

Colorado AFNR Course Scope and Sequence

Course Name	Industrial Maintenance Technology		Course Details	Level 3 course in the Power, Structure, & Technology pathway. This course aligns with content in any strand of the pathway.		
			Course = 0.50 Carnegie Unit Credit			
Course Description	This course covers application of power and technical systems in industrial settings. Content covers basic application of electrical circuitry, motors & controls, hydraulics & pneumatic, and mechanical systems.					
Note:	This is a suggested scope and sequence for the course content. The content will work with any textbook or instructional resource. If locally adapted, make sure all essential knowledge and skills are covered.					
SCED Identification #	18402	Schedule calculation based on 60% of a semester instructional time. Scope and sequence allows for additional time for guest speakers, student presentations, field trips, remediation, or other content topics.				
All courses taught in an approved CTE program must include Essential Skills embedded into the course content. The Essential Skills Framework for this course can be found at https://www.cde.state.co.us/standardsandinstruction/essentialskills						
Unit Number, Title and Brief Description	Suggested % of Instructional Time	CTE or Academic Standard Alignment	Competency / Performance Indicator	Outcome / Measurement	CTSO Integration	
Unit 1: Workplace Equipment Safety	2%	PST.02. Operate and maintain AFNR mechanical equipment and power systems.	PST.02.02. Operate machinery and equipment while observing all safety precautions in AFNR settings.	PST.02.02.02.a. Examine and identify safety hazards associated with equipment, machinery and power units used in AFNR power, structural, and technical systems (e.g., caution, warning, danger, etc.).		
Unit 2: Engine Troubleshooting <ul style="list-style-type: none"> Isolation of problem techniques Application of engine operation knowledge to solve issue 	4%	PST.03. Service and repair AFNR mechanical equipment and power systems.	PST.03.01. Troubleshoot, service and repair components of internal combustion engines using manufacturers' guidelines.	PST.03.01.01.c. Evaluate service and repair needs for internal combustion engines using a variety of performance tests (e.g., manuals, computer-based diagnostics, etc.).		
Unit 3: Engine Maintenance & Service Intervals	2%	PST.03. Service and repair AFNR mechanical equipment and power systems.	PST.03.01. Troubleshoot, service and repair components of internal	PST.03.01.01.c. Evaluate service and repair needs for internal combustion engines using a variety of		

<ul style="list-style-type: none"> Identifying & following service recommendations 			combustion engines using manufacturers' guidelines.	performance tests (e.g., manuals, computer-based diagnostics, etc.).	
Unit 4: Equipment manual & use – Service Intervals & lubrication	3%	<p>PST.02.: Operate and maintain AFNR mechanical equipment and power systems.</p> <p>PST.03. Service and repair AFNR mechanical equipment and power systems</p>	<p>PST.02.01. Perform preventative maintenance and scheduled service to maintain equipment, machinery and power units used in AFNR settings.</p> <p>PST.03.01. Troubleshoot, service and repair components of internal combustion engines using manufacturers' guidelines.</p>	<p>PST.02.01.02.a. Examine operator's manuals to determine recommendations for servicing filtration systems and maintaining fluid levels on equipment, machinery and power units used in AFNR power, structural and technical systems.</p> <p>PST.03.01.02.b. Utilize technical manuals and diagnostic tools to determine service and repair needs of spark-and-compression internal combustion engines used in AFNR power, structural and technical systems.</p>	
Unit 5: Power Transmission <ul style="list-style-type: none"> Gears & Pulley belts PTS Drives Pitch, speed ratio, belt profile & types Gear types & applications Adjustments, universal joints & phasing 	4%	<p>PST.02. Operate and maintain AFNR mechanical equipment and power systems.</p> <p>PST.03. Service and repair AFNR mechanical equipment and power systems.</p>	<p>PST.02.01. Perform preventative maintenance and scheduled service to maintain equipment, machinery and power units used in AFNR settings.</p> <p>PST.03.03. Utilize manufacturers' guidelines to diagnose and troubleshoot malfunctions in machinery, equipment and power source systems (e.g., hydraulic, pneumatic, transmission, steering, suspension, etc.).</p>	<p>PST.02.01.02.c. Assess and adjust equipment (e.g., belts and drives, chains, sprockets, etc.) and maintain fluid conveyance components (e.g., hoses, lines, nozzles, etc.) to ensure proper functioning.</p> <p>PST.03.03.02.a. Compare and contrast operation principles and features of mechanical transmission systems used in AFNR power, structural and technical systems (e.g., belts, chains, gears,</p>	

				<p>bearings, seals, universals, drive shafts, etc.).</p> <p>PST.03.03.02.b. Utilize speed, torque and power measurements to calculate efficiency in power transmission systems used in AFNR power, structural and technical systems.</p> <p>PST.03.03.02.c. Inspect, analyze and repair the components of power transmission systems used in AFNR power, structural and technical systems.</p>	
Unit 6: Bearing types, lubrication & repair	2%	PST.03. Service and repair AFNR mechanical equipment and power systems	PST.03.03. Utilize manufacturers' guidelines to diagnose and troubleshoot malfunctions in machinery, equipment and power source systems (e.g., hydraulic, pneumatic, transmission, steering, suspension, etc.).	<p>PST.03.03.02.a. Compare and contrast operation principles and features of mechanical transmission systems used in AFNR power, structural and technical systems (e.g., belts, chains, gears, bearings, seals, universals, drive shafts, etc.).</p> <p>PST.03.03.02.b. Utilize speed, torque and power measurements to calculate efficiency in power transmission systems used in AFNR power, structural and technical systems.</p> <p>PST.03.03.02.c. Inspect, analyze and repair the</p>	

				components of power transmission systems used in AFNR power, structural and technical systems.	
Unit 7: Equipment specific tools, ID, use Dial indicators, feeler indicators, caliper, torque wrench, feeler gage	2%	PST.01 Apply physical science principles and engineering applications to solve problems and improve performance in AFNR power, structural, and technical systems.	PST.01.02 Apply physical science and engineering principles to design, implement, and improve safe and efficient mechanical systems in AFNR situation. SCIENCE: SC.HS.1.6 SC.HS.1.7 SC.HS.1.9	PST.01.02.03.b Select, maintain, and demonstrate the proper use of tools, machines, and equipment used in different AFNR related mechanical systems.	
Unit 8: Types, purposes & operations of clutches, transitions & final drives	2%	PST.03 Service and repair AFNR mechanical equipment and power systems.	PST.03.03 Utilize manufacturer's guidelines to diagnose and troubleshoot malfunctions in machinery, equipment, and power source systems (e.g. hydraulic, pneumatic, transmission, steering, suspension, etc.)	PST.03.03.02.a Compare and contrast operation principles and features of mechanical transmission systems used in AFNR power, structural, and technical systems (e.g. belts, chains, gears, bearings, seals, universals, drive, shafts, etc)	
Unit 9: Equipment setup, adjustment, & calibration <ul style="list-style-type: none"> Setup to manual specifications, operation adjustment, and critical calibration 	3%	PST.02.: Operate and maintain AFNR mechanical equipment and power systems.	PST.02.02. Operate machinery and equipment while observing all safety precautions in AFNR settings.	PST.02.02.02.c. Adjust equipment, machinery and power units for safe and efficient operation in AFNR power, structural and technical systems.	
Unit 10: Theory of hydraulic operation-thermodynamic laws	2%	PSTS.08 Understand and operate power and mechanical systems for agriculture use. PST.03. Service and repair AFNR mechanical equipment and power systems.	PSTS .08.04 Apply theory & operation of hydraulic systems PST.03.03. Utilize manufacturers' guidelines to diagnose and	PSTS.08.04.a Understand the theory and principle of operation of hydraulic systems PST.03.03.01.a. Research and summarize the applications of common	

			troubleshoot malfunctions in machinery, equipment and power source systems (e.g., hydraulic, pneumatic, transmission, steering, suspension, etc.).	types of hydraulic and pneumatic systems used in AFNR power, structural and technical systems.	
Unit 11: Hydraulic Vocabulary & terms	1%	PST.03 Service and repair AFNR mechanical equipment and power systems.	PST.03.03 Utilize manufacturers' guidelines to diagnose and troubleshoot malfunction in machinery, equipment and power source systems (e.g. hydraulic, pneumatic, transmission, steering, suspension, etc)	PST.03.03.01.a Research and summarize the applications of common types of hydraulic and pneumatic systems used in AFNR power, structural, and technical systems.	
Unit 12: Understand basic hydraulic system components & function <ul style="list-style-type: none"> Pumps, cylinders, flow controls, connectors, hoses, pipping, schematics & symbols 	3%	PST.03. Service and repair AFNR mechanical equipment and power systems.	PST.03.03. Utilize manufacturers' guidelines to diagnose and troubleshoot malfunctions in machinery, equipment and power source systems (e.g., hydraulic, pneumatic, transmission, steering, suspension, etc.).	PST.03.03.01.a. Research and summarize the applications of common types of hydraulic and pneumatic systems used in AFNR power, structural and technical systems.	
Unit 13: Hydraulic Schematics	2%	PST.03. Service and repair AFNR mechanical equipment and power systems.	PST.03.03. Utilize manufacturers' guidelines to diagnose and troubleshoot malfunctions in machinery, equipment and power source systems (e.g., hydraulic, pneumatic, transmission, steering, suspension, etc.).	PST.03.03.01.b. Analyze and interpret hydraulic and pneumatic system symbols and diagrams used in AFNR power, structural and technical systems.	
Unit 14: Understanding difference between open/closed systems, fixed, variable positive and non-positive pumps, and identification of hydraulic pumps	2%	PST.03. Service and repair AFNR mechanical equipment and power systems	PST.03.03. Utilize manufacturers' guidelines to diagnose and troubleshoot malfunctions in machinery, equipment and power source systems (e.g., hydraulic, pneumatic, transmission, steering, suspension, etc.).	PST.03.03.01.a. Research and summarize the applications of common types of hydraulic and pneumatic systems used in AFNR power, structural and technical systems.	

Unit 15: Flow, Directional & Pressure Control Values	1%	PST.03. Service and repair AFNR mechanical equipment and power systems.	PST.03.03. Utilize manufacturers' guidelines to diagnose and troubleshoot malfunctions in machinery, equipment and power source systems (e.g., hydraulic, pneumatic, transmission, steering, suspension, etc.).	PST.03.03.01.a. Research and summarize the applications of common types of hydraulic and pneumatic systems used in AFNR power, structural and technical systems.	
Unit 16: Hydraulic Motor Applications & Design	1%	PST.03. Service and repair AFNR mechanical equipment and power systems.	PST.03.03. Utilize manufacturers' guidelines to diagnose and troubleshoot malfunctions in machinery, equipment and power source systems (e.g., hydraulic, pneumatic, transmission, steering, suspension, etc.).	PST.03.03.01.a. Research and summarize the applications of common types of hydraulic and pneumatic systems used in AFNR power, structural and technical systems.	
Unit 17: Hydraulic Calculations	2%	PST.03. Service and repair AFNR mechanical equipment and power systems.	PST.03.03. Utilize manufacturers' guidelines to diagnose and troubleshoot malfunctions in machinery, equipment and power source systems (e.g., hydraulic, pneumatic, transmission, steering, suspension, etc.).	PST.03.03.01.a. Research and summarize the applications of common types of hydraulic and pneumatic systems used in AFNR power, structural and technical systems.	
Unit 18: Electrical Theory & Ohm's Law	2%	PST.03. Service and repair AFNR mechanical equipment and power systems.	PST.03.02. Service electrical systems and components of mechanical equipment and power systems using a variety of troubleshooting and/or diagnostic methods.	PST.03.02.01.a Compare and contrast basic units of electricity (e.g., volts, amps, watts, and ohms) and the principles that describe their relationship (e.g., Ohm's Law, Power Law, etc.).	
Unit 19: DC Current Circuits	2%	PST.03. Service and repair AFNR mechanical equipment and power systems.	PST.03.02. Service electrical systems and components of mechanical equipment and power systems using a variety of troubleshooting and/or diagnostic methods.	PST.03.02.01.c. Analyze and design electrical circuits for AFNR power, structural and technical systems using knowledge of the basic units of electricity.	

Unit 20: Electrical Schematics/Diagrams	2%	PST.03. Service and repair AFNR mechanical equipment and power systems	PST.03.02. Service electrical systems and components of mechanical equipment and power systems using a variety of troubleshooting and/or diagnostic methods.	PST.03.02.02.b. Analyze and interpret electrical system symbols and diagrams.	
Unit 21: Electrical Motor Power Systems	3%	PST.03. Service and repair AFNR mechanical equipment and power systems	PST.03.02. Service electrical systems and components of mechanical equipment and power systems using a variety of troubleshooting and/or diagnostic methods.	PST.03.02.02.a. Compare and contrast the characteristics of electronic components used in AFNR power, structural and technical systems (e.g., battery, resistor, diode, transistor, capacitor, etc.).	
Unit 22: Electrical Components	2%	PST.03. Service and repair AFNR mechanical equipment and power systems	PST.03.02. Service electrical systems and components of mechanical equipment and power systems using a variety of troubleshooting and/or diagnostic methods.	PST.03.02.02.a. Compare and contrast the characteristics of electronic components used in AFNR power, structural and technical systems (e.g., battery, resistor, diode, transistor, capacitor, etc.).	
Unit 23: Air compressors- Pneumatic Theory of Operation	2%	PST.03. Service and repair AFNR mechanical equipment and power systems	PST.03.03. Utilize manufacturers' guidelines to diagnose and troubleshoot malfunctions in machinery, equipment and power source systems (e.g., hydraulic, pneumatic, transmission, steering, suspension, etc.).	PST.03.03.01.a. Research and summarize the applications of common types of hydraulic and pneumatic systems used in AFNR power, structural and technical systems.	
Unit 24: AC Circuits – 120 & higher voltage	2%	PST.04. Plan, build and maintain AFNR structures.	PST.04.04. Apply electrical wiring principles in AFNR structures.	PST.04.04.02.a. Distinguish electrical circuits and the components of each.	
Unit 25: AC & DC low voltage control systems	3%	PST.04. Plan, build and maintain AFNR structures.	PST.04.04. Apply electrical wiring principles in AFNR structures.	PST.04.04.01.c. Install and/or repair fixtures following appropriate codes and standards.	

			<p>PST.05.02. Performance Indicator: Prepare and/or use electrical drawings to design, install and troubleshoot electronic control systems in AFNR.</p>	<p>PST.05.02.01.a. Examine and categorize electrical control system components used in AFNR systems (e.g., transistors, relays, HVAC, logic controllers, etc.).</p> <p>PST.05.02.01.b. Analyze schematic drawings for electrical control systems used in AFNR systems.</p> <p>PST.05.02.02.a. Differentiate between the purpose of electrical sensors and controls used in AFNR power, structural and technical systems.</p> <p>PST.05.02.02.b. Interpret maintenance schedules for electrical control systems used in AFNR power, structural and technical systems.</p>	
<p>Unit 26: Sensing Devices & PLC</p>	2%	<p>PST.04. Plan, build and maintain AFNR structures</p> <p>PST.05. Use control, monitoring, geospatial and other technologies in AFNR power, structural and technical systems</p>	<p>PST.04.04Apply electrical wiring principles in AFNR structures. <i>SCIENCE: SC.HS.1.8</i></p> <p>PST.05.01. Apply computer and other technologies (e.g., robotics, CNC, UAS, etc.) to solve problems and increase the efficiency of AFNR systems. <i>SCIENCE: NGSS.HS.ETS.1.3 SC.HS.3.9</i></p> <p>PST.05.02. Prepare and/or use electrical drawings to</p>	<p>PST.04.04.01.c. Install and/or repair fixtures following appropriate codes and standards.</p> <p>PST.05.01.01.a. Research and categorize computer technologies used to solve problems and increase efficiency in AFNR systems.</p> <p>PST.05.02.01.a. Examine and categorize electrical control system components used in AFNR systems (e.g.,</p>	

			design, install and troubleshoot electronic control systems in AFNR settings.	transistors, relays, HVAC, logic controllers, etc.). PST.05.02.01.b. Analyze schematic drawings for electrical control systems used in AFNR systems. PST.05.02.03.a. Research and summarize the importance of AFNR power, structural and technical control systems using programmable logic controllers (PLC) and/or other computer- based systems. PST.05.02.03.b. Assess the functions of AFNR power, structural and technical control systems using programmable logic controllers (PLC) in agricultural production and manufacturing.	
Unit 27: Plumbing component & application	2%	PST.04. Plan, build and maintain AFNR structures.	PST.04.03 Follow architectural and mechanical plans to construct, maintain and/or repair AFNR structures (e.g., material selection, site preparation and/or layout, plumbing, concrete/masonry, etc.).	PST.04.03.04.c. Install and/or repair pipes and plumbing equipment and fixtures in AFNR structures.	

CAS Academic Standards Alignment: Online Version: <https://www.cde.state.co.us/apps/standards/>; Download version: <https://www.cde.state.co.us/apps/standards/>

Science:

- SC.HS.1.6 – Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system.
- SC.HS.1.7 – Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems.
- SC.HS.1.8 – Force fields (gravitational, electric, and magnetic) contain energy and can transmit energy across space from one object to another.
- SC.HS.1.9 – Although energy cannot be destroyed, it can be converted to less useful forms as it is captured, stored, and transferred.
- NGSS.HS.ETS.1.3 – Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.
- SC.HS.3.9 – Resource availability has guided the development of human society and use of natural resources has associated costs, risks, and benefits.

Problem Solver:

- **Critical Thinking and Analysis:** The ability to apply a deliberate process of identifying problems, gathering information, and weighing possible solutions, including: making choices rooted in understanding patterns, cause-and-effect relationships, and the impacts that a decision can have on the individual and others.
- **Creativity and innovation:** the ability to demonstrate curiosity and imagination through experimenting with new and emerging ideas.

Empowered Individual:

- **Self-Awareness:** the ability to understand one's own emotions, thoughts, and values, and how personal actions and emotions influence behavior across contexts, including: the capacity to recognize one's strength and limitations with a well-grounded sense of confidence and purpose.