

**Foundational CTE Courses**

Career Exploration (22151)    Employability (22152)    Entrepreneurship (12053)    Workplace Technology Skills (10004)    Leadership & Service (22101)

**Cluster Courses**

Intro to Technology Education (21051)    Maintenance & Light Repair (20104)    Small Engine Mechanics (20110)    Powersports  
Introduction to Vehicle Systems & Maintenance (20106)

**Pathway Courses**

**Automotive Technology**

**Diesel Technology**

**Autobody Technology**

Automotive Engine Repair & Performance (20121)  
Automatic Transmission & Transaxle & Suspension & Steering  
(20123)  
Brakes/Manual Drivetrain & Axles (20122)  
Electrical/Electronic Systems & HVAC (20105)

Automotive Engine Repair & Performance (20121)  
Diesel Technology (20107)

Introduction to Auto Body & Estimating (20124)  
Non-Structural Analysis & Damage Repair (20115)  
Structural Analysis & Damage Repair (20117)  
Auto Body Painting & Refinishing (20116)

**Dual Credit Courses**

Visit [www.sdmylife.com](http://www.sdmylife.com) for a full list of dual credit courses in the Transportation, Distribution & Logistics Career Cluster.

**Academic CTE Courses**

Geometry (02072<sup>^</sup>)    Chemistry (03101<sup>^</sup>)    Environmental Science (03003<sup>^</sup>)

**Capstone CTE Courses**

Entrepreneurship Experience (80026)    Senior Experience (80019<sup>^</sup>)    Youth Apprenticeship (80020)    Service Learning Experience (22104)    Youth Internships (80018<sup>^</sup>)



## Introduction to Vehicle Systems & Maintenance

Career Cluster	Transportation, Distribution & Logistics
Course Code	20106
Prerequisite(s)	None
Credit	0.5 or 1.0
Program of Study and Sequence	Any Foundation course – <b>Introduction to Vehicle Systems &amp; Maintenance</b> – pathway course in the automotive technology; automotive body, collision & refinishing; or diesel pathway
Student Organization	SkillsUSA
Coordinating Work-Based Learning	N/A
Industry Certifications	N/A
Dual Credit or Dual Enrollment	See: <a href="https://sdmylife.com/images/Approved-CTE-Dual-Credit.pdf">https://sdmylife.com/images/Approved-CTE-Dual-Credit.pdf</a>
Teacher Certification	Transportation, Distribution & Logistics Cluster Endorsement; Automotive Technology Pathway Endorsement; *Automotive Technology *7-12 Technology Education
Resources	N/A

### Course Description

Intro to Vehicle Systems & Maintenance is an introductory automobile course. Students will study the basic principles of electrical and mechanical systems used in motor vehicle technology while developing core hand skills. This course is designed to give learners information on basic ownership and maintenance of a vehicle, insights into careers in the automotive service and repair industry, and encourage learners to undertake practical maintenance and repair tasks.

### Program of Study Application

Intro to Vehicle Systems and Maintenance is a cluster course in the Transportation, Distribution and Logistics career cluster. Intro to Vehicle Systems and Maintenance will prepare a student to enter any of the pathways in the cluster.

## Course Standards

**IVSM 1: Students will demonstrate automotive technology safety practices, including Occupational Safety and Health Administration (OSHA) and Environmental Protection Agency (EPA) requirements, for an automotive repair facility.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skill/Concept	IVSM 1.1 Demonstrate automotive technician safety practices. <ul style="list-style-type: none"> <li>● Use protective clothing and safety equipment according to OSHA and EPA requirements</li> <li>● Summarize the proper use of safety data sheet (SDS)</li> <li>● Demonstrate the proper use of hand and power tools</li> <li>● Examine basic shop safety using OSHA standards</li> <li>● Maintain a portfolio of successfully completed safety and equipment exams</li> </ul>
Two Skill/Concept	IVSM 1.2 Understand the way in which waste gasses, emissions, and other environmentally destructive substances are generated and their effects on the environment. <ul style="list-style-type: none"> <li>● Understand the formation of carbon monoxide in internal combustion engines and the effects on the environment</li> <li>● Study the effects of vehicle emissions on the ecosystem</li> <li>● Compare the emissions of hydro-fuel cell, electric, and gasoline powered vehicles</li> </ul>

**IVSM 2: Students explore career opportunities in the Transportation, Distribution and Logistics career cluster and develop leadership skills.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skill/Concept	IVSM 2.1 Demonstrate independent and teamwork skills. <ul style="list-style-type: none"> <li>● Develop a teamwork project (change oil, tire rotation)</li> </ul>
Two Skill/Concept	IVSM 2.2 Explore career opportunities within the industry. <ul style="list-style-type: none"> <li>● Utilize guidance software to research and report on career opportunities</li> <li>● Update student portfolios and personal learning plans</li> </ul>

**IVSM 3: Students will demonstrate an understanding of the safe and appropriate use of tools, equipment and work processes.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skill/Concept	IVSM 3.1. Understand and use the appropriate tools and equipment. <ul style="list-style-type: none"> <li>● Demonstrate proper usage of tools and equipment</li> <li>● Inspect and perform preventative and required maintenance of tools and equipment</li> </ul>
Two Skill/Concept	IVSM 3.2. Diagnose and analyze components and systems. <ul style="list-style-type: none"> <li>● Use DMM (digital multi-meter) to measure electrical voltage, amps and resistance</li> <li>● Demonstrate use of a load tester on a battery, charging, and starting systems</li> </ul>
Two Skill/Concept	IVSM 3.3. Select and demonstrate proper use of measuring devices and mathematical formulas.

	<ul style="list-style-type: none"> <li>● Identify the measuring instruments needed to assure proper tolerance ranges can be achieved (micrometer, caliper)</li> <li>● Identify, apply, and calculate mathematical formulas that apply to the automotive industry (Ohm's Law, cubic displacement, horse power)</li> </ul>
Two Skill/Concept	<p>IVSM 3.4. Use and understand standard and metric units of measurements.</p> <ul style="list-style-type: none"> <li>● Measure brake rotor with caliper and compare to specifications</li> <li>● Measure tread width and mathematically calculate the sidewall height of the tire using the aspect ratio of the tire</li> <li>● Convert standard units and metric units</li> </ul>
Two Skill/Concept	<p>IVSM 3.5. Use measurement devices to diagnose and repair vehicles and components following industry standards.</p> <ul style="list-style-type: none"> <li>● Identify tools and equipment used to measure caster, camber and toe</li> <li>● Measure resistance in spark plug high-tension leads to assure proper operation of ignition system</li> </ul>
Two Skill/Concept	<p>IVSM 3.6. Demonstrate access and proper usage of Technical Service Bulletins (TSB) and service manuals.</p> <ul style="list-style-type: none"> <li>● Utilize service information to find vehicle specifications</li> <li>● Use vehicle owner's manual to find proper quantity and quality of oil to use to perform an engine oil and filter change</li> <li>● Use scan tool to pull trouble codes from vehicle's computer diagnostic system</li> </ul>
Three Strategic Thinking	<p>IVSM. 3.7. Comprehend the importance of calibration processes, systems, and techniques using various measuring and testing devices.</p> <ul style="list-style-type: none"> <li>● Calibrate a dial indicator</li> <li>● Check the accuracy of an outside/inside micrometer</li> <li>● Calibrate an Ohm meter</li> </ul>

**IVSM 4: Students understand scientific principles in relation to chemical, mechanical, and physical functions of various power plants and vehicle systems.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skill/Concept	<p>IVSM 4.1. Demonstrate knowledge of the operation of the internal combustion engine.</p> <ul style="list-style-type: none"> <li>● Identify different types of gasoline and diesel engines and 2 and 4 stroke engines</li> <li>● Compare the similarities and differences in a 2 and 4 stroke cycle</li> </ul>
Two Skill/Concept	<p>IVSM 4.2. Demonstrate a basic understanding of the operating principles of heating and air conditioning systems.</p> <ul style="list-style-type: none"> <li>● Identify the components of heating and air conditioning systems</li> <li>● Describe the air flow and refrigerant flow in heating and air conditioning systems</li> </ul>
Two Skill/Concept	<p>IVSM 4.3. Compare alternate fuel and power sources.</p> <ul style="list-style-type: none"> <li>● Identify and research hybrid, fuel cell, and electric vehicles and explain how these vehicles work for a written report or presentation</li> <li>● Understand fundamental hazards of dealing with hybrid, fuel cell, and electric vehicles</li> </ul>

**IVSM 5: Students perform and document maintenance procedures according to manufacturers' specifications.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Three Strategic Thinking	IVSM 5.1. Demonstrate the procedures and practices for manufacturers' repair and maintenance schedules. <ul style="list-style-type: none"> <li>● Change oil and filter according to manufacturer's specs</li> <li>● Check proper inflation and condition of vehicle tires</li> <li>● Check and refill critical fluids</li> <li>● Inspect belts and hoses</li> </ul>
Three Strategic Thinking	IVSM 5.2. Demonstrate the use of service information to repair a vehicle. <ul style="list-style-type: none"> <li>● Utilize service information to find vehicle specifications</li> <li>● Use vehicle owner manual to find proper quantity and quality of oil to use to perform an engine oil and filter change</li> </ul>
Three Strategic Thinking	IVSM 5.3 Demonstrate tire maintenance/tire care (tire rotation, tread depth, air pressure, and tire wear types).

**IVSM 6: Students explore considerations when purchasing, owning, maintaining, and selling a vehicle.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skill/Concept	IVSM 6.1 Understand and demonstrate skills for purchasing, owning, maintaining and selling a vehicle. <ul style="list-style-type: none"> <li>● Demonstrate knowledge of purchasing a vehicle, including how to select a vehicle</li> <li>● Explore various vehicle types</li> <li>● Compare and contrast buying from a dealer versus purchasing from a private party, and buying versus leasing a vehicle</li> <li>● Understand the costs associated with owning a vehicle including licensing, registration, insurance, loans, interest rates, credit scores, depreciation and other factors</li> </ul>

**IVSM 7: Students will understand and apply appropriate vehicle service and repairs.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skill/Concept	IVSM 7.1 Perform general automotive diagnosis and repair in professional manner within National Automotive Technicians Education Foundation (NATEF) standards. <ul style="list-style-type: none"> <li>● Perform engine compression test (dry/wet)</li> <li>● Set gap and replace spark plugs and wires as needed</li> </ul>
Two Skill/Concept	IVSM 7.2 Perform basic roadside maintenance and repairs, including simple diagnostics. <ul style="list-style-type: none"> <li>● Replace a tire and rim, change wiper blades, and demonstrate other basic maintenance tasks.</li> <li>● Diagnose what to do if check engine light comes on</li> <li>● Check gauges for sufficient oil pressure, fuel, and other indications</li> </ul>
One Recall and Recognition	IVSM 7.3 Understand what items should be in a vehicle in case of problems.

	<ul style="list-style-type: none"> <li>● Flashlights, blankets, basic food, jumper cables, tow strap, small/folding shovel, first aid kit, candle, safety triangle/flares, can of green slime, and other basic necessities.</li> </ul>
Two Skill/Concept	<p>IVSM 7.4 Demonstrate ability to maintain and service lubrication and cooling systems.</p> <ul style="list-style-type: none"> <li>● Analyze engine oil pressure</li> <li>● Remove and install an oil pressure sending unit</li> <li>● Inspect and test cooling system and pressure cap</li> </ul>
Two Skill/Concept	<p>IVSM 7.5 Understand the basic operation of computer-controlled systems, and location and identification of related parts.</p> <ul style="list-style-type: none"> <li>● Use a code reader and or scanner to diagnose computer system failure</li> <li>● Locate and test computer components</li> <li>● Clear trouble codes from computer with scanner</li> </ul>

**IVSM 8: Students understand the function, principles and operation of electrical systems using manufacturers' and industry standards.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skill/Concept	<p>IVSM 8.1 Demonstrate an understanding of how to diagnose and repair electrical systems.</p> <ul style="list-style-type: none"> <li>● Clean battery terminals and electrical connections</li> <li>● Use DVOM (digital volt ohm meter) to check voltage drop at connections</li> <li>● Use DVOM to check resistance in electrical circuits</li> </ul>
Two Skill/Concept	<p>IVSM8.2 Diagnose and service batteries.</p> <ul style="list-style-type: none"> <li>● Check battery state-of-charge with hydrometer or DVOM</li> <li>● Check battery load capacity with load tester</li> <li>● Remove and replace battery</li> </ul>
Two Skill/Concept	<p>IVSM 8.3 Demonstrate knowledge needed to diagnose and repair starting and charging systems.</p> <ul style="list-style-type: none"> <li>● Check starting system draw with starting system tester</li> <li>● Check charging system output with charging system tester</li> </ul>
Two Skill/Concept	<p>IVSM 8.4 Demonstrate ability to properly diagnose and repair lighting systems.</p> <ul style="list-style-type: none"> <li>● Adjust headlights</li> <li>● Remove and replace headlight/taillight bulbs</li> <li>● Replace bulbs</li> <li>● Test electrical system circuits and components</li> </ul>
Two Skill/Concept	<p>IVSM 8.5 Demonstrate ability to properly diagnose and repair heating and air conditioning systems.</p> <ul style="list-style-type: none"> <li>● Test strength and condition of coolant</li> <li>● Remove and replace coolant and flush if needed</li> <li>● Test output temperature of A/C system</li> </ul>

**IVSM 9: Students understand the function and principles of automotive brake, steering and suspension, automatic and manual transmission systems.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skill/Concept	<p>IVSM 9.1 Demonstrate how to diagnose and service hydraulic and friction systems.</p>

	<ul style="list-style-type: none"><li>● Check brake pad dimensions and conditions</li><li>● Check condition of rotor and/or drum</li><li>● Check for leaks, cracks or bulges in brake lines</li><li>● Check emergency brake cable operation</li></ul>
Two Skill/Concept	IVSM 9.2 Demonstrate how to diagnose and service steering and suspension systems. <ul style="list-style-type: none"><li>● Check for proper power steering fluid condition and level</li><li>● Check condition of front and rear struts and/or shocks</li></ul>
Two Skill/Concept	IVSM 9.3 Demonstrate how to diagnose and service automatic and manual transmissions. <ul style="list-style-type: none"><li>● Check automatic and manual transmission fluid levels</li><li>● Replace automatic transmission fluid and filter</li></ul>

Proposed



## Maintenance and Light Repair

Career Cluster	Transportation, Distribution & Logistics
Course Code	20104
Prerequisite(s)	None
Credit	0.5 or 1.0
Program of Study and Sequence	Any foundation course – <b>Maintenance and Light Repair (MLR)</b> – Any advanced course
Student Organization	SkillsUSA
Coordinating Work-Based Learning	N/A
Industry Certifications	N/A
Dual Credit or Dual Enrollment	See: <a href="https://sdmylife.com/images/Approved-CTE-Dual-Credit.pdf">https://sdmylife.com/images/Approved-CTE-Dual-Credit.pdf</a>
Teacher Certification	Transportation, Distribution & Logistics Cluster Endorsement; Automotive Technology Pathway Endorsement; *Automotive Technology
Resources	N/A

### Course Description

This is an entry level course where students will learn basic maintenance procedures and safe work practices. The goal of this course is for students to receive industry-based training at the basic level and advance to the higher level of competency in this field. Students who complete this course should be able to test for their ASE certification in this field.

### Program of Study Application

Maintenance and Light Repair is a cluster course in the Transportation, Distribution and Logistics career cluster. Success in Maintenance and Light Repair will prepare a student to enter any of the pathways in the cluster.



## Course Standards

### MLR 1: Students will demonstrate safety practices for automotive repair.

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skill/Concept	<p>MLR 1.1 Identify and demonstrate general shop safety rules and procedures using Occupational Safety and Health Administration (OSHA) standards.</p> <ul style="list-style-type: none"> <li>● Examine basic shop safety using OSHA 10 standards</li> <li>● Utilize proper ventilation procedures for working within the lab/shop area</li> <li>● Identify marked safety areas</li> <li>● Identify location and types of fire extinguishers and other fire safety equipment</li> <li>● Identify location and use of eyewash stations</li> <li>● Identify location of posted evacuation routes</li> <li>● Demonstrate knowledge of industry requirements for personal protective clothing and equipment</li> <li>● Identify and wear proper clothing, hairstyles and jewelry for lab/shop activities</li> <li>● Locate and demonstrate knowledge of safety data sheets (SDS)</li> </ul>

### MLR 2: Students will demonstrate an understanding of the safe and appropriate use of tools and equipment.

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skill/Concept	<p>LR 2.1 Utilize safe procedures for handling of tools and equipment.</p> <ul style="list-style-type: none"> <li>● Identify and use proper placement of floor jacks and jack stands</li> <li>● Identify and use proper procedures for safe lift operation</li> <li>● Demonstrate knowledge of safety aspects of supplemental restraint systems (SRS), electronic brake control systems and hybrid vehicle high voltage circuits</li> <li>● Demonstrate awareness of the safety aspects of high voltage circuits (such as high intensity discharge [HID] lamps, ignition systems, injection systems, etc.)</li> </ul>

### MLR 3: Students will locate needed information.

<i>Webb Level</i>	<i>Sub-indicator</i>
One Recall	<p>MLR 3.1 Identify sources of service information.</p> <ul style="list-style-type: none"> <li>● Locate and use paper and electronic manuals</li> <li>● Locate and use Technical Service Bulletins (TSB)</li> <li>● Demonstrate awareness of special service messages, service campaigns/recalls, vehicle/service warranty applications, and service interval recommendations</li> </ul>
One Recall	<p>MLR 3.2 Identify proper vehicle identification information.</p> <ul style="list-style-type: none"> <li>● Locate vehicle identification number (VIN) and production date code</li> <li>● Apply knowledge of VIN information</li> <li>● Demonstrate awareness of other vehicle information labels (such as tire, emissions, etc.)</li> </ul>

### MLR 4: Students will understand and apply appropriate business practices.

<i>Webb Level</i>	<i>Sub-indicator</i>
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Three Strategic Thinking	MLR 4.1 Demonstrate the importance of, and the procedures for, maintaining accurate records.
Three Strategic Thinking	MLR 4.2 Understand the concept and application of ethical business practices.
Three Strategic Thinking	MLR 4.3 Understand the concept and application of excellent customer relations practices.

**MLR 5: Students will perform basic vehicle service.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skill/Concept	<p>MLR 5.1 Perform basic vehicle service.</p> <ul style="list-style-type: none"> <li>● Determine fluid type requirements and identify fluid</li> <li>● Check and adjust engine oil</li> <li>● Check and adjust engine coolant level</li> <li>● Check and adjust power steering fluid level</li> <li>● Check and adjust brake fluid level</li> <li>● Check and adjust windshield washer fluid level</li> <li>● Check and adjust differential /transfer case fluid level</li> <li>● Check and adjust transmission fluid level</li> <li>● Check and replace wiper blades</li> <li>● Inspect drive belts, tensioners, and pulleys; check pulley and belt alignment</li> <li>● Inspect and replace air filter</li> <li>● Check and adjust tire air pressure</li> <li>● Inspect exhaust system</li> </ul>

**MLR 6: Students will inspect and repair engine.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skill/Concept	<p>IMLR 6.1 Test and perform actions necessary to repair engine.</p> <ul style="list-style-type: none"> <li>● Demonstrate knowledge of four-cycle engine</li> <li>● Inspect engine assembly for fuel, oil coolant and other leaks; determine necessary action</li> <li>● Perform cooling system pressure tests; test coolant condition; inspect and test radiator, pressure cap, coolant recovery tank and hoses; perform necessary action</li> <li>● Test cooling system for the presence of combustion gases</li> <li>● Drain and recover coolant; flush and refill cooling system with recommended coolant; bleed air as required</li> <li>● Perform oil and filter change; reset oil life monitoring system where applicable</li> <li>● Remove and replace radiator; replace radiator hoses</li> <li>● Inspect powertrain mounts; determine necessary action</li> </ul>

**MLR 7 Students will service an automatic transmission.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skill/Concept	<p>MLR 7.1 Service transmission system.</p> <ul style="list-style-type: none"> <li>● Drain automatic transmission fluid</li> <li>● Visually inspect the amount of debris in oil pan</li> <li>● Remove filter and install new filter</li> </ul>

	<ul style="list-style-type: none"> <li>● Install the proper fluid to the proper level</li> </ul>
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**MLR 8: Students will inspect, diagnose and repair manual drive train and axles.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skill/Concept	<p>MLR 8.1 Diagnose and repair manual drive train and axles.</p> <ul style="list-style-type: none"> <li>● Diagnose fluid loss, level, and condition concerns; determine necessary action</li> <li>● Drain and fill transmission/transaxle and final drive unit</li> <li>● Identify and inspect clutch pedal linkage, cables, automatic adjuster mechanisms, brackets, bushings, pivots, and springs; determine necessary action</li> <li>● Identify and inspect hydraulic clutch slave and master cylinders, lines and hoses; determine necessary action</li> <li>● Bleed clutch hydraulic system</li> <li>● Inspect constant velocity (CV) joint boots</li> <li>● Remove and replace rear wheel drive shaft</li> </ul>

**MLR 9: Students will repair suspension and steering.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skill/Concept	<p>MLR 9.1 Diagnose suspension and steering; determine necessary action.</p> <ul style="list-style-type: none"> <li>● Determine proper power steering fluid types</li> <li>● Flush, fill and bleed power steering system</li> <li>● Diagnose power steering fluid leakage; determine necessary action</li> <li>● Lubricate suspension and steering systems</li> <li>● Inspect, remove and replace shock absorbers</li> <li>● Inspect and install stabilizer bar bushings, brackets, and links</li> <li>● Inspect and install strut cartridge or assembly, coil spring, insulators (silencers), and upper strut mount</li> <li>● Perform pre-alignment inspection and measure vehicle ride height; determine necessary action</li> <li>● Demonstrate knowledge of the principles of steering geometry using caster, camber and toe</li> </ul>
Two Skill/Concept	<p>MLR 9.2 Inspect and repair tire and wheel assembly.</p> <ul style="list-style-type: none"> <li>● Diagnose tire wear patterns; determine necessary action</li> <li>● Diagnose wheel/tire vibration, shimmy, and noise; determine necessary action</li> <li>● Identify vehicles equipped with a tire pressure monitoring system (TPMS)</li> <li>● Demonstrate knowledge of service considerations of vehicles equipped with a TPMS</li> <li>● Rotate tires according to manufacturer's recommendations</li> <li>● Balance wheel and tire assembly (static and dynamic)</li> <li>● Dismount, inspect, and remount tire on wheel</li> <li>● Repair tire using internal patch</li> <li>● Reinstall wheel; torque lug nuts</li> </ul>

**MLR 10: Students will inspect, diagnose and repair brake assembly.**

<i>Webb Level</i>	<i>Sub-indicator</i>

Two Skill/Concept	<p>MLR 10.1 Diagnose and repair brake fluid system.</p> <ul style="list-style-type: none"> <li>● Inspect brake lines, flexible hoses, and fittings for leaks, dents, kinks, rust, cracks, bulging or wear; tighten loose fittings and support; determine necessary action</li> <li>● Select, handle, and fill brake fluids to proper level</li> <li>● Bleed brake system</li> <li>● Test brake fluid for contamination; determine necessary action</li> </ul>
Two Skill/Concept	<p>MLR 10.2 Inspect and repair brake shoes and drum assemblies.</p> <ul style="list-style-type: none"> <li>● Remove, clean, inspect and measure brake drums; determine necessary action</li> <li>● Refinish brake drum; measure final drum diameter</li> <li>● Remove, clean, inspect brake shoes, springs, pins, clips, levers, adjuster/self-adjuster, other related brake hardware, and backing support plates; lubricate and reassemble</li> <li>● Inspect and install wheel cylinders</li> <li>● Pre-adjust brake shoes and parking brake; install brake drums or drum/hub assemblies and wheel bearings</li> <li>● Install wheel, torque lug nuts, and make final checks and adjustments</li> </ul>
Two Skill/Concept	<p>MLR 10.3 Inspect and repair caliper assembly.</p> <ul style="list-style-type: none"> <li>● Remove caliper assembly; inspect for leaks and damage to caliper housing; determine necessary action</li> <li>● Clean and inspect caliper mounting and slides/pins for wear, operation and damage; determine necessary action</li> <li>● Remove, inspect and replace pads and retaining hardware; determine necessary action</li> <li>● Reassemble, lubricate, and reinstall caliper, pads and related hardware; seat pads and inspect for leaks</li> </ul>
Two Skill/Concept	<p>MLR 10.4 Inspect and repair rotor assembly.</p> <ul style="list-style-type: none"> <li>● Clean, inspect and measure rotor thickness, lateral runout and thickness variation; determine necessary action</li> <li>● Remove and reinstall rotor</li> <li>● Refinish rotor on vehicle; measure final rotor thickness</li> <li>● Refinish rotor off vehicle; measure final rotor thickness</li> <li>● Install wheel. Torque lug nuts and make final checks and adjustments</li> </ul>
One Recall	<p>MLR 10.5 Inspect and repair vacuum supply.</p> <ul style="list-style-type: none"> <li>● Check vacuum supply (manifold or auxiliary pump) to vacuum-type power booster</li> <li>● Inspect vacuum-type power booster unit for leaks; inspect the check valve for proper operation; verify proper booster function</li> <li>● Demonstrate knowledge of the causes of wheel bearing noises, wheel shimmy and vibration concerns</li> <li>● Check parking brake cables and components for wear, binding and corrosion; clean, lubricate, adjust or replace as needed</li> </ul>
Two Skill/Concept	<p>MLR 10.6 Inspect and repair brake indicator light components.</p> <ul style="list-style-type: none"> <li>● Check parking brake and indicator light system operation; determine necessary action</li> <li>● Check operation of brake stop light system; determine necessary action</li> </ul>

	<ul style="list-style-type: none"> <li>● Replace tapered roller wheel bearing and race</li> <li>● Clean, inspect, lubricate, install and adjust wheel bearing</li> <li>● Identify and inspect electronic brake control system components; determine necessary action</li> <li>● Demonstrate knowledge of the operation of the brake hydraulic failure warning light</li> </ul>
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**MLR 11: Students will inspect, test and repair electrical/electronic systems.**

<i>Webb Level</i>	<i>Sub-indicator</i>
One Recall	<p>MLR 11.1 Diagnose electrical circuit problems.</p> <ul style="list-style-type: none"> <li>● Diagnose electrical/electronic integrity of series, parallel and series-parallel circuits using principles of electricity (Ohm's Law)</li> <li>● Demonstrate use of wiring diagrams during diagnosis of electrical circuit problems</li> <li>● Demonstrate the proper use of a digital multimeter (DMM) during diagnosis of electrical circuit problems, including source voltage, voltage drop, current flow and resistance</li> <li>● Check electrical circuits with a test light; determine necessary action</li> <li>● Check electrical circuits using fused jumper wires; determine necessary action</li> <li>● Demonstrate knowledge of the causes and effects of shorts, grounds, opens and resistance problems in electrical/electronic circuits</li> <li>● Measure key-off battery drain (parasitic draw); determine necessary action</li> <li>● Inspect and test fusible links, circuit breakers and fuses; determine necessary action</li> <li>● Inspect and test switches, connectors, relays and wires of electrical/electronic circuits</li> <li>● Repair connectors and terminal ends</li> <li>● Perform solder repair of electrical wiring</li> </ul>
Two Skill/Concept	<p>MLR 11.2 Inspect and repair battery problems.</p> <ul style="list-style-type: none"> <li>● Perform battery state-of-charge test; determine necessary action</li> <li>● Perform battery capacity test; confirm proper battery capacity for vehicle application; determine necessary action</li> <li>● Maintain or restore electronic memory functions</li> <li>● Inspect, clean, fill, and/or replace battery, battery cables, connectors, clamps and hold-downs</li> <li>● Perform battery charge</li> <li>● Start a vehicle using jumper cables and a battery or auxiliary power supply</li> </ul>
Two Skill/Concept	<p>MLR 11.3 Diagnose and repair starter.</p> <ul style="list-style-type: none"> <li>● Perform starter current draw tests; determine necessary action</li> <li>● Perform starter circuit voltage drop tests; determine necessary action</li> <li>● Inspect and test starter relays and solenoids; determine necessary action</li> <li>● Remove and replace starter</li> </ul>
Two Skill/Concept	<p>MLR 11.4 Diagnose and repair charging system.</p> <ul style="list-style-type: none"> <li>● Perform charging system output test; determine necessary action</li> <li>● Remove and replace generator (alternator)</li> <li>● Diagnose the cause of dim, or no light operation; determine necessary action</li> </ul>

	<ul style="list-style-type: none"> <li>● Inspect, replace, and aim headlights and bulbs</li> </ul>
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**MLR 12: Students will inspect, diagnose and repair heating and air conditioning.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skill/Concept	MLR 12.1 Identify and visually inspect A/C system components. <ul style="list-style-type: none"> <li>● Locate refrigerant label and identify specified refrigerant type (e.g., R-12, R-134a)</li> <li>● Conduct preliminary performance test of A/C system and determine necessary action</li> <li>● Conduct performance test of the heater/ventilation system</li> <li>● Inspect and replace cabin air filter</li> </ul>

**MLR 13: Students will inspect, diagnose and improve engine performance.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skill/Concept	MLR 13.1 Perform the necessary tests and repairs to improve engine performance. <ul style="list-style-type: none"> <li>● Perform engine cranking and running vacuum tests; determine necessary action</li> <li>● Perform cylinder power balance test; determine necessary action</li> <li>● Perform cylinder cranking compression test; determine necessary action</li> <li>● Perform cylinder leakage test; determine necessary action</li> <li>● Verify engine operating temperature; determine necessary action</li> <li>● Retrieve and record stored diagnostic trouble codes, On-Board Diagnostics (OBD) monitor status and freeze frame data; clear codes when applicable</li> <li>● Obtain and interpret scan tool data</li> <li>● Perform fuel pressure test</li> <li>● Replace fuel filters</li> <li>● Remove and replace secondary ignition components</li> <li>● Remove and replace thermostat and gasket/seal</li> <li>● Perform common fastener and thread repair, to include: removing broken bolt, restoring internal and external threads, and repairing internal threads with a threaded insert</li> </ul>

**MLR 14: Students explore career opportunities in the transportation, distribution and logistics career cluster and develop leadership skills.**

<i>Webb Level</i>	<i>Sub-indicator</i>
One Recall	MLR 14.1 Research career opportunities in the transportation, distribution and logistics fields. <ul style="list-style-type: none"> <li>● Utilizing career exploration software, research and write a report on career opportunities in the field</li> <li>● Utilizing career exploration software, research educational requirements for a chosen career path</li> <li>● Utilizing career exploration software, update student portfolio</li> </ul>



## Small Engine Mechanics

Career Cluster	Transportation, Distribution & Logistics
Course Code	20110
Prerequisite(s)	None
Credit	0.5 or 1.0
Program of Study and Sequence	Any Foundation course – Small Engine Mechanics – Any pathway course - Capstone
Student Organization	SkillsUSA
Coordinating Work-Based Learning	Job Shadow
Industry Certifications	N/A
Dual Credit or Dual Enrollment	See: <a href="https://sdmylife.com/images/Approved-CTE-Dual-Credit.pdf">https://sdmylife.com/images/Approved-CTE-Dual-Credit.pdf</a>
Teacher Certification	Transportation, Distribution & Logistics Cluster Endorsement; Automotive Technology Pathway Endorsement *Automotive Technology ; *7-12 Technology Education
Resources	N/A

### Course Description

Small Engine Mechanics is an introductory course for students interested in obtaining skills needed to maintain and repair internal combustion engines used in industry, recreation, home and landscape maintenance, or personal settings. Students will study various small engine types, parts identification, and engine operation along with other systems found in small engine vehicles. Students will disassemble, inspect, reassemble and troubleshoot an internal combustion engine and look at other components of vehicles that use those engines. This course covers areas of safety, tools, and electrical theory.

### Program of Study Application

Small Engine Mechanics is a cluster course within the Transportation, Distribution and Logistics career cluster.

## Course Standards

### SEM 1: Students will demonstrate shop and tool safety.

<i>Webb Level</i>	<i>Sub-indicator</i>
One Recall & Reproduction	SEM 1.1 Examine basic shop safety using Occupational Safety Health Administration (OSHA) standards, including: <ul style="list-style-type: none"> <li>● Summarize the proper use of Safety Data Sheets (SDS)</li> <li>● Create a safety portfolio</li> <li>● Locate the fire extinguisher, fire blankets, and emergency exits</li> <li>● Never have an open flame near flammable liquids</li> <li>● Do not refuel engine while in operation</li> <li>● Demonstrate proper start up and shutoff procedures (be aware of surroundings when pull-starting small gas engine (SGE))</li> <li>● Eye and hearing protection</li> <li>● Clothing and shoe protection</li> </ul>
Two Skill/Concept	SEM 1.2 Demonstrate proper use of hand and power tools, including: <ul style="list-style-type: none"> <li>● Perform a general tool test (name and function of tool being used, proper use of each tool, care and storage)</li> <li>● Review Torque wrench settings and usage</li> <li>● Spark test tools (Use appropriate spark tester to check spark)</li> </ul>

### SEM 2: Students will demonstrate independent and teamwork skills as well as explore career opportunities within the industry.

<i>Webb Level</i>	<i>Sub-indicator</i>
Three Strategic Thinking	SEM 2.1 Participate in student leadership activities.
Four Extended Thinking	SEM 2.2 Utilize career guidance tools to research and report on career opportunities.
Three Strategic Thinking	SEM 2.3 Develop a teamwork project.

### SEM 3: Students will understand and apply appropriate business practices.

<i>Webb Level</i>	<i>Sub-indicator</i>
Three Strategic Thinking	IVSM 3.1 Demonstrate the importance of, and the procedures for, maintaining accurate work documents and records.
Three Strategic Thinking	IVSM 3.2 Apply concept and application of ethical business practices.
Three Strategic Thinking	IVSM 3.3 Apply excellent customer relations practices.

### SEM 4: Students will apply communication, mathematics and science knowledge and skills to Small Engine Mechanics.

<i>Webb Level</i>	<i>Sub-indicator</i>
Three Strategic Thinking	SEM 4.1 Determine horsepower of any small engine using $HP=W/(T*33,000)$ . (HP = Horsepower, W = Work, T = Time).
Three Strategic Thinking	SEM 4.2 Demonstrate the principle that fluids cannot be compressed by building a basic hydraulic cylinder/motor device on a test bench.



Three Strategic Thinking	SEM 4.3 Perform mathematical calculations and measurements commonly used in small engines, such as: <ul style="list-style-type: none"> <li>• Calculate displacement of any given engine based on the equation <math>d=c*b^2s</math> (c-constant 0.7584, b-bore, s-stroke, d-displacement)</li> <li>• Find the amount of work with the equation <math>w=f*d</math> where w=work in lb./ft (ftlb), f=force in pounds, d=distance</li> </ul>
Three Strategic Thinking	SEM 4.4 Communicate findings related to mathematics and science knowledge and skills to diagnosis problems in small engines.

**SEM 5: Students will troubleshoot an internal combustion engine.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Four Extended Thinking	SEM 5.1 Implement strategic diagnostic procedures, including: <ul style="list-style-type: none"> <li>• Apply small engine trouble shooting procedures</li> <li>• Diagnose and determine needed repair on small engine components</li> <li>• Determine wear on internal engine parts using specialized tools</li> </ul>
Two Skill/Concept	SEM 5.2 Conduct preventative maintenance on an internal combustion engine. <ul style="list-style-type: none"> <li>• Change oil and filter on small engine</li> <li>• Inspect and change air filter</li> <li>• Disassemble, clean, and inspect fuel pump</li> <li>• Disassemble, clean, and inspect carburetor</li> </ul>
Three Strategic Thinking	SEM 5.3 Analyze the functions and operations of a fuel system related to small engine technology. <ul style="list-style-type: none"> <li>• Complete fuel pressure test of system utilizing a fuel pump</li> <li>• Set carburetor float height</li> <li>• Adjust both low and high idle circuits on carburetor engines</li> <li>• Complete fuel injector function test on fuel injected engines</li> </ul>
Three Strategic Thinking	SEM 5.4 Diagnose fuel system problem. <ul style="list-style-type: none"> <li>• Test and determine needed repair on fuel system</li> <li>• Inspect and determine needed repair on air cleaner system</li> </ul>
Three Strategic Thinking	SEM 5.5 Perform fuel system service. <ul style="list-style-type: none"> <li>• Remove and replace the fuel tank, fuel lines and fuel filter system</li> <li>• Service oil-bath or foam type air cleaner</li> <li>• Reassemble and adjust a carburetor</li> <li>• Reassemble and install fuel pump</li> </ul>
Four Extended Thinking	SEM 5.6 Analyze the function and operation of emission systems related to small engines. <ul style="list-style-type: none"> <li>• Research EPA emissions standards and requirements and report on how those laws affect the small engine service industry</li> </ul>
Four Extended Thinking	SEM 5.7 Diagnose emission systems relating to small engine technology. <ul style="list-style-type: none"> <li>• Use an exhaust gas analyzer to determine the amount of HC and NOx emissions contained in the exhaust from a small engine and determine repair strategies</li> <li>• Complete electrical/electronic testing of manifold absolute pressure (MAP) sensor, O<sub>2</sub> (Oxygen) or throttle position sensor and determine whether repair or replacement of parts is needed</li> </ul>
Three Strategic Thinking	SEM 5.8 Perform emission system service on small engine. <ul style="list-style-type: none"> <li>• Replace a MAP sensor</li> </ul>

	<ul style="list-style-type: none"> <li>● Replace a fuel pressure sensor</li> <li>● Demonstrate or observe a fuel map in electronic format</li> </ul>
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**SEM 6: Students will properly test, diagnose, service, and repair charging and electrical systems related to small engines.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Three Strategic Thinking	SEM 6.1 Illustrate the application of Ohm’s law to charging and electrical systems related to small engines. <ul style="list-style-type: none"> <li>● Complete the start amp draw test on a small engine with an electric start system</li> <li>● Compute amperage use of any circuit by using the equation <math>\text{amps}=\text{volts}/\text{ohms}</math></li> </ul>
Two Skill/Concept	SEM 6.2 Interpret schematics, diagrams, and reference information used in small engine electrical systems. <ul style="list-style-type: none"> <li>● Troubleshoot the charging circuit using a manufacturer’s guide</li> <li>● Read a multimeter</li> </ul>
Three Strategic Thinking	SEM 6.3 Use strategy-based diagnostics for determining the cause of a fault in an electrical circuit. <ul style="list-style-type: none"> <li>● Test, diagnose, and service batteries and charging systems</li> <li>● Test, diagnose, and service light systems</li> <li>● Demonstrate the use of equipment and tools for electrical testing and diagnosis</li> <li>● Troubleshoot and repair starting circuit</li> </ul>
Two Skill/Concept	SEM 6.4 Inspect and repair battery problems. <ul style="list-style-type: none"> <li>● Perform battery state-of-charge test; determine necessary action</li> <li>● Perform battery capacity test; confirm proper battery capacity for vehicle application; determine necessary action</li> <li>● Maintain or restore electronic memory functions</li> <li>● Inspect, clean, fill, and/or replace battery, battery cables, connectors, clamps and hold-downs</li> <li>● Perform battery charge</li> <li>● Start a vehicle using jumper cables and a battery or auxiliary power supply</li> </ul>
Two Skill/Concept	SEM 6.5 Diagnose and repair starter. <ul style="list-style-type: none"> <li>● Perform starter current draw tests; determine necessary action</li> <li>● Perform starter circuit voltage drop tests; determine necessary action</li> <li>● Inspect and test starter relays and solenoids; determine necessary action</li> <li>● Remove and replace starter</li> </ul>
Two Skill/Concept	SEM 6.6 Diagnose and repair charging system. <ul style="list-style-type: none"> <li>● Perform charging system output test; determine necessary action</li> <li>● Remove and replace generator (alternator)</li> <li>● Diagnose the cause of dim or no light operation; determine necessary action</li> <li>● Inspect, replace, and aim headlights and bulbs</li> </ul>



## Introduction to Auto Body and Estimating

Career Cluster	Transportation, Distribution & Logistics
Course Code	20124
Prerequisite(s)	None
Credit	0.5 to 1.0
Program of Study and Sequence	Foundation Course – Cluster Course – <b>Introduction to Auto Body and Estimating</b> – Auto Body Non-Structural Analysis and Damage Repair or Auto Body Structural Analysis and Damage Repair
Student Organization	SkillsUSA
Coordinating Work-Based Learning	Field Trips, Youth Internships, Industry Speakers
Industry Certifications	ASE (Automotive Service Excellence); OSHA (Occupational Safety and Health Administration) 10
Dual Credit or Dual Enrollment	See: <a href="https://sdmylife.com/images/Approved-CTE-Dual-Credit.pdf">https://sdmylife.com/images/Approved-CTE-Dual-Credit.pdf</a>
Teacher Certification	Transportation, Distribution & Logistics Cluster Endorsement; Autobody Technology Pathway Endorsement; *Autobody Technology
Resources	N/A

### Course Description

This course is designed to expose the students to different industry terminology, safety practices, auto body estimating and basic auto body repairs. This course is for students to receive basic industry-based training before advancing to higher level courses in this field.

### Program of Study Application

Introduction to Auto Body and Estimating is a first pathway course in the Transportation, Distribution and Logistics career cluster, Automotive Body Collision and Refinishing pathway.

## Course Standards

### IAB 1: Students will demonstrate understanding of auto body safety practices and careers.

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skills/Concepts	<p>IAB 1.1 Demonstrate auto body safety practices.</p> <ul style="list-style-type: none"> <li>● Select and use proper personal safety equipment; take the necessary precautions with hazardous operations and materials in accordance with federal, state, and local regulations</li> <li>● Locate procedures and precautions that may apply to the vehicle being repaired</li> <li>● Identify vehicle system hazard types, locations and recommended procedures (supplemental restraint system (SRS), hybrid/electric/alternative fuel vehicles) before inspecting or replacing components</li> </ul>
Two Skill/Concept	<p>IAB 1.2 Analyze career opportunities in the Transportation, Distribution, &amp; Logistics career cluster.</p> <ul style="list-style-type: none"> <li>● Create a resume</li> <li>● Contact industry leaders</li> <li>● Identify related careers of auto body</li> </ul>

### IAB 2: Demonstrate uses of auto body tools and equipment.

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skill/Concept	<p>IAB 2.1 Demonstrate hand and power tools and their uses.</p> <ul style="list-style-type: none"> <li>● Name tools and their uses</li> <li>● Differentiate between pneumatic and electric</li> <li>● Demonstrate appropriate safety procedures when using tools</li> <li>● Show how to maintain tools</li> </ul>
Three Strategic Thinking	<p>IAB 2.2 Analyze uses of a compressed air system.</p> <ul style="list-style-type: none"> <li>● Components of a compressed air system</li> <li>● Compressed air system maintenance</li> <li>● Uses of compressed air</li> <li>● Safety issues when using compressed air</li> <li>● Operations of a compressed air system</li> <li>● Demonstrate use of compressed air in different operations</li> </ul>

### IAB 3: Employ collision repair estimating processes.

<i>Webb Level</i>	<i>Sub-indicator</i>
Three Strategic Thinking	<p>IAB 3.1 Demonstrate the process involved in obtaining important information.</p> <ul style="list-style-type: none"> <li>● Determine and record customer/vehicle owner information</li> <li>● Identify and record vehicle identification number (VIN) information, including nation of origin, make, model, restraint system, body type, production date, engine type and assembly plant</li> <li>● Identify and record vehicle mileage and options, including trim level, paint code, transmission, accessories and modifications</li> </ul>
Two Skills/Concepts	<p>IAB 3.2 Demonstrate the process of writing a repair estimate.</p> <ul style="list-style-type: none"> <li>● Position the vehicle for inspection</li> <li>● Prepare vehicle for inspection by providing access to damaged areas</li> <li>● Analyze damage to determine appropriate methods for overall repairs</li> </ul>

	<ul style="list-style-type: none"> <li>● Identify and record pre-existing damage</li> <li>● Apply appropriate estimating and parts nomenclature (terminology)</li> <li>● Determine and apply appropriate estimating sequence</li> <li>● Utilize estimating guide procedure pages</li> <li>● Identify operations requiring labor value judgment</li> <li>● Select appropriate labor value for each operation (structural, non-structural, mechanical, and refinish)</li> <li>● Apply math skills to establish charges and totals</li> <li>● Identify procedural differences between computer generated and manually written estimates</li> <li>● Recognize the differences in estimation procedures when using different information provider systems</li> </ul>
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**IAB 4: Apply auto body repair and finishing techniques.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skill/Concept	IAB 4.1 Demonstrate basic auto body repair techniques. <ul style="list-style-type: none"> <li>● Explain proper corrosion protection methods and why you apply them</li> <li>● Demonstrate welding processes</li> <li>● Apply metal straightening techniques</li> <li>● Explain the uses of different body filler options</li> <li>● Demonstrate plastic repair techniques</li> <li>● Explain the purpose of block sanding</li> <li>● Demonstrate block sanding techniques</li> <li>● Demonstrate Hammer and Dolly procedures</li> <li>● Demonstrate proper uses of sandpaper grits</li> </ul>
Two Skill/Concept	IAB 4.2 Demonstrate processes in automotive finishing. <ul style="list-style-type: none"> <li>● Know and understand proper overspray protection</li> <li>● Demonstrate proper refinishing procedures</li> <li>● Explain proper surface preparation</li> <li>● Apply overspray protection</li> <li>● Prepare different surfaces properly</li> <li>● Demonstrate how to use refinishing equipment (including maintenance)</li> <li>● Perform a spray gun test</li> </ul>

**IAB 5: Students will understand and apply appropriate business practices.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Three Strategic Thinking	IAB 5.1 Demonstrate the importance of, and the procedures for, maintaining accurate records.
Three Strategic Thinking	IAB 5.2 Understand the concept and application of ethical business practices.
Three Strategic Thinking	IAB 5.3 Understand the concept and application of excellent customer relations practices.



## Nonstructural Analysis and Damage Repair

Career Cluster	Transportation, Distribution & Logistics
Course Code	20115
Prerequisite(s)	Introduction to Auto Body and Estimating 20120
Credit	1.0
Program of Study and Sequence	Introduction to Auto Body & Estimating – <b>Nonstructural Analysis and Damage Repair</b> – Structural Analysis and Damage Repair – Autobody Painting & Refinishing
Student Organization	SkillsUSA
Coordinating Work-Based Learning	Youth Internships and industry field trips
Industry Certifications	ASE (Automotive Service Excellence) OSHA 10 (Occupational Safety and Health Administration)
Dual Credit or Dual Enrollment	See: <a href="https://sdmylife.com/images/Approved-CTE-Dual-Credit.pdf">https://sdmylife.com/images/Approved-CTE-Dual-Credit.pdf</a>
Teacher Certification	Transportation, Distribution & Logistics Cluster Endorsement; Autobody Technology Pathway Endorsement; *Autobody Technology
Resources	N/A

### Course Description

Non-Structural Analysis and Damage Repair is for students who wish to obtain in-depth knowledge and skills in procedures for non-structural repairs in preparation for postsecondary training and careers as collision repair technicians. Upon completion of this course, proficient students will be able to analyze non-structural collision damage and write and revise repair plans. Students will read and interpret technical texts to determine, understand, and safely perform appropriate repair techniques and procedures. Standards in this course include preparing vehicles for repair, removing and replacing panels and body components, metal finishing, body filling, removing and replacing moveable glass and hardware, metal welding and cutting, and repair of plastics.

### Program of Study Application

Non-Structural Analysis and Damage Repair is an advanced pathway course in the Transportation, Distribution and Logistics career cluster, Automotive Body Collision and Refinishing pathway.

## Course Standards

### NA 1: Students will demonstrate understanding of auto body safety precautions.

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skills/Concepts	<p>NA 1.1 Demonstrate auto body technology safety practices.</p> <ul style="list-style-type: none"> <li>● Select and use proper personal safety equipment; take necessary precautions with hazardous operations and materials in accordance with federal, state, and local regulations</li> <li>● Locate procedures and precautions that may apply to the vehicle being repaired</li> <li>● Identify vehicle system hazard types (supplemental restraint system (SRS), hybrid/electric/alternative fuel vehicles), locations and recommended procedures before inspecting or replacing components</li> <li>● Select and use a National Institute of Occupational Safety and Health (NIOSH) approved air purifying respirator, inspect condition and hazardous operations and materials in accordance with federal, state, and local regulation (e.g. OSHA Standard 1910.134) and applicable state and local regulation</li> </ul>

### NA 2: Students will learn and demonstrate preparation for nonstructural repair.

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skill/Concept	<p>NA 2.1 Analyze and demonstrate processes involved in preparation for nonstructural inspection and repair.</p> <ul style="list-style-type: none"> <li>● Review damage report and analyze damage to determine appropriate methods for overall repair; develop and document a repair plan</li> <li>● Inspect, remove, label, store, and reinstall exterior trim and moldings</li> <li>● Inspect, remove, label, store, and reinstall interior trim and components</li> <li>● Inspect, remove, label, store, and reinstall body panels and components that may interfere with, or be damaged during, repair</li> <li>● Inspect, remove, protect label, store, and reinstall vehicle mechanical and electrical components that may interfere with, or be damaged during, repair</li> <li>● Protect panels, glass, interior parts, and other vehicles adjacent to the repair area</li> <li>● Soap and water wash entire vehicle; complete pre-repair inspection checklist</li> <li>● Prepare damaged area using water-based and solvent-based cleaners</li> <li>● Remove corrosion protection, undercoatings, sealers, and other protective coatings as necessary to perform repairs</li> <li>● Inspect, remove, and reinstall repairable plastics and other components for off-vehicle repair</li> </ul>

### NA 3: Students will learn and demonstrate procedures for outer body panel repairs, replacements and adjustments.

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skills/Concepts	<p>NA 3.1 Demonstrate the processes involved in outer body panel repairs, replacements, and adjustments.</p> <ul style="list-style-type: none"> <li>● Inspect/locate direct, indirect, or hidden damage and direction of impact</li> <li>● Inspect, remove, replace, and align hood, hood hinges, and hood latch</li> </ul>

	<ul style="list-style-type: none"> <li>● Inspect, remove, replace, and align deck lid, lid hinges, and lid latch</li> <li>● Inspect, remove, replace, and align doors, latches, hinges, and related hardware</li> <li>● Inspect, remove, replace and align tailgates, hatches, liftgates and sliding doors</li> <li>● Inspect, remove, replace, and align bumpers, covers, reinforcements, guards, impact absorbers, and mounting hardware</li> <li>● Inspect, remove, replace and align fenders, and related panels</li> <li>● Discuss effects of inspection, removal and replacement of cameras, sensors, other electrical components</li> <li>● Restore corrosion protection during and after the repair</li> <li>● Restore sound deadeners and foam materials</li> <li>● Diagnose and repair water leaks, dust leaks, and wind noise</li> </ul>
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**NA 4: Students will perform metal finishing and body filling.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skill/Concept	<p>NA 4.1 Understand and demonstrate the processes involved in metal finishing and body filling.</p> <ul style="list-style-type: none"> <li>● Prepare a panel for body filler by abrading or removing the coatings, featheredge, and refine scratches before the application of body filler</li> <li>● Locate and repair surface irregularities on a damaged body panel using power tools, hand tools, and weld-on pulling attachments</li> <li>● Demonstrate hammer and dolly techniques</li> <li>● Heat shrink stretched panel areas to proper contour</li> <li>● Cold shrink stretched panel areas to proper contour</li> <li>● Identify body filler defects; correct the cause and condition (pinholing, ghosting, staining, over catalyzing, etc.)</li> <li>● Identify different types of body fillers</li> <li>● Shape body filler to contour; finish sand</li> <li>● Straighten contours of damaged panels to a suitable condition for body fillings or metal finishing using power tools, hand tools, and weld-on pulling attachments</li> </ul>

**NA 5: Students will demonstrate service procedures for moveable glass and hardware.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skill/Concept	<p>NA 5.1 Understand and demonstrate proper repair procedures for moveable glass and hardware.</p> <ul style="list-style-type: none"> <li>● Inspect, adjust, repair or replace window regulators, run channels, glass, power mechanisms, and related controls</li> <li>● Inspect, adjust, repair, remove, reinstall or replace weather-stripping</li> <li>● Inspect, repair or replace, and adjust removable power operated roof panel and hinges, latches, guides, handles, retainer, and controls of sunroofs</li> <li>● Initialize electrical components as needed</li> </ul>

**NA 6: Students will demonstrate plastic repair.**

<i>Webb Level</i>	<i>Sub-indicator</i>



Two Skill/Concept	<p>NA 6.1 Understand and demonstrate repair processes and use of adhesives involved in plastic repair.</p> <ul style="list-style-type: none"> <li>● Identify the types of plastic; determine reparability</li> <li>● Clean and prepare the surface of plastic parts; identify the types of plastic repair procedures</li> <li>● Repair rigid, semi-rigid, and flexible plastic panels</li> <li>● Remove or repair damaged areas from rigid exterior composite panels</li> <li>● Replace bonded rigid exterior composite body panels; straighten or align panel supports</li> </ul>
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**NA 7: Students will demonstrate appropriate business practices.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Three Strategic Thinking	NA 7.1 Demonstrate the importance of, and the procedures for, maintaining accurate records.
Three Strategic Thinking	NA 7.2 Apply ethical business practices.
Three Strategic Thinking	NA 7.3 Apply excellent customer relations practices.

Proposed



## Auto Body Painting and Refinishing

Career Cluster	Transportation, Distribution & Logistics
Course Code	20116
Prerequisite(s)	Intro to Auto Body and Estimating
Credit	1.0
Program of Study and Sequence	Intro to Auto Body and Estimating –Structural Analysis and Damage Repair or Nonstructural Analysis and Damage Repair – <b>Auto Body Painting and Refinishing</b> – Senior Capstone
Student Organization	SkillsUSA
Coordinating Work-Based Learning	Youth Internships, Industry Guest Speakers and Industry Tours
Industry Certifications	Automotive Service Excellence (ASE) Student Certification
Dual Credit or Dual Enrollment	See: <a href="https://sdmylife.com/images/Approved-CTE-Dual-Credit.pdf">https://sdmylife.com/images/Approved-CTE-Dual-Credit.pdf</a>
Teacher Certification	Transportation, Distribution & Logistics Cluster Endorsement; Autobody Technology Pathway Endorsement; *Autobody Technology
Resources	N/A

### Course Description

Students will perform basic paint applications and final inspections to repair, where needed, and refinish vehicles. Students will comply with personal and environmental safety practices associated with clothing and the use of gloves; respiratory protection; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemical/material in accordance with local, state, and federal safety and environmental regulations.

### Program of Study Application

Auto Body Painting and Refinishing is an advanced pathway course in the Transportation, Distribution and Logistics career cluster, automotive body collision and refinishing pathway.

## Course Standards

### PFR 1: Students will understand painting and refinishing safety precautions.

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skills/Concepts	<p>PFR 1.1 Demonstrate auto body painting and refinishing safety practices</p> <ul style="list-style-type: none"> <li>• Select and use proper personal safety equipment; take necessary precautions with hazardous operations and materials according to federal, state, and local regulations</li> <li>• Identify safety and personal health hazards according to Occupational Safety and Health Administration (OSHA) guidelines and the “Right to Know Law”</li> <li>• Inspect spray environment and equipment to ensure compliance with federal, state, and local regulations, and for safety and cleanliness hazards</li> <li>• Select and use a National Institute of Occupational Safety and Health (NIOSH) approved air purifying respirator. Inspect condition and ensure fit and operation. Perform proper maintenance in accordance with OSHA Regulation 1910.134 and applicable state and local regulation</li> <li>• Select and use the proper personal safety equipment for surface preparation, spray gun and related equipment operation, paint mixing, matching and application paint defects, and detailing (gloves, suits, hoods, eye and ear protection, etc.)</li> </ul>

### PFR 2: Students will understand surface preparation procedures.

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skill/Concept	<p>PFR 2.1 Analyze areas for surface preparation.</p> <ul style="list-style-type: none"> <li>• Inspect and identify type of finish, surface condition and film thickness; develop and document a plan for refinishing using a total product system</li> <li>• Identify a complimentary color or shade of undercoat to improve coverage</li> <li>• Identify types of rigid, semi-rigid or flexible plastic parts to be refinished; determine the materials needed, preparation and refinishing procedures</li> <li>• Identify metal parts to be refinished; determine material needed, preparation, and refinishing procedures</li> </ul>
Two Skill/Concept	<p>PFR 2.2 Prepare automotive surface to be refinished.</p> <ul style="list-style-type: none"> <li>• Soap and water wash entire vehicle; use appropriate cleaner to remove contaminants</li> <li>• Inspect and identify type of finish, surface condition, and film thickness</li> <li>• Develop and document a plan for refinishing using a total product system</li> <li>• Remove paint finish as needed</li> <li>• Dry- or wet-sand areas to be refinished</li> <li>• Featheredge areas to be refinished</li> <li>• Apply suitable metal treatment or primer in accordance with total paint product systems</li> <li>• Mask and protect areas that will not be refinished</li> <li>• Demonstrate different masking techniques (recess/back masking, foam door type, etc.)</li> <li>• Mix primer, primer-surfacer and primer-sealer</li> <li>• Identify a complimentary color or shade of undercoat to improve coverage</li> </ul>

	<ul style="list-style-type: none"> <li>• Apply primer onto surface of repaired area</li> <li>• Apply two-component finishing filler to minor surface imperfections</li> <li>• Block sand area to which primer-surfacer has been applied</li> <li>• Dry-sand area to which finishing filler has been applied</li> <li>• Remove dust from area to be refinished, including cracks or moldings on adjacent areas</li> <li>• Clean area to be refinished using a final cleaning solution</li> <li>• Remove, with a tack rag, any dust or lint particles from the area to be refinished</li> <li>• Apply suitable primer sealer to the area being refinished</li> <li>• Scuff sand to remove nibs or imperfections from a sealer</li> <li>• Apply stone chip resistant coating</li> <li>• Restore caulking and seam sealers to repaired areas</li> <li>• Prepare adjacent panels for blending</li> </ul>
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**PFR 3: Students will understand spray gun and related equipment operation.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skills/Concepts	<p>PFR 3.1 Inspect, prepare and demonstrate usage of spray gun and related equipment.</p> <ul style="list-style-type: none"> <li>• Inspect, clean, and determine condition of spray guns and related equipment (air hoses, regulators, air lines, air source, and spray environment)</li> <li>• Select spray gun setup (fluid needle, nozzle, and cap) for product being applied</li> <li>• Test and adjust spray gun using fluid, air and pattern control valves</li> <li>• Demonstrate an understanding of the operation of pressure spray equipment</li> </ul>

**PFR 4: Students will understand and perform paint mixing, matching, and applying automotive refinishing materials to achieve invisible repair.**

<i>Webb Level</i>	<i>Sub-indicator</i>
One Recall	<p>PFR 4.1 Understand the process for mixing and matching automotive paint.</p> <ul style="list-style-type: none"> <li>• Identify color code by manufacturer's vehicle information label</li> <li>• Shake, stir, reduce, catalyze/activate, and strain refinish materials</li> <li>• Identify product expiration dates as applicable</li> <li>• Identify and mix paint using a formula</li> <li>• Identify poor hiding colors; determine necessary action</li> <li>• Identify alternative color formula to achieve a blendable match</li> <li>• Identify the material's equipment and preparation differences between solvent and waterborne technologies</li> </ul>
Two Skill/Concept	<p>PFR 4.2 Correctly apply automotive paint to prepared surfaces.</p> <ul style="list-style-type: none"> <li>• Apply finish using appropriate spray techniques (gun arc, angle, distance, travel speed, and spray pattern overlap) for the finish being applied</li> <li>• Apply selected product on test or let-down panel; check for color match</li> <li>• Apply single stage topcoat</li> <li>• Apply basecoat/clearcoat for panel blending and panel refinishing</li> <li>• Apply basecoat/clearcoat for overall refinishing</li> </ul>

	<ul style="list-style-type: none"> <li>• Remove nibs or imperfections from basecoat</li> <li>• Refinish plastic parts</li> <li>• Apply multi-stage coats for panel blending and overall refinishing</li> <li>• Tint color using formula to achieve a blendable match</li> </ul>
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**PFR 5: Students will identify causes and correction procedures for paint defects.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skill/Concept	<p>PFR 5.1 Identify paint defects, understand the causes, and correct paint defects such as:</p> <ul style="list-style-type: none"> <li>• Identify blistering (raising of the paint surface, air entrapment); correct the cause(s) and the condition</li> <li>• Identify a dry spray appearance in the paint surface; correct the cause(s) and the condition</li> <li>• Identify the presence of fish-eyes (crater-like openings) in the finish; correct the cause(s) and the condition</li> <li>• Identify lifting; correct the cause(s) and the condition</li> <li>• Identify clouding (mottling and streaking in metallic finishes); correct the cause(s) and the condition</li> <li>• Identify orange peel; correct the cause(s) and the condition</li> <li>• Identify overspray; correct the cause(s) and the condition</li> <li>• Identify solvent popping in freshly painted surface; correct the cause(s) and the condition</li> <li>• Identify sags and runs in paint surface; correct the cause(s) and the condition</li> <li>• Identify sanding marks or sand scratch swelling; correct the cause(s) and the condition</li> <li>• Identify contour mapping/edge mapping; correct the cause(s) and the condition</li> <li>• Identify color difference (off-shade); correct the cause(s) and the condition</li> <li>• Identify tape tracking; correct the cause(s) and the condition</li> <li>• Identify low gloss condition; correct the cause(s) and the condition</li> <li>• Identify poor adhesion; correct the cause(s) and the condition</li> <li>• Identify paint cracking (shrinking, splitting, crowsfeet or line-checking, micro-checking, etc.); correct the cause(s) and the condition</li> <li>• Identify corrosion; correct the cause(s) and the condition</li> <li>• Identify dirt or dust in the paint surface; correct the cause(s) and the condition</li> <li>• Identify water spotting; correct the cause(s) and the condition</li> <li>• Identify finish damage caused by bird droppings, tree sap, and other natural causes; correct the condition</li> <li>• Identify finish damage caused by airborne contaminants (acids, soot, rail dust, and other industrial-related causes); correct the condition</li> <li>• Identify die-back conditions (dulling of the paint film showing haziness); correct the cause(s) and the condition</li> <li>• Identify chalking (oxidation); correct the cause(s) and the condition</li> <li>• Identify bleed-through (staining); correct the cause(s) and the condition</li> <li>• Identify pin-holing; correct the cause(s) and the condition</li> </ul>

	<ul style="list-style-type: none"> <li>• Identify buffing-related imperfections (swirl marks, wheel burns); correct the condition</li> <li>• Identify pigment flotation (color change through film build); correct the cause(s) and the condition</li> </ul>
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**PRF 6: Students will understand and perform detailing of paint refinishing.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skill/Concept	PRF 6.1 Perform final vehicle inspection. <ul style="list-style-type: none"> <li>• Perform vehicle clean-up; complete quality control using a checklist</li> <li>• Apply decals, transfers, tapes, woodgrains, pinstripes (painted and taped), etc.</li> <li>• Sand, buff and polish fresh or existing finish to remove defects as required</li> <li>• Clean interior, exterior, and glass</li> <li>• Clean body openings (door jambs and edges, etc.)</li> <li>• Remove overspray</li> </ul>

**PRF 7: Students will demonstrate appropriate business practices.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Three Strategic Thinking	PRF 7.1 Demonstrate the importance of, and the procedures for, maintaining accurate records.
Three Strategic Thinking	PRF 7.2 Apply ethical business practices.
Three Strategic Thinking	PRF 7.3 Apply excellent customer relations practices.

Proposed



## Automatic Transmission/Transaxle and Suspension/Steering

Career Cluster	Transportation, Distribution & Logistics
Course Code	20123
Prerequisite(s)	Introduction to Vehicle Systems and Maintenance or Maintenance and Light Repair - Recommended
Credit	1.0
Program of Study and Sequence	Foundational courses – Introduction to Vehicle Systems and Maintenance or Maintenance and Light Repair – <b>Automotive Transmission/Transaxle and Suspension/Steering</b> – Capstone Experience
Student Organization	SkillsUSA
Coordinating Work-Based Learning	N/A
Industry Certifications	ASE
Dual Credit or Dual Enrollment	See: <a href="https://sdmylife.com/images/Approved-CTE-Dual-Credit.pdf">https://sdmylife.com/images/Approved-CTE-Dual-Credit.pdf</a>
Teacher Certification	Transportation, Distribution & Logistics Cluster Endorsement; Autobody Technology Pathway Endorsement *Autobody Technology
Resources	N/A

### Course Description

Students will learn how to inspect, analyze, and service the vehicle's automatic transmission/transaxle and suspension/steering systems. They will learn how to evaluate problems and determine the correct solution for the task at hand. Students will comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations. Course standards are based on the Maintenance and Light Repair (MLR) standards for ASE MLR.

### Program of Study Application

Automatic Transmission/Transaxle and Suspension/Steering is an advanced pathway course in the Transportation, Distribution and Logistics career cluster, automotive technology career pathway.

## Course Standards

**ATSS 1: Students will demonstrate automotive technology safety practices, as identified in Occupational Safety and Health Administration (OSHA) and Environmental Protection Agency (EPA) requirements for an automotive repair facility.**

<i>Webb Level</i>	<i>Sub-indicator</i>
One Recall & Reproduction	ATSS 1.1 Demonstrate automotive technology safety practices. <ul style="list-style-type: none"> <li>● Identify general shop safety rules and procedures</li> <li>● Identify and use proper procedures for safe jack and lift operations</li> <li>● Utilize proper ventilation procedures for working within the lab/shop area</li> <li>● Identify the location and the types of fire extinguishers and other fire safety equipment</li> <li>● Identify the location and use of eye wash stations</li> <li>● Identify the location of posted evacuation routes</li> <li>● Locate and demonstrate knowledge of Safety Data Sheets (SDS)</li> <li>● Properly dispose chemicals in accordance with applicable federal, state, and local law</li> </ul>

**ATSS 2: Students will demonstrate proper tool selection and usage.**

<i>Webb Level</i>	<i>Sub-indicator</i>
One Recall & Reproduction	ATSS 2.1 Demonstrate proper tool selection and usage. <ul style="list-style-type: none"> <li>● Identify tools and their usage in automotive applications</li> <li>● Identify standard and metric designation</li> <li>● Demonstrate safe handling and use of appropriate tools</li> <li>● Demonstrate proper cleaning, storage, and maintenance of tools and equipment</li> <li>● Demonstrate proper use of precision measuring tools (e.g. micrometer, dial-indicator, dial-caliper)</li> </ul>

**ATSS 3: Students will perform diagnostics and repair on the vehicle's automatic transmission and transaxle.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skill/Concept	ATSS 3.1 Inspect and identify drivetrain components. <ul style="list-style-type: none"> <li>● Research vehicle service information including fluid type, vehicle service history, service precautions, and technical service bulletins</li> <li>● Check fluid level in a transmission or transaxle equipped with a dipstick</li> <li>● Check fluid level in a transmission or transaxle not equipped with a dipstick</li> <li>● Check transmission fluid condition; check for leaks</li> <li>● Identify drive train components and configuration</li> </ul>
Two Skill/Concept	ATSS 3.2 Perform maintenance on vehicle automatic transmission and transaxle while on the vehicle. <ul style="list-style-type: none"> <li>● Inspect, adjust, and/or replace external manual valve shift linkage, transmission range sensor/switch, and/or park/neutral position switch</li> <li>● Inspect for leakage at external seals, gaskets, and bushings</li> <li>● Inspect, replace and/or align power train mounts</li> <li>● Drain and replace fluid and filter(s); use proper fluid type per manufacturer specification</li> </ul>



Four Extended Thinking	<p>ATSS 3.3 Analyze the vehicle's automatic transmission and transaxle while off the vehicle.</p> <ul style="list-style-type: none"> <li>• Describe the operational characteristics of a continuously variable transmission (CVT)</li> <li>• Describe the operational characteristics of a hybrid vehicle drive train</li> </ul>
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**ATSS 4: Students will perform maintenance on vehicle suspension and steering systems.**

Webb Level	Sub-indicator
Two Skill/Concept	<p>ATSS 4.1 Inspect, Identify, and repair wheels and tires.</p> <ul style="list-style-type: none"> <li>• Inspect tire condition; identify tire wear patterns; check for correct tire size, application (load and speed ratings), and air pressure as listed on the tire information placard/label</li> <li>• Rotate tires according to manufacturer's recommendations including vehicles equipped with tire pressure monitoring systems (TPMS)</li> <li>• Dismount, inspect, and remount tire on wheel; balance wheel and tire assembly</li> <li>• Dismount, inspect, and remount tire on wheel equipped with tire pressure monitoring system sensor</li> <li>• Inspect tire and wheel assembly for air loss; determine necessary action</li> <li>• Repair tire following vehicle manufacturer approved procedure</li> <li>• Identify indirect and direct tire pressure monitoring systems (TPMS); calibrate system; verify operation of instrument panel lamps</li> <li>• Demonstrate knowledge of steps required to remove and replace sensors in a tire pressure monitoring system (TPMS) including relearn procedure</li> </ul>
Four Extended Thinking	<p>ATSS 4.2 Analyze and evaluate the suspension and steering system components</p> <ul style="list-style-type: none"> <li>• Research vehicle service information including fluid type, vehicle service history, service precautions, and technical service bulletins</li> <li>• Disable and enable supplemental restraint system (SRS); verify indicator lamp operation</li> <li>• Identify suspension and steering system components and configurations</li> </ul>
Three Strategic Thinking	<p>ATSS 4.3 Inspect and assess the suspension and steering system.</p> <ul style="list-style-type: none"> <li>• Inspect rack and pinion steering gear inner tie rod ends (sockets) and bellows boots</li> <li>• Inspect power steering fluid level and condition</li> <li>• Flush, fill, and bleed power steering system; use proper fluid type per manufacturer specification</li> <li>• Inspect for power steering fluid leakage</li> <li>• Remove, inspect, replace, and/or adjust power steering pump drive belt.</li> <li>• Inspect and replace power steering hoses and fittings</li> <li>• Inspect pitman arm, relay (centerlink/intermediate) rod, idler arm, mountings, and steering linkage damper</li> <li>• Inspect tie rod ends (sockets), tie rod sleeves, and clamps</li> <li>• Inspect upper and lower control arms, bushings, and shafts</li> <li>• Inspect and replace rebound bumpers</li> <li>• Inspect track bar, strut rods/radius arms, and related mounts and bushings</li> <li>• Inspect upper and lower ball joints (with or without wear indicators)</li> </ul>

	<ul style="list-style-type: none"> <li>• Inspect suspension system coil springs and spring insulators (silencers)</li> <li>• Inspect suspension system torsion bars and mounts</li> <li>• Inspect and/or replace front/rear stabilizer bar (sway bar) bushings, brackets, and links</li> <li>• Inspect, remove, and/or replace strut cartridge or assembly; inspect mounts and bushings</li> <li>• Inspect front strut bearing and mount</li> <li>• Inspect rear suspension system lateral links/arms (track bars), control (trailing) arms</li> <li>• Inspect rear suspension system leaf spring(s), spring insulators (silencers), shackles, brackets, bushings, center pins/bolts, and mounts</li> <li>• Inspect, remove, and/or replace shock absorbers; inspect mounts and bushings</li> <li>• Inspect electric power steering assist system</li> <li>• Identify hybrid vehicle power steering system electrical circuits and safety precautions</li> <li>• Describe the function of suspension and steering control systems and components, (i.e. active suspension, and stability control)</li> </ul>
Two Skill/Concept	<p>ATSS 4.43 Inspect and measure vehicle wheel alignment.</p> <ul style="list-style-type: none"> <li>• Perform pre-alignment inspection; measure vehicle ride height</li> <li>• Describe alignment angles (camber, caster and toe)</li> </ul>

Proposed

## Automotive Engine Repair and Performance

Career Cluster	Transportation, Distribution & Logistics
Course Code	20121
Prerequisite(s)	Introduction to Vehicle Systems and Maintenance or Maintenance and Light Repair - Recommended
Credit	1.0
Program of Study and Sequence	Foundational courses – Introduction to Vehicle Systems and Maintenance or Maintenance and Light Repair – <b>Automotive Engine Repair and Performance</b> – Capstone Experience
Student Organization	SkillsUSA
Coordinating Work-Based Learning	N/A
Industry Certifications	ASE
Dual Credit or Dual Enrollment	See: <a href="https://sdmylife.com/images/Approved-CTE-Dual-Credit.pdf">https://sdmylife.com/images/Approved-CTE-Dual-Credit.pdf</a>
Teacher Certification	Transportation, Distribution & Logistics Cluster Endorsement
Resources	N/A

### Course Description

Completion of Automotive Engine Repair and Performance will help students prepare for post-secondary education and training. This course will further students' technical education experience and help prepare them for the workforce. Course standards are based on the Maintenance and Light Repair (MLR) standards for ASE MLR.

Students will learn:

- How to work safely on the vehicle in a workshop situation.
- Engine operation based on the six operating systems: lubrication, cooling, fuel, ignition, air induction and exhaust systems.
- General engine maintenance to include valve train, lubrication and cooling system.
- General engine performance to include computerized controls, fuel, air induction, exhaust systems and emissions control systems.

### Program of Study Application

Automotive Engine Repair and Performance is an advanced pathway course in the Transportation, Distribution and Logistics career cluster, automotive technology pathway.

## Course Standards

**EPER 1: Students will demonstrate automotive technology safety practices, as identified in Occupational Safety and Health Administration (OSHA) and Environmental Protection Agency (EPA) requirements for an automotive repair facility.**

<i>Webb Level</i>	<i>Sub-indicator</i>
One Recall & Reproduction	<p>EPER 1.1 Demonstrate automotive technology safety practices.</p> <ul style="list-style-type: none"> <li>● Identify general shop safety rules and procedures</li> <li>● Identify and use proper procedures for safe jack and lift operations</li> <li>● Utilize proper ventilation procedures for working within the lab/shop area</li> <li>● Identify the location and the types of fire extinguishers and other fire safety equipment</li> <li>● Identify the location and use of eye wash stations</li> <li>● Identify the location of posted evacuation routes</li> <li>● Locate and demonstrate knowledge of Safety Data Sheets (SDS)</li> </ul>

**EPER 2: Students will demonstrate proper tool selection and usage.**

<i>Webb Level</i>	<i>Sub-indicator</i>
One Recall & Reproduction	<p>EPER 2.1. Demonstrate proper tool selection and usage:</p> <ul style="list-style-type: none"> <li>● Identify tools and their usage in automotive applications</li> <li>● Identify standard and metric designation</li> <li>● Demonstrate safe handling and use of appropriate tools</li> <li>● Demonstrate proper cleaning, storage, and maintenance of tools and equipment</li> <li>● Demonstrate proper use of precision measuring tools (e.g. micrometer, dial-indicator, dial-caliper)</li> </ul>

**EPER 3: Students will prepare the vehicle for service.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skill/Concept	<p>EPER 3.1 Perform preparatory procedures for vehicle service.</p> <ul style="list-style-type: none"> <li>● Identify information needed and the service requested on a repair order</li> <li>● Identify purpose and demonstrate proper use of fender covers, mats</li> <li>● Demonstrate use of the three C's: concern, cause, and correction</li> <li>● Review vehicle service history</li> <li>● Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction</li> </ul>

**EPER 4: Students will perform engine repair.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skill/Concept	<p>EPER 4.1 Perform engine maintenance operations.</p> <ul style="list-style-type: none"> <li>● Research vehicle service information, including fluid type, vehicle service history, service precautions, and technical service bulletins</li> <li>● Verify operation of the instrument panel engine warning indicators</li> <li>● Inspect engine assembly for fuel, oil, coolant, and other leaks; determine necessary action</li> <li>● Install engine covers using gaskets, seals, and sealers as required.</li> </ul>

	<ul style="list-style-type: none"> <li>• Verify engine mechanical timing</li> <li>• Perform common fastener and thread repair, to include: removing broken bolt, restoring internal and external threads, and repairing internal threads with thread insert</li> <li>• Identify service precautions related to service of the internal combustion engine of a hybrid vehicle</li> </ul>
Two Skill/Concept	<p>EPER 4.2 Understand component operation and perform maintenance on cylinder head and valve train.</p> <ul style="list-style-type: none"> <li>• Adjust valves (mechanical or hydraulic lifters)</li> <li>• Identify components of the cylinder head and valve train</li> </ul>
Two Skill/Concept	<p>EPER 4.3 Test, inspect and perform maintenance on the lubrication and cooling system.</p> <ul style="list-style-type: none"> <li>• Perform cooling system pressure and dye tests to identify leaks; check coolant condition and level; inspect and test radiator, pressure cap, coolant recovery tank, heater core, and galley plugs; determine necessary action</li> <li>• Inspect, replace, and/or adjust drive belts, tensioners, and pulleys; check pulley and belt alignment</li> <li>• Remove, inspect, and replace thermostat and gasket/seal</li> <li>• Inspect and test coolant; drain and recover coolant; flush and refill cooling system; use proper fluid type per manufacturer specification; bleed air as required</li> <li>• Perform engine oil and filter change; use proper fluid type per manufacturer specification; reset maintenance reminder as required</li> <li>• Identify components of the lubrication and cooling systems</li> </ul>

**EPER 5: Students will test, diagnose, and repair engine performance issues.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Three Strategic Thinking	<p>EPER 5.1. Perform engine diagnostics and analyze retrieved data.</p> <ul style="list-style-type: none"> <li>• Research vehicle service information, including fluid type, vehicle service history, service precautions, and technical service bulletins</li> <li>• Perform engine absolute manifold pressure tests (vacuum/boost); document results</li> <li>• Perform cylinder power balance test; document results</li> <li>• Perform cylinder cranking and running compression tests; document results</li> <li>• Perform cylinder leakage test; document results</li> <li>• Verify engine operating temperature</li> <li>• Remove and replace spark plugs; inspect secondary ignition components for wear and damage</li> </ul>
Three Strategic Thinking	<p>EPER 5.2. Test the computerized controls and analyze retrieved data.</p> <ul style="list-style-type: none"> <li>• Retrieve and record diagnostic trouble codes (DTC), On-board Diagnostic (OBD) monitor status, and freeze frame data; clear codes when applicable</li> <li>• Describe the use of the OBD monitors for repair verification</li> </ul>
Two Skill/Concept	<p>EPER 5.3. Perform maintenance on the fuel, air Induction, and exhaust systems</p> <ul style="list-style-type: none"> <li>• Replace fuel filter(s) where applicable</li> <li>• Inspect, service, or replace air filters, filter housings, and intake duct work</li> </ul>

	<ul style="list-style-type: none"> <li>• Inspect integrity of the exhaust manifold, exhaust pipes, muffler(s), catalytic converter(s), resonator(s), tail pipe(s), and heat shields; determine necessary action</li> <li>• Inspect condition of exhaust system hangers, brackets, clamps, and heat shields; determine necessary action</li> <li>• Check and refill diesel exhaust fluid (DEF)</li> </ul>
Two Skill/Concept	<p>EPER 5.4. Perform maintenance operations on emissions control system.</p> <ul style="list-style-type: none"> <li>• Inspect, test, and service Positive Crankcase Ventilation (PCV) filter/breather, valve, tubes, orifices, and hoses; perform necessary action</li> </ul>

**EPER 6: Students will understand and apply appropriate business practices.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Three Strategic Thinking	EPER 6.1 Demonstrate the importance of, and the procedures for, maintaining accurate records.
Three Strategic Thinking	EPER 6.2 Understand the concept and application of ethical business practices.
Three Strategic Thinking	EPER 6.3 Understand the concept and application of excellent customer relations practices.

Proposed



## Brakes/Manual Drivetrain & Axles

Career Cluster	Transportation, Distribution & Logistics
Course Code	20122
Prerequisite(s)	Introduction to Vehicle Systems and Maintenance or Maintenance and Light Repair - Recommended
Credit	1.0
Program of Study and Sequence	Foundational courses – Introduction to Vehicle Systems and Maintenance or Maintenance and Light Repair – <b>Brakes/Manual Drivetrain &amp; Axles</b> – Capstone Experience
Student Organization	SkillsUSA
Coordinating Work-Based Learning	N/A
Industry Certifications	Automotive Service Excellence (ASE) Student Certification
Dual Credit or Dual Enrollment	See: <a href="https://sdmylife.com/images/Approved-CTE-Dual-Credit.pdf">https://sdmylife.com/images/Approved-CTE-Dual-Credit.pdf</a>
Teacher Certification	Transportation, Distribution & Logistics Cluster Endorsement
Resources	N/A

### Course Description

Students in this course will learn theory and operation as well as diagnosis and repair of brake systems and manual drivetrains. Completion of this course will aid students as they continue their education at the post-secondary level or in the workforce and in the preparation for their ASE certification test. (The examples include what students may test for ASE (Automotive Service Excellence) certification). Course standards are based on the Maintenance and Light Repair (MLR) standards for ASE MLR.

### Program of Study Application

Brakes/Manual Drivetrain & Axles is an advanced pathway course in the Transportation, Distribution and Logistics career cluster, automotive technology pathway.

## Course Standards

**AB 1: Students will demonstrate automotive technology safety practices, including Occupational Safety and Health Administration (OSHA) and Environmental Protection Agency (EPA) requirements, for an automotive repair facility.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skills/Concepts	AB 1.1 Demonstrate automotive technician safety practices. <ul style="list-style-type: none"> <li>● Use protective clothing and safety equipment according to OSHA and EPA requirements</li> <li>● Summarize the proper use of Safety Data Sheet (SDS)</li> <li>● Demonstrate the proper use of hand and power tools</li> <li>● Examine basic shop safety using OSHA standards.</li> <li>● Maintain a portfolio of successfully completed safety and equipment exams</li> </ul>

**AB 2: Students will demonstrate knowledge of brake system theory and procedure.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skills/Concepts	AB 2.1 Analyze and diagnose automotive brake hydraulic and friction systems. <ul style="list-style-type: none"> <li>● Identify and interpret brake system concerns; determine needed action</li> <li>● Research vehicle service information including fluid type, vehicle service history, service precautions, and technical service bulletins</li> <li>● Describe procedure for performing a road test to check brake system operation including an anti-lock brake system (ABS)</li> <li>● Identify brake system components and configuration</li> </ul>

**AB 3: Students will demonstrate knowledge and procedure of the hydraulic brake system.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Three Strategic Thinking	AB 3.1 Analyze and draw conclusions concerning malfunctions of brake hydraulic systems. <ul style="list-style-type: none"> <li>● Diagnose pressure concerns in the brake system using hydraulic principles (Pascal's Law)</li> <li>● Check master cylinder for internal/external leaks and proper operation; determine needed action</li> <li>● Identify components of hydraulic brake warning light system</li> <li>● Diagnose poor stopping, pulling or dragging concerns caused by malfunctions in the hydraulic system; determine needed action</li> </ul>
Two Skills/Concepts	AB 3.2 Apply repair skills to correct malfunctions of brake hydraulic systems. <ul style="list-style-type: none"> <li>● Inspect brake lines, flexible hoses, and fittings for leaks, dents, kinks, rust, cracks, bulging, wear, and loose fittings/supports; determine needed action</li> <li>● Remove, bench bleed, and reinstall master cylinder</li> <li>● Replace brake lines, hoses, fittings, and supports</li> <li>● Fabricate brake lines using proper material and flaring procedures (double flare and ISO types)</li> <li>● Select, handle, store, and fill brake fluids to proper level; use proper fluid type per manufacturer specification</li> <li>● Inspect, test, and/or replace components of brake warning light system</li> <li>● Bleed and/or flush brake system</li> <li>● Test brake fluid for contamination</li> </ul>



	<ul style="list-style-type: none"> <li>● Measure brake pedal height, travel, and free play (as applicable); determine needed action</li> </ul>
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**AB 4: Students will demonstrate knowledge of theory and repair procedures for drum brake systems.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Three Strategic Thinking	AB 4.1 Assess and evaluate operation of drum brake systems. <ul style="list-style-type: none"> <li>● Diagnose poor stopping, noise, vibration, pulling, grabbing, dragging or pedal pulsation concerns; determine needed action</li> </ul>
Two Skill/Concept	AB 4.2 Repair drum brake systems. <ul style="list-style-type: none"> <li>● Remove, clean, and inspect brake drum; measure brake drum diameter; determine serviceability</li> <li>● Refinish brake drum and measure final drum diameter; compare with manufacturer's specification</li> <li>● Remove, clean, inspect, and/or replace brake shoes, springs, pins, clips, levers, adjusters/self-adjusters, other related brake hardware, and backing support plates; lubricate and reassemble</li> <li>● Inspect wheel cylinders for leaks and proper operation; remove and replace as needed</li> <li>● Pre-adjust brake shoes and parking brake; install brake drums or drum/hub assemblies and wheel bearings; perform final checks and adjustments</li> </ul>

**AB 5: Students will demonstrate knowledge of theory and repair procedures for disc brake systems.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Three Strategic Thinking	AB 5.1 Assess and evaluate operation of disc brake systems. <ul style="list-style-type: none"> <li>● Diagnose poor stopping, noise, vibration, pulling, grabbing, dragging, or pulsation concerns; determine needed action</li> <li>● Inspect caliper mounting and slides/pins for proper operation, wear, and damage; determine needed action</li> <li>● Describe importance of operating vehicle to burnish/break-in replacement brake pads according to manufacturer's recommendations</li> </ul>
Two Skill/Concept	AB 5.2 Repair disc brake systems. <ul style="list-style-type: none"> <li>● Remove, inspect, and/or replace brake pads and retaining hardware; determine needed action</li> <li>● Lubricate and reinstall caliper, brake pads, and related hardware; seat brake pads; inspect for leaks</li> <li>● Clean and inspect rotor and mounting surface; measure rotor thickness, thickness variation, and lateral runout; determine needed action</li> <li>● Remove and reinstall/replace rotor</li> <li>● Refinish rotor on vehicle; measure final rotor thickness and compare with specification</li> <li>● Refinish rotor off vehicle; measure final rotor thickness and compare with specification</li> <li>● Retract and re-adjust caliper piston on an integrated parking brake system.</li> <li>● Check brake pad wear indicator; determine needed action</li> <li>● Remove and clean caliper assembly; inspect for leaks, damage, and wear; determine needed action</li> </ul>

**AB 6: Students will demonstrate knowledge of theory and repair procedures for power assist units.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skill/Concept	AB 6.1 Analyze power-assist units. <ul style="list-style-type: none"> <li>● Check brake pedal travel with and without engine running to verify proper power booster operation</li> <li>● Identify components of the brake power assist system (vacuum and hydraulic); check vacuum supply (manifold or auxiliary pump) to vacuum-type power booster</li> </ul>

**AB 7: Students will demonstrate knowledge of theory and repair procedures for related systems – Wheel Bearings, Parking Brakes and Electrical.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skill/Concept	AB 7.1 Diagnose related systems (i.e., wheel bearings, parking brakes, electrical). <ul style="list-style-type: none"> <li>● Diagnose wheel bearing noises, wheel shimmy, and vibration concerns; determine needed action</li> <li>● Check parking brake system components for wear, binding, and corrosion; clean, lubricate, adjust and/or replace as needed</li> <li>● Check parking brake operation and parking brake indicator light system operation; determine needed action</li> <li>● Check operation of brake stop light system</li> </ul>
Two Skill/Concept	AB 7.2 Repair related systems. <ul style="list-style-type: none"> <li>● Replace wheel bearing and race</li> <li>● Inspect and replace wheel studs</li> <li>● Remove, reinstall, and/or replace sealed wheel bearing assembly</li> <li>● Remove, clean, inspect, repack, and install wheel bearings; replace seals; install hub and adjust bearings</li> </ul>

**AB 8: Students will demonstrate knowledge of theory and repair procedures for related systems – Antilock Brake Systems (ABS), Traction Control Systems (TCS), Electronic Stability Control (ESC).**

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skill/Concept	AB 8.1 Diagnose Electronic Brake Control Systems: ABS, TCS and ESC Systems <ul style="list-style-type: none"> <li>● Identify and inspect electronic brake control system components (ABS, TCS, ESC); determine needed action.</li> <li>● 2. Describe the operation of a regenerative braking system</li> </ul>

**AB 9: Students will demonstrate knowledge of theory and repair procedures for manual drivetrain and axles.**

<i>Webb Level</i>	<i>Sub-indicator</i>
One Recall and Reproduction	AB 9.1 Identify manual transmission information. <ul style="list-style-type: none"> <li>● Research vehicle service information including fluid type, vehicle service history, service precautions, and technical service bulletins</li> <li>● Identify manual drivetrain and axle components and configuration</li> </ul>
Two Skill/Concept	AB 9.2 Perform general maintenance procedures. <ul style="list-style-type: none"> <li>● Drain and refill manual transmission/transaxle and final drive unit; use proper fluid type per manufacturer's specification</li> <li>● Check fluid condition; check for leaks</li> </ul>

**AB 10: Students will perform maintenance procedures for hydraulic clutches.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skill/Concept	AB 10.1 Check clutch hydraulic system. <ul style="list-style-type: none"> <li>● Check and adjust clutch master cylinder fluid level; use proper fluid type per manufacturer specification</li> <li>● Check for hydraulic system leaks</li> </ul>

**AB 11: Students will define the operation of electronic manual transmission/transaxle.**

<i>Webb Level</i>	<i>Sub-indicator</i>
One Recall and Reproduction	AB 11.1 Research Manual Transmission/Transaxle. <ul style="list-style-type: none"> <li>● Describe the operational characteristics of an electronically controlled manual transmission/transaxle</li> </ul>

**AB 12: Students will inspect, diagnose, and perform repair procedures for drivetrain components.**

<i>Webb Level</i>	<i>Sub-indicator</i>
One Recall and Reproduction	AB 12.1 Inspect, diagnose, and repair drive shaft, half shafts, universal joints and constant-velocity (CV) joints. <ul style="list-style-type: none"> <li>● Inspect, remove, and/or replace bearings, hubs, and seals</li> <li>● Inspect, service, and/or replace shafts, yokes, boots, and universal/CV joints</li> <li>● Inspect locking hubs</li> <li>● Check for leaks at drive assembly and transfer case seals; check vents; check fluid level; use proper fluid type per manufacturer specification</li> </ul>

**AB 13: Students will inspect, diagnose, and perform repair procedures for the differential assembly.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skill/Concept	AB 13.1 Perform maintenance on differential case assembly. <ul style="list-style-type: none"> <li>● Clean and inspect differential case; check for leaks; inspect housing vent</li> <li>● Check and adjust differential case fluid level; use proper fluid type per manufacturer's specification</li> <li>● Drain and refill differential housing</li> <li>● Inspect and replace drive axle wheel studs</li> </ul>

**AB 14: Students will understand and apply appropriate business practices.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Three Strategic Thinking	AB 14.1 Demonstrate the importance of, and the procedures for, maintaining accurate records.
Three Strategic Thinking	AB 14.2 Understand the concept and application of ethical business practices.
Three Strategic Thinking	AB 14.3 Understand the concept and application of excellent customer relations practices.



## Diesel Technology

Career Cluster	Transportation, Distribution & Logistics
Course Code	20107
Prerequisite(s)	Automotive Engine Repair and Performance
Credit	1.0
Program of Study and Sequence	Automotive Engine Repair and Performance – <b>Diesel Technology</b> – Capstone Experience
Student Organization	SkillsUSA
Coordinating Work-Based Learning	N/A
Industry Certifications	N/A
Dual Credit or Dual Enrollment	See: <a href="https://sdmylife.com/images/Approved-CTE-Dual-Credit.pdf">https://sdmylife.com/images/Approved-CTE-Dual-Credit.pdf</a>
Teacher Certification	Transportation, Distribution & Logistics Cluster Endorsement
Resources	N/A

### Course Description

Students will develop an understanding of the Automotive Diesel service and repair pathway including Over the Road Transportation, Construction Equipment and Agricultural Equipment. The goal of this course is for students to receive industry training at the basic level and then be able to advance to the higher level of competency in this field. Completion of this course will help students with post-secondary education and training and prepare them for the workforce and further technical education, qualifications and experience.

### Program of Study Application

Diesel Technology is a second pathway course in the Transportation, Distribution and Logistics career cluster, Diesel pathway.

## Course Standards

### DT 1: Students will adhere to health and safety standards in the workplace, including systems and procedures.

<i>Webb Level</i>	<i>Sub-indicator</i>
One Recall	<p>DT 1.1 Apply skills and knowledge of health and safety practices and expectations to ensure a safe working environment for the individual and co-workers (fellow students).</p> <ul style="list-style-type: none"> <li>● Identify and describe personal safety equipment, including eye, hair and hearing protection, clothing and footwear</li> <li>● Know and understand how to work safely around vehicles in the workplace</li> <li>● Identify, isolate and remove potential work place hazards, that is, fix the risks</li> <li>● Know and understand how to work safely with hoists and lifting equipment</li> <li>● Understand how to identify and manage potential and actual fires and fire hazards in the workplace</li> <li>● Know and understand evacuation procedures in the workplace, including personal and collective responsibilities</li> <li>● Know and understand how to work safely using hand and shop tools and equipment</li> <li>● Know and understand how to work safely with hazardous materials, including disposal and storage</li> </ul>

### DT 2: Students will learn and understand basic electricity and electronics principles.

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skill/Concept	<p>DT 2.1 Understand and implement basic electricity and electronic principles that apply to diesel powered equipment, including starting, charging, lighting and accessories.</p> <ul style="list-style-type: none"> <li>● Understand basic electricity theory</li> <li>● Explain the basic fundamentals of electricity</li> <li>● Calculate values of resistance, current and voltage using Ohms Law.</li> <li>● Explore series circuits</li> <li>● Investigate parallel circuits</li> <li>● Examine series-parallel circuits</li> <li>● Explore common electrical components</li> <li>● Investigate the starter, its related components and circuits</li> <li>● Explore the principles and components relating to the charging circuit</li> </ul>
Two Skill/Concept	<p>DT 2.2 Perform basic electrical repair techniques.</p> <ul style="list-style-type: none"> <li>● Make solder connections</li> <li>● Demonstrate the proper use of a digital multi-meter</li> <li>● Diagnose the condition of starter circuits, performing the necessary steps using a load tester and multi-meter</li> <li>● Analyze the function and condition of a lead-acid battery</li> </ul>

### DT 3: Students will demonstrate their understanding of basic aspects of diesel engines.

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skills/Concepts	<p>DT 3.1 Understand the technical and nontechnical aspects of diesel engines.</p> <ul style="list-style-type: none"> <li>● Know and understand different types of hand, shop and measurement tools</li> </ul>

	<ul style="list-style-type: none"> <li>● Distinguish between different types of fasteners</li> <li>● Understand the role of the technician in the diesel industry</li> <li>● Identify, define and demonstrate basic diesel engine principles</li> <li>● Identify and define power formulas in diesel industry</li> <li>● Disassemble a diesel engine</li> <li>● Assemble a diesel engine per engine manual</li> <li>● Demonstrate the ability to rebuild a cylinder head</li> <li>● Start a diesel engine</li> </ul>
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**DT 4: Students will apply principles of basic hydraulic systems.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skill/Concept	DT 4.1 Research and inspect basic mobile hydraulics. <ul style="list-style-type: none"> <li>● Evaluated different types of hydraulic pumps for possible repairs (e.g. gear, vane, and piston)</li> <li>● Report how basic hydraulic systems have evolved and developed</li> <li>● Calculate the force of a given cylinder under given pressures</li> <li>● Inspect a hydraulic jack</li> <li>● Examine a hydraulic cylinder</li> <li>● Explore the fundamentals of hydraulic ISO symbols</li> </ul>

**DT 5: Students will demonstrate how basic braking systems operate.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skill/Concept	DT 5.1 Identify and understand basic vehicle braking systems, including hydraulic and air brake systems. <ul style="list-style-type: none"> <li>● Explore the principles of brakes</li> <li>● Demonstrate the hydraulic drum brake rebuild procedure</li> <li>● Demonstrate the hydraulic disc brake rebuild procedure</li> <li>● Understand different types of power brakes</li> <li>● Explain the operation of brake valves</li> <li>● Examine the fundamentals of the air system</li> </ul>

**DT 6: Students will apply principles of fuel systems on diesel engines.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skill/Concept	DT 6.1 Differentiate between, and identify components of, fuel delivery systems and electrical/hybrid technologies. <ul style="list-style-type: none"> <li>● Identify principles, components, systems and circuits for fuel delivery systems</li> <li>● Analyze fuel injection components and principle</li> <li>● Demonstrate how to time an in-line fuel pump</li> <li>● Demonstrate how to time a rotary fuel pump</li> <li>● Analyze non-starting situations related to fuel and engine phasing</li> </ul>

**DT 7: Students will understand components and apply principles of undercarriage components and systems.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skill/Concept	DT 7.1 Demonstrate knowledge of drivetrain components and function.

	<ul style="list-style-type: none"> <li>● Demonstrate knowledge of parts and components of an axle, u joints, driveshaft and other drivetrain components</li> </ul>
Two Skill/Concept	DT 7.2 Demonstrate knowledge of parts and components of the chassis. <ul style="list-style-type: none"> <li>● Identify suspension, steering, shocks, airbag, and other chassis components</li> <li>● Demonstrate operation plus inspect and adjust fifth-wheel plate</li> </ul>
Two Skill/Concept	DT 7.3 Demonstrate knowledge of parts and components of differentials and transmissions. <ul style="list-style-type: none"> <li>● Identify knowledge of differential and transmission components</li> </ul>
Two Skill/Concept	DT 7.4 Demonstrate knowledge of tires and rims. <ul style="list-style-type: none"> <li>● Inspect and repair tires</li> <li>● Identify tire and rim wear</li> <li>● Understand tire markings (e.g. DOT numbers.)</li> </ul>

**DT 8: Students will understand and apply appropriate business practices.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Three Strategic Thinking	DT 8.1 Demonstrate the importance of, and the procedures for, maintaining accurate records.
Three Strategic Thinking	DT 8.2 Understand the concept and application of ethical business practices.
Three Strategic Thinking	DT 8.3 Understand the concept and application of excellent customer relations practices.

Proposed



## Electrical/Electronic Systems and Heating Ventilation Air Conditioning (HVAC)

Career Cluster	Transportation, Distribution & Logistics
Course Code	20105
Prerequisite(s)	Introduction to Vehicle Systems and Maintenance or Maintenance and Light Repair - Recommended
Credit	1.0
Program of Study and Sequence	Foundational courses – Introduction to Vehicle Systems and Maintenance or Maintenance and Light Repair – <b>Electrical/Electronic Systems and HVAC</b> – Capstone Experience
Student Organization	SkillsUSA
Coordinating Work-Based Learning	N/A
Industry Certifications	Automotive Service Excellence (ASE) Student Certification
Dual Credit or Dual Enrollment	See: <a href="https://sdmylife.com/images/Approved-CTE-Dual-Credit.pdf">https://sdmylife.com/images/Approved-CTE-Dual-Credit.pdf</a>
Teacher Certification	Transportation, Distribution & Logistics Cluster Endorsement; Automotive Technology Pathway Endorsement; *Automotive Technology
Resources	N/A

### Course Description

Students in Electrical/Electronic Systems and Heating Ventilation Air Conditioning (HVAC) will learn theory and operation as well as diagnosis and repair of Electrical/Electronic and HVAC systems. Completion of this course will aid students as they continue their education at the post-secondary level or in the workforce and in preparation for the ASE certification test. Course standards are based on the Maintenance and Light Repair (MLR) standards for ASE MLR.

### Program of Study Application

Electrical/Electronic Systems and Heating Ventilation Air Conditioning (HVAC) is an advanced pathway course in the Transportation, Distribution and Logistics career cluster, automotive technology pathway.



## Course Standards

**EEHVAC 1: Students will demonstrate automotive technology safety practices, including Occupational Safety and Health Administration (OSHA) and Environmental Protection Agency (EPA) requirements, for an automotive repair facility.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skills/Concepts	EEHVAC 1.1 Demonstrate automotive technician safety practices. <ul style="list-style-type: none"> <li>● Use protective clothing and safety equipment according to OSHA and EPA requirements</li> <li>● Summarize the proper use of safety data sheet (SDS)</li> <li>● Demonstrate the proper use of hand and power tools</li> <li>● Examine basic shop safety using OSHA standards</li> <li>● Maintain a portfolio of successfully completed safety and equipment exams</li> </ul>

**EEHVAC 2: Students will perform maintenance, diagnostic and repair procedures of electrical/electronic systems.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Three Strategic Thinking	EEHVAC 2.1 Demonstrate knowledge of the vehicle electrical system. <ul style="list-style-type: none"> <li>● Research vehicle service information including vehicle service history, service precautions, and technical service bulletins</li> <li>● Demonstrate knowledge of electrical/electronic series, parallel, and series and parallel circuits using principles of electricity (Ohm's Law)</li> <li>● Demonstrate proper use of a digital multimeter (DMM) when measuring source voltage, voltage drop (including grounds), current flow, and resistance</li> <li>● Demonstrate knowledge of the causes and effects from shorts, grounds, opens, and resistance problems in electrical/electronic circuits</li> <li>● Identify electrical/electronic system components and configuration</li> </ul>
Two Skills/Concepts	EEHVAC 2.2 Test and repair electrical problems. <ul style="list-style-type: none"> <li>● Use a test light to check operation of electrical circuits</li> <li>● Use fused jumper wires to check operation of electrical circuits</li> <li>● Measure key-off battery drain (parasitic draw)</li> <li>● Inspect and test fusible links, circuit breakers, and fuses; determine necessary action</li> <li>● Repair and/or replace connectors, terminal ends, and wiring of electrical/electronic systems (including solder repair)</li> <li>● Use wiring diagrams to trace electrical/electronic circuits</li> </ul>

**EEHVAC 3: Students will perform maintenance, diagnostic and repair procedures while also identifying characteristics of high voltage battery systems.**

<i>Webb Level</i>	<i>Sub-indicator</i>
One Recall	EEHVAC 3.1 Identify battery requirements. <ul style="list-style-type: none"> <li>● Identify safety precautions for high voltage systems on electric, hybrid electric, and diesel vehicles</li> </ul>

	<ul style="list-style-type: none"> <li>Identify electrical/electronic modules, security systems, radios, and other accessories that require reinitialization or code entry after reconnecting vehicle battery</li> <li>Identify hybrid vehicle auxiliary (12v) battery service, repair, and test procedures</li> </ul>
Two Skills/Concepts	EEHVAC 3.2 Service battery. <ul style="list-style-type: none"> <li>Perform battery state-of-charge test; determine necessary action</li> <li>Confirm proper battery capacity for vehicle application; perform battery capacity and load test; determine necessary action</li> <li>Maintain or restore electronic memory functions</li> <li>Inspect and clean battery; fill battery cells; check battery cables, connectors, clamps, and hold-downs</li> <li>Perform slow/fast battery charge according to manufacturer's recommendations</li> <li>Jump-start vehicle using jumper cables and a booster battery or an auxiliary power supply</li> </ul>

**EEHVAC 4: Students will perform maintenance, diagnostic and repair procedures of starting systems.**

<i>Webb Level</i>	<i>Sub-indicator</i>
One Recall	EEHVAC 4.1 Explain starting system operation. <ul style="list-style-type: none"> <li>Demonstrate knowledge of an automatic idle-stop/start-stop system</li> </ul>
Two Skill/Concept	EEHVAC 4.2 Inspect and repair starting system. <ul style="list-style-type: none"> <li>Perform starter current draw test; determine necessary action</li> <li>Perform starter circuit voltage drop tests; determine necessary action</li> <li>Inspect and test starter relays and solenoids; determine necessary action</li> <li>Remove and install starter in a vehicle</li> <li>Inspect and test switches, connectors, and wires of starter control circuits; determine necessary action</li> </ul>

**EEHVAC 5: Students will perform maintenance, diagnostic and repair procedures of the charging system.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skill/Concept	EEHVAC 5.1 Remove, inspect, and replace charging system components. <ul style="list-style-type: none"> <li>Perform charging system output test; determine necessary action</li> <li>Inspect, adjust, and/or replace generator (alternator) drive belts; check pulleys and tensioners for wear; check pulley and belt alignment</li> <li>Remove, inspect, and/or replace generator (alternator)</li> <li>Perform charging circuit voltage drop tests; determine necessary action</li> </ul>

**EEHVAC 6: Students will identify and perform repair procedures of electrical systems.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skill/Concept	EEHVAC 6.1 Identify and inspect lighting, instrument cluster, driver information, and body electrical systems and verify operation. <ul style="list-style-type: none"> <li>Identify system voltage and safety precautions associated with high-intensity discharge headlights</li> </ul>

	<ul style="list-style-type: none"> <li>● Inspect interior and exterior lamps and sockets including headlights and auxiliary lights (fog lights/driving lights); replace as needed</li> <li>● Verify operation of instrument panel gauges and warning/indicator lights; reset maintenance indicators</li> <li>● Verify windshield wiper and washer operation; replace wiper blades</li> <li>● Describe the operation of keyless entry/remote-start systems</li> </ul>
Two Skill/Concept	EEHVAC 6.2 Perform the following repair operations. <ul style="list-style-type: none"> <li>● Aim headlights</li> <li>● Disable and enable supplemental restraint system (SRS) and verify indicator lamp operation</li> <li>● Remove and reinstall door panel</li> </ul>

**EEHVAC 7: Students will research and identify heating, ventilation, and air conditioning components.**

<i>Webb Level</i>	<i>Sub-indicator</i>
One Recall	EEHVAC 7.1 Obtain vehicle service information on heating and air conditioning components. <ul style="list-style-type: none"> <li>● Research vehicle service information, including refrigerant/oil type, vehicle service history, service precautions, and technical service bulletins</li> <li>● Identify heating, ventilation and air conditioning (HVAC) components and configuration</li> </ul>

**EEHVAC 8: Students will inspect and understand repair procedures for the refrigeration system.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skill/Concept	EEHVAC 8.1 Inspect and demonstrate understanding of repair procedures for refrigeration system components. <ul style="list-style-type: none"> <li>● Inspect and replace A/C compressor drive belts, pulleys, and tensioners; visually inspect A/C components for signs of leaks; determine necessary action</li> <li>● Identify hybrid vehicle A/C system electrical circuits and the service/safety precautions</li> <li>● Inspect A/C condenser for airflow restrictions; determine necessary action</li> </ul>

**EEHVAC 9: Students will perform repair procedures for the heating and cooling system.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skill/Concept	EEHVAC 9.1 Analyze heating and engine cooling systems problems. <ul style="list-style-type: none"> <li>● Inspect engine cooling and heater systems hoses and pipes; determine necessary action</li> </ul>

**EEHVAC 10: Students will perform inspection and identification procedures for the heating, ventilation and air conditioning (HVAC) system.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skill/Concept	EEHVAC 10.1 Inspect and identify operating systems and related controls. <ul style="list-style-type: none"> <li>● Inspect A/C-heater ducts, doors, hoses, cabin filters, and outlets; determine necessary action</li> <li>● Identify the source of A/C system odors</li> </ul>

**EEHVAC 11: Students will understand and apply appropriate business practices.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Three Strategic Thinking	EEHVAC 11.1 Demonstrate the importance of, and the procedures for, maintaining accurate records.
Three Strategic Thinking	EEHVAC 11.2 Understand the concept and application of ethical business practices.
Three Strategic Thinking	EEHVAC 11.3 Understand the concept and application of excellent customer relations practices.

Proposed



## Powersports

Career Cluster	Transportation, Distribution & Logistics
Course Code	TO BE ASSIGNED
Prerequisite(s)	None
Credit	None
Program of Study and Sequence	Any Foundation course – <b>Powersports</b> – Any pathway course - Capstone
Student Organization	SkillsUSA
Coordinating Work-Based Learning	Job Shadow
Industry Certifications	N/A
Dual Credit or Dual Enrollment	See: <a href="https://sdmylife.com/images/Approved-CTE-Dual-Credit.pdf">https://sdmylife.com/images/Approved-CTE-Dual-Credit.pdf</a>
Teacher Certification	Transportation, Distribution & Logistics Cluster Endorsement; Automotive Technology Pathway Endorsement *Automotive Technology; *7-12 Technology Education
Resources	N/A

### Course Description

Powersports is an introductory course for students interested in obtaining skills needed to maintain and repair powersports vehicles. Students will study the various powersports types, parts identification, and engine operation along with other systems and components found in powersports vehicles. Students will inspect, disassemble, reassemble, and troubleshoot an internal combustion engine and all other systems found in powersports.

### Program of Study Application

Powersports is a cluster course within the Transportation, Distribution and Logistics career cluster.

## Course Standards

### PV 1: Students will demonstrate shop and tool safety.

<i>Webb Level</i>	<i>Sub-indicator</i>
One Recall & Reproduction	PV 1.1 Examine basic shop safety using Occupational Safety and Health Administration (OSHA) standards. <ul style="list-style-type: none"> <li>● Summarize the proper use of Safety Data Sheets (SDS)</li> <li>● Create a safety portfolio</li> <li>● Locate the fire extinguisher, fire blankets, and emergency exits</li> <li>● Never have an open flame near flammable liquids</li> <li>● Do not refuel engine while in operation</li> <li>● Demonstrate proper start up and shutoff procedures (be aware of surroundings when pull-starting small gas engine (SGE))</li> <li>● Wear appropriate eye and hearing protection</li> <li>● Wear appropriate clothing and shoe protection</li> </ul>
Two Skill/Concept	PV 1.2 Demonstrate proper use of hand and power tools. <ul style="list-style-type: none"> <li>● Perform a general tool test (name and function of tool being used, proper use of each tool, care and storage)</li> <li>● Review Torque wrench settings and usage</li> <li>● Spark test tools (Use appropriate spark tester to check spark)</li> </ul>

### PV 2: Students will demonstrate independent and teamwork skills as well as explore career opportunities within the industry.

<i>Webb Level</i>	<i>Sub-indicator</i>
Three Strategic Thinking	PV 2.1 Participate in student leadership activities.
Four Extended Thinking	PV 2.2 Utilize career guidance tools to research and report on career opportunities.
Three Strategic Thinking	PV 2.3 Develop a teamwork project.

### PV 3: Students will understand and apply appropriate business practices.

<i>Webb Level</i>	<i>Sub-indicator</i>
Three Strategic Thinking	PV 3.1 Demonstrate the importance of, and the procedures for, maintaining accurate records.
Three Strategic Thinking	PV 3.2 Apply concept and application of ethical business practices.
Three Strategic Thinking	PV 3.3 Apply excellent customer relations practices.

### PV 4: Students will troubleshoot an internal combustion engine.

<i>Webb Level</i>	<i>Sub-indicator</i>
Four Extended Thinking	PV 4.1 Implement strategic diagnostic procedures.
Two Skill/Concept	PV 4.2 Conduct preventative maintenance on an internal combustion engine. <ul style="list-style-type: none"> <li>● Inspect and change oil and oil filter</li> <li>● Inspect and change air filter</li> </ul>

	<ul style="list-style-type: none"> <li>● Disassemble, clean, and inspect fuel pump</li> <li>● Disassemble, clean, and inspect carburetor</li> </ul>
Three Strategic Thinking	<p>PV 4.3 Analyze the functions and operations of a fuel system related to powersports vehicles.</p> <ul style="list-style-type: none"> <li>● Complete fuel pressure test of system utilizing a fuel pump</li> <li>● Set carburetor float height</li> <li>● Adjust both low and high idle circuits on carburetor engines</li> <li>● Complete fuel injector function test on fuel injected engines</li> </ul>
Three Strategic Thinking	<p>PV 4.4 Diagnose fuel system problems.</p> <ul style="list-style-type: none"> <li>● Test and determine needed repair on fuel system</li> <li>● Inspect and determine needed repair on air cleaner system</li> </ul>
Three Strategic Thinking	<p>PV 4.5 Perform fuel system service.</p> <ul style="list-style-type: none"> <li>● Remove and replace the fuel tank, fuel lines and fuel filter system</li> <li>● Service oil-bath or foam type air cleaner</li> <li>● Reassemble and adjust a carburetor</li> <li>● Reassemble and install fuel pump</li> </ul>
Four Extended Thinking	<p>PV 4.6 Analyze the function and operation of emission systems related to powersports vehicles.</p> <ul style="list-style-type: none"> <li>● Research EPA emissions standards and requirements and</li> <li>● Explain how emissions regulations affect the small engine service industry</li> </ul>
Four Extended Thinking	<p>PV 4.7 Diagnose emission systems relating to powersports vehicles.</p>

**PV 5: Students will properly test, diagnose, service, and repair charging and electrical systems.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skill/Concept	<p>PV 5.1 Inspect and repair battery problems.</p> <ul style="list-style-type: none"> <li>● Perform battery state-of-charge test; determine necessary action</li> <li>● Perform battery capacity test; confirm proper battery capacity for vehicle application; determine necessary action</li> <li>● Maintain or restore electronic memory functions</li> <li>● Inspect, clean, fill, and/or replace battery, battery cables, connectors, clamps and hold-downs</li> <li>● Perform battery charge</li> <li>● Start a vehicle using jumper cables and a battery or auxiliary power supply</li> </ul>
Two Skill/Concept	<p>PV 5.2 Diagnose and repair starter.</p> <ul style="list-style-type: none"> <li>● Perform starter current draw tests; determine necessary action</li> <li>● Perform starter circuit voltage drop tests; determine necessary action</li> <li>● Inspect and test starter relays and solenoids; determine necessary action</li> <li>● Remove and replace starter</li> </ul>
Two Skill/Concept	<p>PV 5.3 Diagnose and repair charging system.</p> <ul style="list-style-type: none"> <li>● Perform charging system output test; determine necessary action</li> <li>● Remove and replace generator (alternator)</li> <li>● Diagnose the cause of dim, or no light operation; determine necessary action</li> <li>● Inspect, replace, and aim headlights and bulbs</li> </ul>
Two Skill/Concept	<p>PV 5.4 Understand safety aspects of supplemental restraint systems (SRS), electronic brake control systems and hybrid vehicle high voltage circuits.</p>

Two Skill/Concept	PV 5.5 Understand and demonstrate awareness of the safety aspects of high voltage circuits (such as high intensity discharge [HID] lamps, ignition systems, injection systems, etc.).
Two Skill/Concept	PV 5.6 Utilize safe procedures for operating electric vehicles and systems.

**PV 6: Inspect, diagnose and repair drivetrain, transmission, axles and final drive components.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skill/Concept	PV 6.1 Demonstrate understanding of drivetrain components to include primary transmission and final drive components. <ul style="list-style-type: none"> <li>● Drain transmission fluid</li> <li>● Visually inspect the amount of debris in oil pan</li> <li>● Remove filter and install new filter</li> <li>● Install the proper fluid to the proper level</li> </ul>
Two Skill/Concept	PV 6.2 Diagnose and repair drive train and axles. <ul style="list-style-type: none"> <li>● Diagnose fluid loss, level, and condition concerns; determine necessary action</li> <li>● Drain and fill transmission/transaxle and final drive unit</li> <li>● Identify and inspect clutch pedal linkage, cables, automatic adjuster mechanisms, brackets, bushings, pivots, and springs; determine necessary action</li> <li>● Identify and inspect hydraulic clutch slave and master cylinders, lines and hoses; determine necessary action</li> <li>● Bleed clutch hydraulic system</li> <li>● Inspect constant velocity (CV) joint boots</li> <li>● Remove and replace rear wheel drive shaft</li> </ul>

**PV 7: Students will repair suspension and steering.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skill/Concept	PV 7.1 Diagnose suspension and steering; determine necessary action. <ul style="list-style-type: none"> <li>● Determine proper power steering fluid types</li> <li>● Flush, fill and bleed power steering system</li> <li>● Diagnose power steering fluid leakage; determine necessary action.</li> <li>● Lubricate suspension and steering systems</li> <li>● Inspect, remove and replace shock absorbers</li> <li>● Inspect and install stabilizer bar bushings, brackets, and links.</li> <li>● Inspect and install strut cartridge or assembly, coil spring, insulators (silencers), and upper strut mount</li> <li>● Perform pre-alignment inspection and measure vehicle ride height; determine necessary action</li> <li>● Demonstrate knowledge of the principles of steering geometry using caster, camber and toe</li> </ul>
Two Skill/Concept	PV 7.2 Inspect and repair tire and wheel assembly. <ul style="list-style-type: none"> <li>● Diagnose tire wear patterns; determine necessary action</li> <li>● Diagnose wheel/tire vibration, shimmy, and noise; determine necessary action</li> <li>● Identify vehicles equipped with a tire pressure monitoring system (TPMS)</li> </ul>



	<ul style="list-style-type: none"> <li>● Demonstrate knowledge of service considerations of vehicles equipped with a TPMS</li> <li>● Rotate tires according to manufacturer's recommendations</li> <li>● Balance wheel and tire assembly (static and dynamic)</li> <li>● Dismount, inspect, and remount tire on wheel</li> <li>● Repair tire using internal patch</li> <li>● Reinstall wheel; torque lug nuts</li> </ul>
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**PV 8: Students will inspect, diagnose and repair brake assembly.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skill/Concept	PV 8.1 Diagnose and repair brake fluid system. <ul style="list-style-type: none"> <li>● Inspect brake lines, flexible hoses, and fittings for leaks, dents, kinks, rust, cracks, bulging or wear; tighten loose fittings and support; determine necessary action</li> <li>● Select, handle, and fill brake fluids to proper level</li> <li>● Bleed brake system</li> <li>● Test brake fluid for contamination; determine necessary action</li> </ul>
Two Skill/Concept	PV 8.2 Inspect and repair brake assemblies. <ul style="list-style-type: none"> <li>● Remove, clean, inspect and measure brake drums; determine necessary action</li> <li>● Refinish brake drum; measure final drum diameter</li> <li>● Remove, clean, inspect brake shoes, springs, pins, clips, levers, adjuster/self-adjuster, other related brake hardware, and backing support plates; lubricate and reassemble</li> <li>● Inspect and install wheel cylinders</li> <li>● Pre-adjust brake shoes and parking brake; install brake drums or drum/hub assemblies and wheel bearings</li> <li>● Install wheel, torque lug nuts, and make final checks and adjustments</li> </ul>
Two Skill/Concept	PV 8.3 Inspect and repair brake indicator light components. <ul style="list-style-type: none"> <li>● Check parking brake and indicator light system operation; determine necessary action</li> <li>● Check operation of brake stop light system; determine necessary action</li> <li>● Replace tapered roller wheel bearing and race</li> <li>● Clean, inspect, lubricate, install and adjust wheel bearing</li> <li>● Identify and inspect electronic brake control system components; determine necessary action</li> <li>● Demonstrate knowledge of how the brake hydraulic failure warning light operates</li> </ul>

**PV 9: Students will inspect, diagnose and repair heating and air conditioning.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skill/Concept	PV 9.1 Identify and visually inspect A/C system components. <ul style="list-style-type: none"> <li>● Locate refrigerant label and identify specified refrigerant type (e.g., R-12, R-134a)</li> <li>● Conduct preliminary performance test of A/C system and determine necessary action</li> <li>● Conduct performance test of the heater/ventilation system</li> </ul>

	<ul style="list-style-type: none"> <li>● Inspect and replace cabin air filter</li> </ul>
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**PV 10: Students will inspect, diagnose and improve engine performance.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skill/Concept	<p>PPV 10.1 Perform the necessary tests and repairs to improve engine performance.</p> <ul style="list-style-type: none"> <li>● Perform engine cranking and running vacuum tests; determine necessary action</li> <li>● Perform cylinder power balance test; determine necessary action</li> <li>● Perform cylinder cranking compression test; determine necessary action</li> <li>● Perform cylinder leakage test; determine necessary action</li> <li>● Verify engine operating temperature; determine necessary action</li> <li>● Retrieve and record stored diagnostic trouble codes, On-Board Diagnostics (OBD) monitor status and freeze frame data; clear codes when applicable</li> <li>● Obtain and interpret scan tool data</li> <li>● Remove and replace secondary ignition components</li> <li>● Remove and replace thermostat and gasket/seal</li> <li>● Perform common fastener and thread repair, to include: removing broken bolt, restoring internal and external threads, and repairing internal threads with a threaded insert</li> </ul>

Proposed



## Structural Analysis and Damage Repair

Career Cluster	Transportation, Distribution & Logistics
Course Code	20117
Prerequisite(s)	Introduction to Auto Body and Estimating 20120
Credit	0.5 to 1.0
Program of Study and Sequence	Introduction to Auto Body & Estimating – <b>Structural Analysis and Damage Repair</b> – Auto Body Painting & Refinishing
Student Organization	SkillsUSA
Coordinating Work-Based Learning	Youth Internships, Industry Guest Speakers and Tour of Local Industries.
Industry Certifications	Automotive Service of Excellence (ASE) and Occupational Safety and Health Administration (OSHA) 10
Dual Credit or Dual Enrollment	See: <a href="https://state-sd.zoom.us/j/96110845135?pwd=RStxcVh2ay8rSVdvWTFJRHEaFNLUT09">https://state-sd.zoom.us/j/96110845135?pwd=RStxcVh2ay8rSVdvWTFJRHEaFNLUT09</a>
Teacher Certification	Transportation, Distribution & Logistics Cluster Endorsement; Autobody Technology Pathway Endorsement; *Autobody Technology
Resources	N/A

### Course Description

Students will measure and repair structural and frame damage. The goal of this course is for students to receive industry-based training at the basic level and advance to higher level of competency in this field.

### Program of Study Application

Structural Analysis and Damage Repair is an advanced pathway course in the Transportation, Distribution and Logistics career cluster, Automotive Body Collision and Refinishing pathway.

## Course Standards

### SA 1: Students will demonstrate auto body technology safety practices.

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skills/Concepts	<p>SA 1.1 Demonstrate auto body technology safety practices:</p> <ul style="list-style-type: none"> <li>• Select and use proper personal safety equipment; take necessary precautions with hazardous operations and materials in accordance with federal, state, and local regulations</li> <li>• Locate procedures and precautions that may apply to the vehicle being repaired</li> <li>• Identify vehicle system hazard types (supplemental restraint system (SRS), hybrid/electric/alternative fuel vehicles), locations and recommended procedures</li> <li>• Inspect or replace components</li> <li>• Select and use a National Institute of Occupational Safety and Health (NIOSH) approved air purifying respirator</li> <li>• Inspect condition and hazardous operations and materials in accordance with federal, state, and local regulation (e.g. OSHA Regulation 1910.134) and applicable state and local regulation</li> </ul>

### SA 2: Students will inspect and repair frames.

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skill/Concept	<p>SA 2.1 Measure and analyze structural damage.</p> <ul style="list-style-type: none"> <li>• Measure and diagnose structural damage using a tram gauge</li> <li>• Analyze mash, sag, side sway, twist, and diamond damage</li> <li>• Identify heat limitations and monitoring procedures for structural components</li> <li>• Measure and diagnose structural damage using a three-dimensional measuring system (mechanical, electronic, and laser)</li> <li>• Determine the extent of direct and indirect damage and the direction of impact; document the methods and sequence of repair</li> <li>• Analyze and identify crush and collapse zones</li> </ul>
Two Skill/Concept	<p>SA 2.2 Make necessary repairs to the frame.</p> <ul style="list-style-type: none"> <li>• Attach vehicle to anchoring devices</li> <li>• Demonstrate an understanding of structural foam applications</li> </ul>

### SA 3: Students will inspect, measure and repair unibody and unitized structures.

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skills/Concepts	<p>SA 3.1 Analyze and determine unibody and unitized structural damage.</p> <ul style="list-style-type: none"> <li>• Measure and diagnose unibody damage using a tram gauge</li> <li>• Measure and diagnose unibody vehicles using a dedicated (fixture) measuring system</li> <li>• Diagnose and measure unibody vehicles using a three-dimensional measuring system (mechanical, electronic, and laser)</li> <li>• Determine the extent of the direct and indirect damage and the direction of impact; plan and document the methods and sequence of repair</li> </ul>

	<ul style="list-style-type: none"> <li>Analyze and identify crush/collapse zones</li> </ul>
Two Skills/Concepts	<p>SA 3.2 Repair unibody and unitized structures.</p> <ul style="list-style-type: none"> <li>Attach anchoring devices to vehicle; remove or reposition components as necessary</li> <li>Identify proper cold stress relief methods</li> <li>Determine sectioning procedures of a steel body structure</li> <li>Remove and replace damaged structural components</li> <li>Restore corrosion protection to repaired or replaced structural areas and anchoring locations</li> </ul>

**SA 4: Students will inspect and repair or replace stationary glass.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Two Skill/Concept	<p>SA 4.1 Inspect vehicles for glass damage and determine manufacturer's specifications for glass window replacement.</p> <ul style="list-style-type: none"> <li>Identify considerations for removal, handling, and installation of advanced glass systems (rain sensors, navigation, cameras, and collision avoidance systems)</li> <li>Remove and reinstall or replace modular glass using recommended materials</li> <li>Check for water leaks, dust leaks, and wind noise</li> </ul>

**SA 5: Students will demonstrate proficiency in welding, cutting and joining.**

<i>Webb Level</i>	<i>Sub-indicator</i>
One Recall	<p>SA 5.1 Analyze and identify correct welding procedures to be used in auto body repair work.</p> <ul style="list-style-type: none"> <li>Identify the considerations for cutting, removing, and welding various types of steel, aluminum, and other metals</li> <li>Determine the correct Gas Metal Arc Welding (GMAW) welder type, electrode/wire type, diameter, and gas to be used in a specific welding situation</li> <li>Identify hazards, foam coatings and flammable materials prior to welding/cutting procedures</li> <li>Determine the joint type (butt weld with backing, lap, etc.) for weld being made</li> <li>Determine the type of weld (continuous, stitch weld, plug, etc.) for each specific welding operation</li> <li>Identify different methods of attaching structural components (squeeze type resistance spot welding, riveting, structural adhesive, Metal Inert Gas (MIG) bronze, TIG welding, other future equipment/new techniques aligned to current industry practices, etc.)</li> </ul>
Two Skill/Concept	<p>A 5.2 Perform proper welding operations to specific auto body repairs.</p> <ul style="list-style-type: none"> <li>Set up attach work clamp (ground) and adjust the GMAW welder to "tune" for proper electrode stickout, voltage, polarity, flow rate, and wire-feed speed required for the substrate being welded</li> <li>Store, handle, and install high-pressure gas cylinders; test for leaks</li> <li>Determine the proper angle of the gun to the joint and direction of gun travel for the type of weld being made</li> </ul>

	<ul style="list-style-type: none"> <li>• Protect adjacent panels, glass, vehicle interior, etc. from welding and cutting operations</li> <li>• Clean and prepare the metal to be welded, assure good metal fit-up, apply weld through primer if necessary, clamp or tack as required</li> <li>• Perform the following welds: plug, butt weld with and without backing, and fillet, in the flat, horizontal, vertical and overhead positions</li> <li>• Perform visual evaluation and destructive test on each weld type</li> <li>• Identify the causes of various welding defects; make necessary adjustments</li> <li>• Identify cause of contact tip burn-back and failure of wire to feed; make necessary adjustments</li> <li>• Identify cutting process for different substrates and locations; perform cutting operation</li> </ul>
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**SA 6: Students will demonstrate appropriate business practices.**

<i>Webb Level</i>	<i>Sub-indicator</i>
Three Strategic Thinking	SA 6.1 Demonstrate the importance of, and the procedures for, maintaining accurate records.
Three Strategic Thinking	SA 6.2 Understand the concept and application of ethical business practices.
Three Strategic Thinking	SA 6.3 Understand the concept and application of excellent customer relations practices.

Proposed