Course Title: **Machinery Maintenance 1**
Course Number: **9204310**
Course Credit: **1**

Course Description:
The Machinery Maintenance 1 course prepares students for entry into the Industrial Machinery Mechanics industry. Content emphasizes beginning skills and concepts as a recommended requisite for entry into Machinery Maintenance 2. Students study workplace safety and organization, basics of electricity and electronics, mathematical calculations, proper use of hand and power tools, read and interpret plans and drawings, and perform measuring and layout operations.

CTE Standards and Benchmarks	
04.0	Apply safety rules and procedures--The student will be able to:
04.01	Practice shop safety rules and procedures.
04.02	Practice personal safety rules and procedures.
04.03	Practice fire safety rules and procedures.
04.04	Practice electrical safety rules and procedures.
04.05	Practice tool safety rules and procedures.
04.06	Practice ladder and scaffolding safety rules and procedures.
04.07	Maintain a clean work and shop area.
04.08	Perform tag lockout procedures.
04.09	Identify Occupational Safety and Health Administration (OSHA) requirements and procedures.
04.10	Use Materials Safety Data Sheets (MSDS).
05.0	Explain basic electricity and electronics--The student will be able to:
05.01	Define electrical/electronic terms.
05.02	Explain the theory and application of magnetism.
05.03	Explain Ohm's law.
05.04	Describe direct current (DC) and alternating current (AC) circuits.
05.05	Identify the advantages and disadvantages of alternating current (AC) and direct current (DC) motors for various applications.

CTE Standards and Benchmarks	
	05.06 Describe the use of programmable logic controllers (PLCs) in the industry.
06.0	Perform mathematical calculations--The student will be able to:
	06.01 Make job-related decimal and fraction calculations.
	06.02 Solve job-related problems by adding, subtracting, multiplying, and dividing numbers.
	06.03 Solve job-related problems using a hand-held calculator.
	06.04 Solve job-related problems using basic formulas.
	06.05 Solve job-related problems using basic geometry.
	06.06 Measure a work piece and compare the measurements with blueprint specifications.
	06.07 Solve job-related problems using mathematical handbooks, charts, and tables.
	06.08 Convert measurements from English to metric and from metric to English units.
	06.09 Solve job-related problems using proportions.
	06.10 Solve job-related problems using statistics.
07.0	Use and maintain hand tools--The student will be able to:
	07.01 Demonstrate the safe use of hand tools such as screwdrivers, hammers, wrenches, pliers, hacksaws, punches, chisels, drills, files, tin snips, taps, and dies.
	07.02 Use measuring devices.
	07.03 Use wrenches and screwdrivers.
	07.04 Use pipefitting tools.
	07.05 Use sheet-metal tools.
	07.06 Safely use ropes, slings, pulleys, and block and tackle.
	07.07 Select the proper tool for each job application.
	07.08 Select correct tools for metric and standard fasteners.
	07.09 Identify state-of-the-art innovations and explore their uses.
	07.10 Identify and select fasteners for various applications, taking into account the effects of corrosion on each, including threaded fasteners, nuts, washers, rivets, locking pins, keys, self-tapping screws, locking-nut fasteners, and self-retaining nuts.

CTE Standards and Benchmarks	
	07.11 Describe the techniques and liability issues regarding retrofitting fasteners for ease of removal.
08.0	Use and maintain portable power tools--The student will be able to:
	08.01 Demonstrate the safe use of portable power tools, drills, belt and disc sanders, grinders, circular saws, saber saws, metal shears, electric and pneumatic impact wrenches, rotary and pneumatic chipping hammers, drill presses, and bench grinders.
	08.02 Use and maintain light- and heavy-duty drills.
	08.03 Use and maintain electric hammers.
	08.04 Use and maintain pneumatic drills and hammers.
	08.05 Use and maintain power screwdrivers and nut runners.
	08.06 Use and maintain linear motion saws.
	08.07 Use and maintain circular saws.
	08.08 Use and maintain belt, pad, and disc sanders.
	08.09 Use and maintain grinders and shears.
09.0	Read plans and drawings--The student will be able to:
	09.01 Identify dimensions.
	09.02 Identify lists of materials and specifications.
	09.03 Identify section and detail views.
	09.04 Sketch and dimension a part.
	09.05 Disassemble and assemble parts using an exploded-view drawing.
	09.06 Interpret blueprint abbreviations.
	09.07 Identify dimensioning of radii, round holes, fillets, and chamfers.
	09.08 Identify screw threads and bolt types.
	09.09 Apply dimensional tolerances.
	09.10 Identify the metal-fabrication symbols used in blueprints.
10.0	Perform measuring and layout operations--The student will be able to:

CTE Standards and Benchmarks	
10.01	Perform basic geometric-construction operations.
10.02	Safely use marking gauges, center punches, scribes, surface gauges, squares, dividers, dial indicators, protractors, surface plates, depth gauges, and circumference rules.
10.03	Develop patterns using parallel lines, radial lines, and triangulation.
10.04	Make metal-fabrication sketches.
10.05	Read and measure with steel rules.
10.06	Read and measure with micrometers.
10.07	Read and measure with vernier tools.
10.08	Read and measure with digital and dial calipers.
10.09	Read and measure with digital and dial indicators.

Course Title: **Machinery Maintenance 2**
Course Number: **9204320**
Course Credit: **1**

Course Description:
The Machinery Maintenance 2 course is designed to build on the skills and knowledge students learned in Machinery Maintenance 1 for entry into the Industrial Machinery Mechanics industry. Content emphasizes beginning skills and concepts as a recommended requisite for entry into Machinery Maintenance 3. Students study industrial and manufacturing processes, benchwork skills, troubleshooting skills and techniques, lubrication processes, and rigging.

CTE Standards and Benchmarks	
11.0	Demonstrate basic knowledge of industrial and manufacturing processes--The student will be able to:
11.01	Demonstrate knowledge of the use of current manufacturing processes.
11.02	Demonstrate an understanding of the importance and impact of routine maintenance of machines and equipment.
11.03	Understand the processes of separating, forming, conditioning, fabricating, and finishing of materials.
11.04	Identify and classify manufacturing systems into types, such as customized production, batch production, and continuous production.
11.05	Explain the difference between primary and secondary manufacturing processes.
12.0	Perform benchwork skills--The student will be able to:
12.01	Identify safety and shop rules.
12.02	Cut materials by using hand hacksaws.
12.03	Cut threads by using hand taps.
12.04	Cut threads by using dies.
12.05	Repair threads by chasing and thread inserts.
12.06	Install dowel pins using tapered and straight reamers.
12.07	Ream holes by using tapered and straight reamers.
12.08	Hand-sharpen cutting tools by using abrasive stones.
12.09	Hone and lap surfaces.
12.10	Remove damaged screws and other hardware.

CTE Standards and Benchmarks	
	12.11 Deburr workpieces.
13.0	Troubleshoot electrical circuits--The student will be able to:
	13.01 Describe the safety requirements and precautions for troubleshooting electrical circuits.
	13.02 Disconnect and reconnect electric motors.
	13.03 Identify the parts and function of electrical control equipment.
	13.04 Define digital devices and PLC logic/ladder logic to troubleshoot.
	13.05 Identify the function of input and output devices and the controller.
	13.06 Explain how to troubleshoot a sequence of events.
	13.07 Use and maintain electrical test equipment for troubleshooting.
14.0	Identify common troubles and basic troubleshooting techniques--The student will be able to:
	14.01 Analyze the possible causes of common troubles in industrial machinery performance.
	14.02 Identify basic troubleshooting techniques for bearings.
	14.03 Identify basic troubleshooting techniques for pumps.
	14.04 Identify basic troubleshooting techniques for drive systems.
	14.05 Identify basic troubleshooting techniques for electrical circuits.
	14.06 Identify basic troubleshooting techniques for hydraulics.
	14.07 Identify basic troubleshooting techniques for pneumatics.
	14.08 Identify basic troubleshooting techniques for PLCs.
15.0	Handle and apply lubricants--The student will be able to:
	15.01 Explain the functions of lubrication.
	15.02 Explain the properties of oil lubricants and the factors determining the selection of lubricants.
	15.03 Identify the types, advantages, and functions of lubricant additives.
	15.04 Explain the types of circulating oils and their purposes.

CTE Standards and Benchmarks	
	15.05 Identify grease application.
	15.06 Identify lubricating systems and methods.
	15.07 Explain lubricant storage and handling methods.
	15.08 Explain the types of oil filters and their uses.
	15.09 Lubricate a piece of industrial equipment.
	15.10 Define the role of preventive maintenance in total equipment maintenance.
	15.11 Describe the major tasks of preventive maintenance: cleaning, inspection, lubrication, minor repair, and information feedback.
	15.12 Review a typical maintenance program.
16.0	Perform rigging functions--The student will be able to:
	16.01 Demonstrate the safety procedures for performing rigging and lifting operations.
	16.02 Identify and inspect fiber and wire rope.
	16.03 Tie knots and hitches.
	16.04 Identify and use the components of rigging hardware.
	16.05 Perform rigging and lifting operations.
	16.06 Demonstrate the proper operation of a forklift.

Course Title: **Machinery Maintenance 3**
Course Number: **9204330**
Course Credit: **1**

Course Description:
The Machinery Maintenance 3 course is designed to build on the skills and knowledge students learned in Machinery Maintenance 1 & 2 for entry into the Industrial Machinery Mechanics industry. Content emphasizes beginning skills and concepts as a recommended requisite for entry into Machinery Maintenance 4. Students study basic elements of physics, installation of drive components, troubleshoot pneumatic and fluid-drive systems, and maintaining air compressors.

CTE Standards and Benchmarks	
20.0	Explain the basic elements of physics as related to industrial machinery maintenance and repair--The student will be able to:
20.01	Explain the standards of measurement and the impact of action and working forces, including tension, compression, torque, and shear.
20.02	Identify the principles and laws of motion and explain how they affect acceleration and deceleration.
20.03	Explain the relationship of work, power, and energy to the types of collisions and conservation of momentum.
20.04	Explain the operation of simple machines, including the lever, inclined plane, screw, wedge, wheel and axle, pulley, and jacking screws.
20.05	Identify the ways of producing power for mechanical efficiency, in terms of gear ratios, work forces, and the types of work done by a crane hook, forklift truck, and screw or bolt.
20.06	Use linear, liquid, and weight units of measurement to measure areas, areas within areas, and volume.
20.07	Describe the mechanical and chemical properties of materials commonly used in industry.
20.08	Explain the laws and conditions governing static and kinetic friction, the problems caused by friction, and the effects of the angle of repose.
20.09	Explain molecular action as a result of temperature extremes, chemical reaction, and moisture content.
20.10	Draw conclusions or make inferences from data.
20.11	Identify health-related problems that may result from exposure to work-related chemicals and hazardous materials, and know the proper precautions required for handling such materials.
20.12	Explain pressure measurement in terms of pounds per square inch (PSI), inches of mercury, and Kilopascal (kPa).
21.0	Install and maintain drive components--The student will be able to:
21.01	Demonstrate safety procedures for installing and maintaining drive components.
21.02	Identify the types of bearings, their cross-referencing, and their uses.

CTE Standards and Benchmarks	
	21.03 Remove, inspect, and/or replace bearings.
	21.04 Remove and replace seals.
	21.05 Perform shaft alignment.
	21.06 Identify the types of belts.
	21.07 Identify the types of chains.
	21.08 Perform tension adjustments and alignment on belt and chain drives.
	21.09 Troubleshoot belt and chain drives.
	21.10 Identify the types of gears.
	21.11 Remove, replace, and align gears, sprockets, and couplings.
	21.12 Remove, replace, or repair V-joints and jack shafts.
	21.13 Adjust gear backlash.
	21.14 Troubleshoot gear drives.
	21.15 Disassemble, inspect, reassemble, and adjust clutches.
	21.16 Identify the types of variable-speed drives.
	21.17 Troubleshoot variable-speed drives.
	21.18 Identify the types of cams and link mechanisms.
	21.19 Troubleshoot cam-and-link mechanism problems.
22.0	Maintain and troubleshoot pneumatic systems--The student will be able to:
	22.01 Explain the safety procedures for troubleshooting pneumatic systems.
	22.02 Diagram an air supply system.
	22.03 Install system components.
	22.04 Demonstrate system-maintenance techniques.
	22.05 Explain proper troubleshooting procedures.

CTE Standards and Benchmarks	
	22.06 Troubleshoot air compressors.
	22.07 Troubleshoot, repair, and install control valves.
	22.08 Troubleshoot air motors.
23.0	Maintain and troubleshoot fluid-drive systems--The student will be able to:
	23.01 Explain the safety procedures for maintaining and troubleshooting fluid-drive systems.
	23.02 Install adjustable-speed drives.
	23.03 Troubleshoot adjustable-speed drives.
	23.04 Explain the operation of fluid couplings.
	23.05 Install fluid couplings.
	23.06 Install torque converters.
	23.07 Perform preventive maintenance.
	23.08 Apply a "dynamic" magnetic/mechanical braking device to a motor.
	23.09 Mount the equipment.
24.0	Maintain reciprocating, positive-displacement, and rotary air compressors--The student will be able to:
	24.01 Relate force, weight, mass, and density to a pneumatic system.
	24.02 Demonstrate the safety procedures for maintaining reciprocating, positive-displacement, and rotary air compressors.
	24.03 Demonstrate the operation of reciprocating compressors.
	24.04 Demonstrate the operation of positive-displacement and rotary air compressors.
	24.05 Demonstrate primary and secondary air treatment.
	24.06 Demonstrate the operation of valves, cylinders, and motors.
	24.07 Check oil level.
	24.08 Change oil.
	24.09 Drain water from tank.

CTE Standards and Benchmarks
24.10 Test for efficiency of compressor.
24.11 Inspect storage tank for quality.
24.12 Test pressure control switch.

Course Title: **Machinery Maintenance 4**
Course Number: **8743240**
Course Credit: **1**

Course Description:
The Machinery Maintenance 4 course is designed to build on the skills and knowledge students learned in Machinery Maintenance 1, 2, and 3 for entry into the Industrial Machinery Mechanics industry. Students explore career opportunities and requirements of a professional industrial machinery mechanic. Students study elementary predictive-preventive-maintenance planning, maintain and troubleshoot hydraulic and robotic systems, and understanding employability skills.

CTE Standards and Benchmarks	
25.0	Plan an elementary predictive-preventive-maintenance (PPM) schedule--The student will be able to:
25.01	List the types of predictive-preventive maintenance.
25.02	Describe the purpose of preventive-maintenance schedules.
25.03	Create a preventive-maintenance schedule form using a machine manual or the manufacturer recommendations.
25.04	Identify troubles caused by the lack of preventive maintenance.
25.05	Create a maintenance log and make entries for a machine or equipment.
25.06	Create a preventive-maintenance schedule from a maintenance-failures log.
26.0	Maintain and repair hydraulic-system components--The student will be able to:
26.01	Explain the safety procedures for installing hydraulic lines.
26.02	Explain Pascal's law.
26.03	Explain Bernoulli's principle.
26.04	Explain how heat and pressure relate to power and transmission.
26.05	Describe the physical and chemical properties of a fluid.
26.06	Install and maintain a contaminant-removal system.
26.07	Determine reservoir requirements.
26.08	Classify and select pumps for specific applications.
26.09	Compute hose requirements.

CTE Standards and Benchmarks	
	26.10 Install hydraulic lines.
	26.11 Select and install control valves.
27.0	Troubleshoot hydraulic systems--The student will be able to:
	27.01 Explain the safety procedures for troubleshooting hydraulic systems.
	27.02 Read a hydraulic schematic.
	27.03 Install hydraulic components.
	27.04 Connect electrically controlled valves.
	27.05 Explain hydraulic-system troubleshooting techniques.
	27.06 Repair and replace valves.
	27.07 Repair and replace cylinders.
	27.08 Repair and replace pumps and motors.
28.0	Maintain and troubleshoot robotic systems--The student will be able to:
	28.01 Identify uses of robotics in industry.
	28.02 Identify safety procedures related to robotic systems.
	28.03 Identify mechanical, hydraulic, pneumatic, and electric/electronic components of robotic systems.
	28.04 Perform routine maintenance and calibration of robotic systems.
	28.05 Remove, replace and adjust robotic system components.
29.0	Demonstrate an understanding of employability skills and career opportunities--The student will be able to:
	29.01 Demonstrate knowledge of good workplace behavior and how to address improper workplace behavior.
	29.02 Discuss motivation and human behavior.
	29.03 Develop a personal stress management plan.
	29.04 Demonstrate knowledge of ways to improve reading, listening and writing skills.
	29.05 Demonstrate knowledge of techniques for making effective presentations to internal and external customers.

CTE Standards and Benchmarks	
29.06	Use different forms of communication, such as e-mail, fax and phones.
29.07	Provide effective feedback and make suggestions.
29.08	Demonstrate appropriate customer service skills and techniques.
29.09	Demonstrate knowledge of roles and responsibilities of team members.
29.10	Align team goals (that are specific, documented, measurable and achievable) to customer and business production needs.
29.11	Effectively communicate production and process information to internal and external customers.
29.12	Develop personal career plan that includes goals, objectives, and strategies.
29.13	Examine licensing, certification, and industry credentialing requirements.
29.14	Evaluate and compare employment opportunities that match career goals.
29.15	Identify and exhibit traits for retaining employment.
29.16	Identify opportunities and research requirements for career advancement.
29.17	Research the benefits of ongoing professional development.
29.18	Examine and describe entrepreneurship opportunities as a career planning option.

Course Title: **Industrial Machinery Mechanic Capstone**
Course Number: **9204350**
Course Credit: **1**

Course Description:
This optional course provides students with extended content and skills essential to the planning, design, creation, and presentation of an industrial machinery maintenance capstone project.

CTE Standards and Benchmarks	
30.0	Conceive, design, and present a project(s) that encompass all the skills learned--The student will be able to:
30.01	Create and produce an original working drawing.
30.02	Compose a well written design proposal and present to instructor for approval.
31.0	Plan, organize, and carry out a project plan--The student will be able to:
31.01	Determine the scope of a project.
31.02	Organize tasks.
31.03	Determine project priorities.
31.04	Identify required resources.
31.05	Record project progress in a process journal.
31.06	Record and account for budget expenses during the life of the project.
31.07	Carry out the project plan to successful completion and delivery.
32.0	Formulate strategies to properly manage resources--The student will be able to:
32.01	Identify required resources and associated costs for each stage of the project plan.
32.02	Create a project budget based on the identified resources.
32.03	Determine the methods needed to acquire needed resources.
32.04	Demonstrate good judgment in the use of resources.
32.05	Recycle and reuse resources where appropriate.
32.06	Demonstrate an understanding of proper legal and ethical waste disposal.

CTE Standards and Benchmarks	
33.0	Use tools, materials, and processes in an appropriate and safe manner--The student will be able to:
33.01	Identify the proper tool for a given job.
33.02	Use tools and machines in a safe manner.
33.03	Adhere to laboratory safety rules and procedures.
33.04	Identify the application of processes appropriate to the task at hand.
33.05	Identify materials appropriate to their application.
34.0	Create a portfolio describing the project, including drawings and specifications, the tasks and rationale, process journal, budget report, and the results--The student will be able to:
34.01	Create a Design Portfolio documenting drawings and specifications.
34.02	Create a Bill of Material (BOM) for your project.
34.03	Create and deliver a presentation to communicate project results.