electrically heated mirrors, windshields, back lights, and panels to determine needed repairs.
25. Demonstrate self-grounding procedures (anti-static) for handling electronic components.
26. Check for module communication errors using a scan tool.
27. Use wiring diagrams, component location, and diagnostic flowcharts during diagnosis of electrical circuit problems.
28. Identify safe disabling techniques of high voltage systems on hybrid and electric vehicles.

Mechanical and Electrical Components II

Course Credit	1.0
Grade Levels	11-12
Prerequisites	Mechanical and Electrical Components I

Mechanical and Electrical Components II covers knowledge and skills regarding the diagnosis and repair of collision-related mechanical damage to brakes, heating and air conditioning, cooling systems, drive train, fuel intake and exhaust systems, and restraint systems. This course extends skills learned in Mechanical and Electrical Components Repair I.

Content standards are written to meet Automotive Service Excellence (ASE) Education Foundation requirements, which also specify task lists, program hours, and safety standards.

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Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork.

	3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing. 4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway. 5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork. 6. Apply literacy, mathematical, and scientific principles and precision measurements when diagnosing problems and making repairs. 7. Work independently, collaboratively, and in teams to explore concerns, find causes, and take appropriate action by applying principles of STEM.

MECHANICAL AND ELECTRICAL COMPONENTS II CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Brakes	1. Inspect brake lines (double flare and ISO types), hoses, and fittings for damage or wear and replace as needed to ensure tight fittings and support. 2. Bleed manual, pressure, or vacuum hydraulic brake system. 3. Pressure test brake hydraulic system to determine necessary action. 4. Remove and reinstall brake drums or drum and hub assemblies and adjust brake shoes or pads. 5. Remove, clean, inspect, and reinstall caliper and rotor assembly and mountings for wear and damage.

	6. Inspect parking brake system operation, repair or adjust as necessary, and verify that brakes are operating correctly. 7. Compare and contrast various types of advanced braking systems. *Examples: ABS, electronic parking brake, hydraulic, electronic, traction and stability control*
Heating and Air Conditioning	8. Verify correct operation of certified refrigerant recovery and recharging equipment. 9. Locate and identify A/C system service ports. 10. Recover, label, and recycle refrigerant from an A/C system. 11. Select refrigerant, evacuate, and recharge the A/C system. 12. Inspect, adjust, repair and replace A/C compressor drive belts, pulley alignment, compressor mount, mufflers, hoses, lines, fittings, orifice tube, expansion valve, seals, condenser, accumulator and drier (receiver and drier), and component wiring. 13. Summarize safe handling procedures associated with high voltage A/C compressors and wiring. 14. Inspect and protect open A/C system components from contaminants during repairs.
Cooling Systems	15. Check engine cooling and heater system hoses and belts, and remove, inspect and replace fan (both electrical and mechanical), fan sensors, fan pulley, fan clutch, and fan shroud; check operation. 16. Inspect, test, remove, and replace radiator, pressure cap, coolant system components, and water pump, replace auxiliary oil and fluid coolers, and check oil levels. 17. Recover, refill, and bleed system with proper coolant and check for leaks and level of protection. 18. Describe the differences between hybrid and electric cooling systems.

Drive Train	19. Remove, replace, and adjust shift or clutch linkage, electronic sensors, wires, and connectors. 20. Remove, replace, and reinstall powertrain assembly, powertrain mounts, drive axle assembly, half shafts, axle constant velocity (CV) joints and driveshafts, and universal joints. 21. Follow safe handling procedures when handling high voltage powertrain components.
Fuel, Intake, and Exhaust Systems	22. Inspect, remove, and replace exhaust pipes, mufflers, converters, resonators, tail pipes, and heat shields. 23. Inspect, remove, and replace fuel and diesel exhaust fluid (DEF) tanks, tank filter, cap, filler hose, pump and sending unit and inertia switch, and inspect and replace fuel lines and hoses. 24. Inspect, remove, and replace engine components of air intake systems, canister, filter, vent, and purge lines of fuel vapor (EVAP) control systems.
Restraint Systems	25. Inspect, remove, and replace seat belt and shoulder harness assembly and components, inspect restraint system mounting areas for damage, and repair as needed. a. Identify one-time use fasteners used with airbag and seat belt components. 26. Inspect the operation of the seat belt system. 27. Conduct pre-scan inspection to verify operation of Supplemental Restraint System (SRS) and use diagnostic trouble codes (DTC) to diagnose and determine repairs. 28. Inspect, protect, remove, replace, and identify components of the Supplemental Restraint Systems (SRS) sensors and wiring, ensure sensor orientation, and dispose of deployed and undeployed airbag(s) and pretensioners. 29. Describe the purposes and functions of advanced restraining and occupant classification systems (OCS).

Non-Structural Analysis and Damage Repair (Body Components)

Course Credit	1.0
Grade Levels	9-12
Prerequisites	

Non-Structural Analysis and Damage Repair (Body Components) presents knowledge and skills regarding current and emerging technologies in analysis and repair of collision-damaged non-structural components, including methods, equipment, and processes used to inspect, measure, repair, and replace non-structural parts. Standards are designed to equip students to perform basic repairs on automotive non-structural components.

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Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork.

	3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing. 4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway. 5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork. 6. Apply literacy, mathematical, and scientific principles and precision measurements when diagnosing problems and making repairs. 7. Work independently, collaboratively, and in teams to explore concerns, find causes, and take appropriate action by applying principles of STEM.

NON-STRUCTURAL ANALYSIS AND DAMAGE REPAIR (BODY COMPONENTS) CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Safety Precautions	1. Locate OEM procedures to identify material composition and precautions for the vehicle being repaired. *Examples: mild steel, high strength steel, ultra-high strength steel, aluminum* 2. Identify advanced vehicle system precautions and inspections, including recommended procedures before inspecting or replacing components.
Preparation	3. Review damage report and analyze damage to determine appropriate methods for overall repair and develop and document a repair plan. 4. Inspect, remove, protect, label, store, inventory, and reinstall exterior and interior trim moldings and components. 5. Inspect, remove, inventory, and reinstall or protect body panels and components that may interfere with or be damaged during repair.

Outer Body Panel Repairs, Replacements, and Adjustments	6. Locate direct, indirect, and hidden damage and determine the direction of impact. 7. Inspect, remove, and replace welded steel panels or panel assemblies. 8. Determine the extent of damage to aluminum body panels and repair or replace. 9. Inspect, remove, replace, and align bolts on panels and components. 10. Inspect, remove, replace, overhaul, and align bumpers, bumper covers, and components. 11. Restore corrosion protection, sound deadeners, and foam materials according to OEM procedures. 12. Replace door skins. 13. Perform panel bonding and weld bonding. 14. Identify one-time use fasteners, labels, and decals and replace as necessary.
Metal Finishing and Body Filling	15. Prepare a panel for body filler by abrading or removing the coatings. 16. Demonstrate hammer and dolly techniques and perform finishing techniques for metal, including aluminum. 17. Heat and cold-shrink stretched panel areas to proper contour. 18. Identify different types of body filler and defects. 19. Mix and apply body filler, shape body filler to contour, and finish sand. 20. Locate and repair surface irregularities and straighten contours on a damaged panel using weld-on and glue-pulling dent repair.

Moveable Glass and Hardware	21. Inspect, adjust, overhaul, repair, or replace window regulators, run channels, glass, power mechanisms, and related controls. 22. Inspect, adjust, repair, remove, reinstall, or replace weather-stripping. 23. Inspect, remove, repair or replace, and adjust removable power operated roof panel and hinges, latches, guides, handles, retainer, and controls of sunroofs. 24. Inspect, remove, reinstall, and align convertible top and related mechanisms. 25. Identify or recalibrate electrical components that may need to be initialized.
Plastics, Adhesives, and Welding	26. Identify the types of plastic and repair procedures and clean and prepare the surfaces of plastic parts. *Examples: rigid, semi-rigid, and flexible plastic panels* 27. Identify bonded rigid exterior body panels and straighten or align panel supports. 28. Repair plastic parts by welding. *Examples: nitrogen, airless* 29. Perform a single-sided, double-sided, and tab procedures for adhesive bonded repair. 30. Shape and reform damaged plastic.

Non-Structural Welding, Cutting, and Joining

Course Credit	1.0
Grade Levels	9-12
Prerequisites	Non-Structural Analysis and Damage Repair

Non-Structural Welding, Cutting, and Joining is designed to equip students with knowledge and skills regarding automotive cutting and welding processes including resistance type spot welding and metal inert gas (MIG) welding. Standards focus on ensuring that students can perform automotive cutting and welding procedures safely. This course incorporates personal and environmental safety practices associated with clothing, respiratory and eye protection, tools and power equipment, ventilation, and the handling, storage, and disposal of chemicals and materials in accordance with local, state, and federal safety and environmental regulations.

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Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork.

	3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing. 4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway. 5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork. 6. Apply literacy, mathematical, and scientific principles and precision measurements when diagnosing problems and making repairs. 7. Work independently, collaboratively, and in teams to explore concerns, find causes, and take appropriate action by applying principles of STEM.

NON-STRUCTURAL WELDING, CUTTING, AND JOINING CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Welding, Cutting and Joining Precautions	1. Locate OEM procedures to determine materials and precautions for the vehicle being repaired. 2. Identify advanced vehicle system precautions and inspect to determine locations and recommended procedures before inspecting or replacing components.
Metal Welding, Cutting, and Joining	3. Identify the procedures for cutting, removing, and welding various types of steel, aluminum, and other metals. 4. Determine and identify the correct GMAW welder type, electrode and wire type, diameter, and gas to be used in a specific welding situation.

5. Set up and adjust GMAW welder including proper gun angle, travel speed, and direction required for the substrate being welded.
6. Store, handle, and install high-pressure gas cylinders and test for leaks.
7. Protect adjacent panels and components during welding or cutting procedures.
8. Identify hazards, foam coatings and flammable materials, and computers and other electrical components prior to welding and cutting procedures.
9. Clean and prepare the metal to be welded, assure good metal fit-up, and apply corrosion protection per OEM specifications.
10. Determine and perform the joint type and weld type for welds being made on specific operations.
    Examples: butt weld with backing, lap; continuous, stitch weld, plug
11. Perform visual evaluation and destructive test on each weld type.
12. Identify the causes of various welding defects and make necessary adjustments.
13. Identify and perform cutting processes for different substrates and locations.
14. Identify different methods of attaching structural components.
    Examples: squeeze type resistance spot welding (STRSW), riveting, structural adhesive, MIG bronze, rivet bonding, weld bonding

Painting and Refinishing I

Course Credit	1.0
Grade Levels	10-12
Prerequisites	Non-Structural Welding, Cutting, and Joining

Painting and Refinishing I is designed to equip students with knowledge and skills regarding the selection, preparation, and application of automotive finishes. This course incorporates personal and environmental safety practices associated with clothing, respiratory and eye protection, tools and power equipment, ventilation, and the handling, storage, and disposal of chemicals and materials in accordance with local, state, and federal safety and environmental regulations. Students will prepare vehicles for painting and operate spray equipment.

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Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork.

3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.
4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway.
5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork.
6. Apply literacy, mathematical, and scientific principles and precision measurements when diagnosing problems and making repairs.
7. Work independently, collaboratively, and in teams to explore concerns, find causes, and take appropriate action by applying principles of STEM.

PAINTING AND REFINISHING I CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Safety Precautions in Painting and Refinishing

1. Identify safety and personal health hazards according to OSHA guidelines and the "Right to Know" Law.
2. Inspect spray environment and equipment to ensure compliance with federal, state, and local regulations, and to eliminate safety and cleanliness hazards.
3. Select and use a National Institute for Occupational Safety and Health (NIOSH) approved supplied-air (fresh air make-up) respiratory system and perform maintenance in accordance with OSHA Regulation 1910.134 and applicable state and local regulations.

Surface Preparation

4. Inspect, remove, store, protect, and replace exterior trim and components as necessary for proper surface preparation.
5. Wash the entire vehicle with soap and water and use appropriate cleaner to remove contaminants.
6. Inspect and identify type of finish, surface condition, and film thickness, and develop and document a plan for refinishing using a total product system.
7. Identify and remove paint finish as needed, and select suitable sandpaper to sand and featheredge areas to be refinished.
8. Mix and apply suitable metal treatment, primer, primer-surfacer, and primer-sealer in accordance with total product systems following paint manufacturer's technical data sheet instructions.
9. Demonstrate masking techniques.
   Examples: recess and backmasking, foam door type
10. Apply and sand two-component finishing filler to correct minor surface imperfections.
11. Guide coat and block sand area to which primer-surfacer has been applied, using correct grade and grit sandpaper.
12. Clean area to be refinished using the recommended final cleaning procedures.
13. Apply primer sealer to the area being refinished.
14. Apply and restore stone chip resistant coating, caulking, and seam sealers to repaired areas and replacement panels as required.
15. Prepare adjacent panels for blending using paint manufacturer's procedures.
16. Identify the types of rigid, semi-rigid, or flexible plastic parts and metal parts to be refinished to determine needed materials, preparation, and refinishing procedures.

Spray Gun Operation	17. Inspect, clean, and determine condition of spray guns and related equipment, including air hoses, regulators, air lines, air source, spray environment, and fillers. 18. Select spray gun setup (fluid needle, nozzle, and cap) for product being applied. 19. Test and adjust spray gun using fluid, air, and pattern control valves. 20. Assemble pressure spray equipment and perform coating application.

Painting and Refinishing II

Course Credit	1.0
Grade Levels	10-12
Prerequisites	Painting and Refinishing I

Painting and Refinishing II is designed to equip students with knowledge and skills regarding diagnosis and repair of automotive surface defects and the application of various automotive paint finishes. The course extends skills covered in Painting and Refinishing I. Skills include mixing, matching, and applying paint; identifying and correcting defects; and applying final details.

Content standards are written to meet Automotive Service Excellence (ASE) Education Foundation requirements, which also specify task lists, program hours, and safety standards.

Career and Technical Student Organizations are integral, co-curricular components of each career and technical education course. These organizations enhance classroom instruction while helping students develop leadership abilities, expand workplace-readiness skills, and access opportunities for personal and professional growth. Students in the Transportation, Distribution and Logistics career cluster affiliate with SkillsUSA.

Foundational standards, shown in the table below, are an important part of every course. Through these standards, students learn and apply safety concepts, explore career opportunities and requirements, practice the skills needed to succeed in the workplace, develop leadership qualities and take advantage of the opportunities afforded by Career and Technical Student Organizations (CTSOs), and learn and practice essential digital literacy skills. The foundational standards are to be incorporated throughout the course.

Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork.

3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.
4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway.
5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork.
6. Apply literacy, mathematical, and scientific principles and precision measurements when diagnosing problems and making repairs.
7. Work independently, collaboratively, and in teams to explore concerns, find causes, and take appropriate action by applying principles of STEM.

PAINTING AND REFINISHING II CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Paint Mixing, Matching, and Applying

1. Identify color code by manufacturer's vehicle information label.
2. Shake, stir, reduce, catalyze and activate, and strain refinish materials.
3. Apply finish using correct spray techniques for the finish being applied, including gun arc, angle, distance, travel speed, and spray pattern overlap.
4. Apply product on a test or let-down panel to check for color match.
    a. Store and maintain a color catalog.
5. Apply single stage topcoats.

	6. Apply basecoat, multi-stage and clear coat for panel blending, panel refinishing, cut-ins, and overalls. 7. Identify poor hiding colors and tint color using formula to achieve a blendable match. 8. Identify and mix paint and alternative color formula to achieve a blendable match. 9. Identify the materials, equipment, and preparation differences between solvent and waterborne technologies.
Paint Defects - Causes and Cures	10. Locate paint defects and identify their causes and preventive measures. *Examples: blistering, dry spray, fish-eyes, lifting, mottling, orange peel, overspray, solvent pop, sags, runs, sand scratch swelling, contour mapping, color difference, tape tracking, low gloss, poor adhesion, paint cracking, corrosion, water spotting* 11. Inspect paint finish to determine types of damage and a course of action to correct the damage. *Examples: bird droppings, tree sap, and other natural causes; industrial fallout, die-back, chalking, bleed-through, pinholing* 12. Correct conditions causing buffing-related imperfections. *Examples: swirl marks, wheel burns*
Final Detail	13. Apply decals, transfers, tapes, stone guards, moldings, and emblems. 14. Sand, buff, and polish new finish to remove defects (nib sand) and texture as required. 15. Sand, buff, and polish existing finish to recondition defects as required. 16. Measure and record film thickness before and after buffing. 17. Clean interior, exterior, glass, and body openings and utilize a checklist to verify satisfactory completion of all finishing tasks. *Examples: door jambs, gaps, edges*

Structural Analysis and Damage Repair

Course Credit	1.0
Grade Levels	11-12
Prerequisites	Painting and Refinishing II

Structural Analysis and Damage Repair is designed to equip students with knowledge and skills regarding methods of determining structural misalignment and the processes used to effect repairs. This course presents the methods, techniques, and equipment employed in the inspection, measurement, and repair of automotive structures, including frame and body and glass components. Standards focus on ensuring that students can locate, identify, and repair structural components to factory specifications. This course incorporates personal and environmental safety practices associated with clothing, respiratory and eye protection, hand tools and power equipment, ventilation, and the handling, storage, and disposal of chemicals and materials in accordance with local, state, and federal safety and environmental regulations.

Content standards are written to meet Automotive Service Excellence (ASE) Education Foundation requirements, which also specify task lists, program hours, and safety standards.

Career and Technical Student Organizations are integral, co-curricular components of each career and technical education course. These organizations enhance classroom instruction while helping students develop leadership abilities, expand workplace-readiness skills, and access opportunities for personal and professional growth. Students in the Transportation, Distribution and Logistics career cluster affiliate with SkillsUSA.

Foundational standards, shown in the table below, are an important part of every course. Through these standards, students learn and apply safety concepts, explore career opportunities and requirements, practice the skills needed to succeed in the workplace, develop leadership qualities and take advantage of the opportunities afforded by Career and Technical Student Organizations (CTSOs), and learn and practice essential digital literacy skills. The foundational standards are to be incorporated throughout the course.

Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces.

2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork.
3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.
4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway.
5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork.
6. Apply literacy, mathematical, and scientific principles and precision measurements when diagnosing problems and making repairs.
7. Work independently, collaboratively, and in teams to explore concerns, find causes, and take appropriate action by applying principles of STEM.

STRUCTURAL ANALYSIS AND DAMAGE REPAIR CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Safety Precautions

1. Locate and follow OEM procedures and precautions to identify material and composition of the vehicle being repaired.
   Examples: mild steel, high strength steel, ultra-high strength steel
2. Identify advanced vehicle system precautions and inspection locations and recommended procedures before inspecting or replacing components.

Frame Inspection and Repair	3. Measure and diagnose structural damage using a metric tape measure and a tram gauge. 4. Complete proper installation of the vehicle onto a repair bench or frame rack. 5. Analyze, straighten, and align mash (collapse), sag, side sway, twist, and diamond damage. 6. Remove and replace damaged structural components and protective coatings and restore corrosion protection to repaired or replaced frame areas and anchoring locations. 7. Analyze, identify, align, and replace misaligned or damaged steering, suspension, and powertrain mounting points and components. 8. Identify and analyze heat limitations, monitoring procedures, and crush and collapse zones for structural components. 9. Identify and describe structural foam applications. *Examples: wand application, spray gun, part components* 10. Measure and diagnose structural damage using a three-dimensional measuring system. *Examples: mechanical, electronic, laser* 11. Determine and document the extent of direct and indirect damage, the direction of impact, and the methods and sequence of repair.
Unibody and Unitized Structure Inspection, Measurement, and Repair	12. Analyze, identify, align, and replace misaligned or damaged steering, suspension, and powertrain mounting points that can cause vibration, steering, and chassis alignment problems. 13. Measure and diagnose unibody damage using a metric tape measure, tram gauge, and a dedicated (fixed) measuring system. 14. Diagnose and measure unibody vehicles using a three-dimensional measuring system. *Examples: mechanical, electronic, laser*

	15. Attach anchoring devices to vehicles and remove or reposition components as necessary. 16. Straighten and align roof rails and headers, roof panels, rocker panels, pillars, vehicle openings, wheelhouse assemblies, rear body sections, upper and lower rails, and suspension and components. 17. Make recommendations for repair or replacement of structural components. 18. Identify proper cold stress relief methods. 19. Determine sectioning procedures of a steel body structure. 20. Remove and replace damaged structural components. 21. Determine the extent of damage to aluminum structural components and repair, weld, or replace them.
Stationary Glass	22. Identify considerations for removal and handling of one-time-use parts and installation of advanced glass systems (comfort and safety features). 23. Remove and reinstall or replace modular glass using recommended materials. 24. Check glass systems for water leaks, dust leaks, and wind noise. 25. Identify considerations for pre-scan, post-scan, and recalibration procedures.

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