CareerClusters™ PATHWAYS TO COLLEGE & CAREER READINESS
Manufacturing

Learning that works for Colorado CTE®

Colorado CTE Course – Scope and Sequence

Course Name	Power and Energy Technology (Industrial Maintenance)	Course Details Course = 0.50 Carnegie Unit Credit	Credit = 1.0 Prerequisite: Introduction to Manufacturing CTE Credential: CTE Manufacturing
Course Description	Power and energy is a fundamental study of conventional energy sources and the generation and conversions of energy to power. Emphasis will be placed on heat engines or internal combustion engines, the control of mechanisms, solar energy, electricity, and the future sources of energy.		
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 #	20101	Schedule calculation based on 60 calendar days of a 90-day semester. 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

Instructional Unit Topic	Suggested Length of Instruction	CTE or Academic Standard Alignment	Competency / Performance Indicator	Outcome / Measurement	CTSO Integration
Career Development		Integrate multiple sources of career information from diverse formats to make informed career decisions, solve problems, and manage personal career plans. Identify and describe careers and the entry requirements for occupations in the Energy Industry.	Investigate and research career opportunities in the energy and power fields. Student is expected to: (A) Identify employers' expectations and appropriate work habits; (B) identify career development, employment, and entrepreneurship opportunities and certification	Report about career opportunities in the energy and power fields. Include information on knowledge and skills, industry credentials or certifications, and experience or specialized training that are required.	Updates to ICAP

			requirements for the field of energy and power of transportation systems; and (C) discuss certification requirements to meet state academic standards and qualifications for employment in selected fields of study.		
Safety		Demonstrate health and safety procedures, regulations, and personal health practices and determine the meaning of symbols, key terms, and domain-specific words and phrases as related to the Energy, Environment, and Utilities sector workplace environment. Relate and follow safety rules pertaining to moving mechanical systems.	Student is expected to: (A) apply safety rules based on Occupational Safety and Health Administration (OSHA) Standards; and (B) understand hazards associated with working with power equipment and mechanical systems.	Demonstrate proper method of lifting, and cleanup method for fluids. List which extinguisher will fight which type of fire. Demonstrate proper personal protective equipment (PPE). Identify color coding safety standards.	
Work, Energy and Power		Examine the relationship between power and energy sources.	Student is expected to: (A) Define work, power, and energy;	Describe energy sources: • Thermal • Radiant • Nuclear • Chemical	

		Understand how energy converts from one form to another. Interpret and explain terminology and practices specific to the Energy, Environment, and Utilities sector.	(B) Describe sources of energy; and (C) Apply mathematics formula that calculates power. (D) Examine the relationship between power and energy; (E) Understand the categories of energy; (F) Explain the Law of Conservation of Energy; and (G) Define the Law of Thermodynamics.	• Electrical • Mechanical • Fluid Determine uses of work, power and energy. Apply equations to find missing information pertaining to work, energy and power. Summarize various methods of transferring energy. Compare efficiency of various types of light bulbs. Investigate examples of renewable energy sources. Investigate examples of nonrenewable energy sources. Explain how you would design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy. Create a graphic of the design.	
Power Transmission		Understand the transmission of energy and power.	Understand the interrelationships among components of power	Identify the six simple machines and classify the mechanical advantage of various simple machines.	

		Understand how a mechanical system operates. Research methods of energy procurement, transmission, distribution, and storage.	transmission systems. Student is expected to: (A) Understand the types of simple machines used to transmit energy and power; (B) Identify the parts of a power train; (C) Understand both liquid and gas forms of power transmission; and (D) Understand the laws that govern electricity.	Solve problems involving simple machines, input and output forces, and mechanical advantage. Describe the relationship of force and speed when either is changed by the advantage of a mechanical device. List the various forms of fluid power. Apply characteristics of Boyle's Law, Charles Law, and Archimedes principle. Describe how a fluid is able to transfer force as well as change the relationship between force and distance or speed Apply and memorize Ohm's Law: • Differentiate between accelerating current and direct current. • Explain differences between series, parallel, and series-parallel circuits. • Define voltage, current, and resistance.	

				• Calculate current, voltage, and resistance in a circuit by using Ohm's Law. • Recognize and apply when Kirchoff's Law is demonstrated. Define electrical quantities. Design and construct an electrical circuit with a power generation source. Explain the flow of energy from generation through distribution to the customer.	
Tools		Select and use tools and equipment appropriately for services and repair of power and energy system machines and technology.	The student knows the functions and applications of the tools, equipment, technologies, and materials used in the field of energy and power of transportation systems. The student is expected to: (A) discuss the safe use of hand and power tools and equipment commonly used in the maintenance and repair of engines; and (B) discuss the use of audits and inspections to maintain compliance with safety, health, and	Demonstrate safe and appropriate use of tools, machines, and materials in power and energy technology: • Common hand tools (screwdrivers, hammers, wrenches, pliers, hacksaws, punches, chisels, drills, files, tin snips, taps, and dies) • Basic electrical hand tools • Demonstrate the safe use of portable power tools, drills, belt and disc sanders, grinders, circular saws, saber saws, metal shears, electric and	

			environmental regulations.	pneumatic impact wrenches, rotary and pneumatic chipping hammers, drill presses, and bench grinders. • Electrical testing tools • Common pipefitting tools • Common sheet-metal tools	
Power and Energy Systems		Understand key concepts and components of power and energy systems.	Demonstrate technical knowledge and skills related to power and energy systems. The student will be able to: (A) identify and define key terms, categories, and parts of a steam power system; (B) identify and define key terms, categories, and parts of a hydraulic or pneumatic system; (C) identify and define key terms, categories, and parts of an electric power system; (D) identify and define key terms,	Classify the components of electrical generating systems, including boilers, generators, alternators, turbines, motors, engines, pumps, and switchgear. Discriminate the differences and similarities of power generation, including use of different fuel types and different power plant uses. Summarize the basic operating principles of fossil, hydroelectric, and internal combustion systems. Describe the location of equipment in the plant, how the equipment operates, and normal operating parameters. Describe the theory, construction, and application of the mechanical	

			categories, and parts of a solar power system; (E) identify and define key terms, categories, and parts of a nuclear power system; and (F) construct, test, and evaluate a variety of systems.	components of various types of power generation systems. Examine energy systems in buildings. Investigate the policies and codes for the systems and report on the findings. Design a hydraulic system to perform a specific task, applying the principles of fluid kinematics and hydrostatics to outline how the system functions. The design should include specifications for pumps, pipes, and flow rates.	
Engines and motors		Understand components and operations of compact engines.	Investigate two-cycle and four-cycle engine operations and explain its principles. Student is expected to: (A) describe the basic components of a small engine (B) describe two-cycle engine operation; and (C) explain the difference between a 4-cycle and 2-cycle engine.	Describe the four-cycle engine operation and explain the purpose of each. Explain valve timing and its parts. Compare the lubrication system in a four-cycle engine to the system of a two-cycle engine. Compare and contrast the advantages and disadvantages of two-cycle and four-cycle engines. Disassemble and reassemble a basic compact engine.	

				Identify and differentiate between the different types of fuel and power sources used in conjunction with engines and motors. Recommend the types and sizes of engines/motors best suited for a range of applications. Provide a written justification, citing specific textual evidence, to support the Recommendations.	
Industrial Electricity		Examine principles of industrial electricity systems and components.	Apply concepts of electricity to industrial circuit and components. Student is expected to: (A) identifies components of electrical circuits and how to measure them; (B) examines the principles of AC circuits and understand how certain components react; (C) calculate the effects of AC components in circuits; (D) explores the different types of	Describe the safety requirements and precautions for troubleshooting electrical circuits. Disconnect and reconnect electric motors. Identify the parts and function of electrical control equipment. Explain maintenance procedures and how to troubleshoot a sequence of events.	

			electrical motors; and practice electrical motor maintenance procedures.		
Industrial Equipment and Machines		Demonstrate knowledge of the use of current manufacturing processes Operate, repair, and test machines, devices, and equipment based on electrical or mechanical principles in order to diagnose machine malfunctions, using basic hand and small electric tools and equipment. Demonstrate an understanding of the importance and impact of routine maintenance of machines and equipment.	Apply knowledge of scientific principles and technical skills to the operation and repair of industrial machines and equipment. Student is expected to: (A) identify common machinery used in manufacturing and energy and power industries; (B) understand the basic operations of common machines; (C) examine the machines and identify common systems and components; and (D) investigate and apply general maintenance and repair practices.	Identify and demonstrate common bench work skills to repair or maintain machines including: cutting and repair o threads, installing dowel pins, hole-reaming, removing damaged screws and hardware, deburring work pieces, etc.) Identify preventative maintenance processes and procedures for common industrial machines. *Machines may vary by industry and local business applications.	
Alternative Energy		Understand the sources of alternative energy. Research the environmental implications of energy conversion processes and	The student determines and evaluates the importance and scope of energy and natural resources. The student is expected to:		

		energy transmission systems.	(A) identify various types of natural resources; (B) identify renewable, non-renewable, and sustainable energy resources and determine their availability; (C) evaluate the impacts of energy production on natural resources and the economy; (D) analyze the geographic and demographic uses of natural resources; and (E) explore alternative energy systems, machines, and technologies.		
