Florida Department of Education
CLUSTER CURRICULUM FRAMEWORK

Cluster Title: Industrial Machinery Maintenance Technology
Cluster Type: Job Preparatory
Occupational Area: Industrial Education

Components One Core, Two Programs, Four Occupational Completion Points

	Secondary	PSAV
Grade Level	9-12, 30, 31	30, 31
Facility Code	203	203
CTSO	SkillsUSA-VICA	SkillsUSA-VICA
Co-op Method	Yes	Yes
Apprenticeship	Yes	Yes

I. **PURPOSE:** The purpose of the programs in this cluster is to prepare students for employment or advanced training in the industrial-machinery maintenance-technology industry.

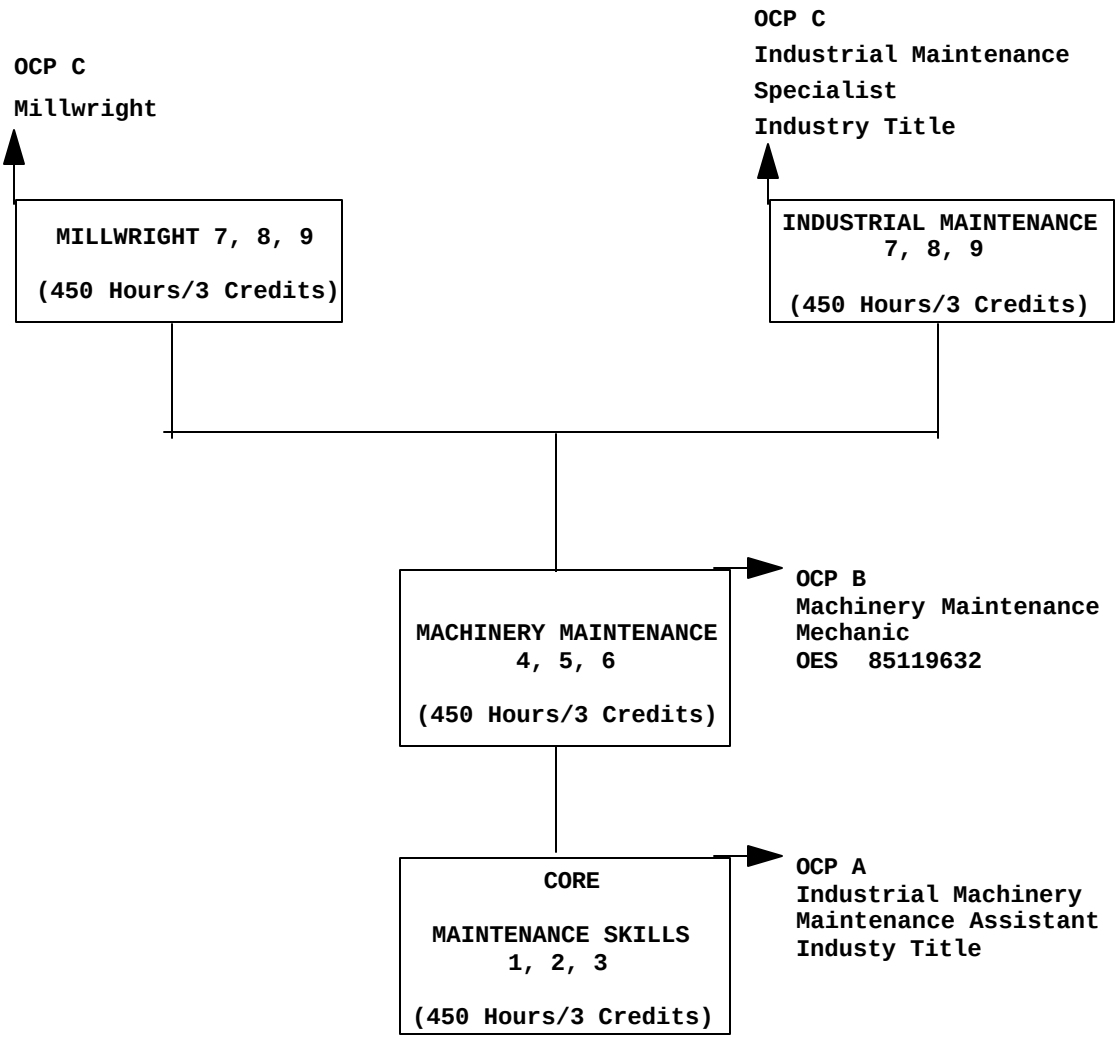
This cluster of programs focuses on broad, transferable skills, stresses the understanding of all aspects of the industrial-machinery maintenance-technology industry, and demonstrates elements of the industry such as planning, management, finance, technical and production skills, underlying principles of technology, labor issues, community issues, and health, safety, and environmental issues.

II. **PROGRAM STRUCTURE:** This cluster is a planned sequence of instruction consisting of two programs with one common core and four occupational completion points. The recommended sequence allows students to complete specified portions of the program for employment or to remain for advanced training. A student who completes the applicable competencies at any occupational completion point may either continue with the training program or terminate as an occupational completer.

It is recommended that students complete the core or demonstrate a mastery of the student performance standards contained in the core before advancing to the course(s) in the next level of either of the two programs, Millwright or Industrial Machinery Maintenance and Repair Specialist.

The following diagram illustrates the program

INDUSTRIAL MACHINERY MAINTENANCE TECHNOLOGY CLUSTER



At the secondary level, the programs in this cluster consist of the following courses, which include the core:

MILLWRIGHT - 9 secondary credits
CORE
8743210 Maintenance Skills 1
8743220 Maintenance Skills 2
8743230 Maintenance Skills 3

MACHINERY MAINTENANCE
8743240 Machinery Maintenance 4
8743250 Machinery Maintenance 5
8743260 Machinery Maintenance 6

MILLWRIGHT
8743270 Millwright 7
8743280 Millwright 8
8743290 Millwright 9

INDUSTRIAL MACHINERY MAINTENANCE - 9 secondary credits
CORE
8743210 Maintenance Skills 1
8743220 Maintenance Skills 2
8743230 Maintenance Skills 3

MACHINERY MAINTENANCE
8743240 Machinery Maintenance 4
8743250 Machinery Maintenance 5
8743260 Machinery Maintenance 6

INDUSTRIAL MACHINERY MAINTENANCE
8743170 Industrial Maintenance 7
8743180 Industrial Maintenance 8
8743190 Industrial Maintenance 9

III. **LABORATORY ACTIVITIES:** Classroom, shop, and laboratory activities are an integral part of this cluster. These activities include instruction in the use of safety procedures, tools, equipment, materials, and processes found in the industry. Equipment and supplies should be provided to enhance hands-on experiences for students in the chosen occupation.

IV. **SPECIAL NOTE: SkillsUSA**-VICA, Inc. is the appropriate Career and Technical Student Organization (CTSO) for providing leadership training and for reinforcing specific career and technical skills. Career and Technical Student Organizations, when provided, shall be an integral part of the career and technical instructional program, and the activities of such organizations are defined as part of the curriculum in accordance with Rule 6A-6.065, FAC.

Efficient and safe work practices are critical in this cluster of programs. For this reason, it may be useful to refer to the National Occupational Testing Institute for Machine Trades and Standards from the National Tooling and Machining Association,

9300 Livingston Road, Ft. Washington, MD 20744. The Metalworking Industry Skills Standards Board approves these standards.

This cluster of programs prepares students for entry-level positions such as Industrial Machinery Maintenance Assistant (Industry Title), Machinery Maintenance Mechanic (OES 85110), Industrial Machinery Maintenance and Repair Specialist (Industry Title), and Millwright (OES 85123).

The programs in this cluster may be offered in postsecondary adult vocational (PSAV) courses. Vocational credit shall be awarded to the student on a transcript in accordance with Section 230.643, F.S.

Cooperative training - OJT is appropriate for this program. Whenever cooperative training - OJT is offered, the following are required for each student: a training plan, signed by the student, teacher, and employer, which includes instructional objectives and a list of on-the-job and in-school learning experiences; a workstation that reflects equipment, skills and tasks that are relevant to the occupation which the student has chosen as a career goal. The student must receive compensation for work performed.

In accordance with Rule 6A-10.040, FAC, the minimum basic-skills grade levels required for postsecondary adult vocational students to complete the programs in this cluster are listed before the intended outcomes for each program. These grade-level numbers correspond to grade-equivalent scores obtained on one of the state-designated basic-skills examinations. If a student does not meet the basic-skills level required for completion of the program, remediation should be provided concurrently through Vocational Preparatory Instruction (VPI). Please refer to the Rule for exemptions.

When a secondary student with a disability is enrolled in a vocational class with modifications to the curriculum framework, the particular outcomes and student performance standards, which the student must master to earn credit, must be specified on an individual basis. The job or jobs for which the student is being trained should be reflected in the student's desired postschool outcome statement on the Transition Individual Educational Plan (Transition IEP).

V. SCANS Competencies: To accomplish the Secretary's Commission on Achieving Necessary Skills (SCANS) competencies, instructional strategies for this cluster must include methods that require students to identify, organize, and use resources appropriately; to work with each other cooperatively and productively; to acquire and use information; to understand social, organizational, and technological systems; and to work with a variety of tools and equipment. Instructional strategies must also incorporate methods to improve students' personal qualities and higher-order thinking skills.

The standard length for this program is 1350 hours.

Florida Department of Education
INTENDED OUTCOMES

Program Title: **Industrial Machinery Maintenance**

	Secondary	PSAV
Program Number:	**8743100**	**I470303**
CIP Number:	0647.030300	0647.030300
Grade Level:	9-12, 30, 31	30, 31
Length:	9 Credits	1,350 Hours
Certification:	TEC CONSTR @7 G	TEC CONSTR @7 G
	MILLWRIGHT @7 G	MILLWRIGHT @7 G
	BLDG CONST @7 G	BLDG CONST @7 G
	IND ENGR @7 G	IND ENGR @7 G

Basic-Skills Grade Level:	
Math	9
Language	9
Reading	9

INTENDED OUTCOMES: After successfully completing the appropriate course(s) for each occupational completion point of this program, the student will be able to perform the following:

OCCUPATIONAL COMPLETION POINT - DATA CODE - A (450 Hours)
INDUSTRIAL MACHINERY MAINTENANCE ASSISTANCE - INDUSTRY TITLE

01.0 Apply safety rules and procedures.
02.0 Explain the basic elements of physics as related to Industrial Machinery Maintenance and Repair.
03.0 Explain basic electricity and electronics.
04.0 Perform mathematical calculations.
05.0 Read plans and drawings.
06.0 Perform measuring and layout operations.
07.0 Perform computer applications.
08.0 Use and maintain hand tools.
09.0 Use and maintain portable power tools.
10.0 Handle and apply lubricants.
11.0 Perform benchwork skills.
12.0 Perform gas and electric arc welding and cutting operations.
13.0 Perform rigging functions.
14.0 Install and remove machinery.
15.0 Demonstrate conveyor-maintenance techniques.
16.0 Identify common troubles and basic troubleshooting techniques.
17.0 Demonstrate appropriate communication skills.
18.0 Demonstrate employability skills.
19.0 Describe the role of job ownership and entrepreneurship.
20.0 Apply customer-service skills.

OCCUPATIONAL COMPLETION POINT - DATA CODE - B (450 Hours)
MACHINERY MAINTENANCE MECHANIC - OES 85119632

21.0 Plan an elementary predictive-preventive-maintenance (PPM) schedule.
22.0 Perform gas- and arc-welding procedures.
23.0 Perform machine-shop operations.
24.0 Maintain piping and tubing systems.
25.0 Troubleshoot electrical circuits.
26.0 Install and maintain drive components.
27.0 Maintain reciprocating, positive-displacement, and rotary air compressors.
28.0 Maintain and repair hydraulic-system components.
29.0 Troubleshoot hydraulic systems.
30.0 Maintain and troubleshoot pneumatic systems.
31.0 Maintain and troubleshoot fluid-drive systems.
32.0 Maintain and troubleshoot robotic systems.
33.0 Perform pump maintenance and repair.
34.0 Explain the operation of industrial-pollution control systems.
35.0 Troubleshoot air-conditioning and refrigeration systems .
36.0 Identify boilers.
37.0 Maintain internal combustion engines.

OCCUPATIONAL COMPLETION POINT - DATA CODE - C (450 Hours)
INDUSTRIAL MACHINERY MAINTENANCE AND REPAIR SPECIALIST

38.0 Prepare for machinery startup.
39.0 Apply vibration-analysis skills.
40.0 Perform machinery balancing.
41.0 Demonstrate predictive-preventive-maintenance (PPM) technologies.
42.0 Use computer-maintenance-management systems (CMMS).
43.0 Perform failure analysis (FA).
44.0 Improve rotating-equipment performance.
45.0 Generate machine improvements and maintenance management.

Florida Department of Education
STUDENT PERFORMANCE STANDARDS

Program Title: Industrial Machinery Maintenance
Secondary Number: 8743100
Postsecondary Number: I470303

OCCUPATIONAL COMPLETION POINT - DATA CODE - A
INDUSTRIAL MACHINERY MAINTENANCE ASSISTANCE - INDUSTRY TITLE

01.0 APPLY SAFETY RULES AND PROCEDURES--The student will be able to:

01.01 Practice shop safety rules and procedures.
01.02 Practice personal safety rules and procedures.
01.03 Practice fire safety rules and procedures.
01.04 Practice electrical safety rules and procedures.
01.05 Practice tool safety rules and procedures.
01.06 Practice ladder and scaffolding safety rules and procedures.
01.07 Maintain a clean work and shop area.
01.08 Perform tag lockout procedures.
01.09 Identify Occupational Safety and Health Administration (OSHA) requirements and procedures.
01.10 Use Materials Safety Data Sheets (MSDS).

02.0 EXPLAIN THE BASIC ELEMENTS OF PHYSICS AS RELATED TO INDUSTRIAL MACHINERY MAINTENANCE AND REPAIR--The student will be able to:

02.01 Explain the standards of measurement and the impact of action and working forces, including tension, compression, torque, and shear.
02.02 Identify the principles and laws of motion and explain how they affect acceleration and deceleration.
02.03 Explain the relationship of work, power, and energy to the types of collisions and conservation of momentum.
02.04 Explain the operation of simple machines, including the lever, inclined plane, screw, wedge, wheel and axle, pulley, and jacking screws.
02.05 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.
02.06 Use linear, liquid, and weight units of measurement to measure areas, areas within areas, and volume.
02.07 Describe the mechanical and chemical properties of materials commonly used in industry.
02.08 Explain the laws and conditions governing static and kinetic friction, the problems caused by friction, and the effects of the angle of repose.
02.09 Explain molecular action as a result of temperature extremes, chemical reaction, and moisture content.
02.10 Draw conclusions or make inferences from data.
02.11 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.

02.12 Explain pressure measurement in terms of pounds per square inch (PSI), inches of mercury, and Kilopascal (KPa).

03.0 EXPLAIN BASIC ELECTRICITY AND ELECTRONICS--The student will be able to:

03.01 Define electrical/electronics terms.
03.02 Explain the theory and application of magnetism.
03.03 Explain Ohm's law.
03.04 Describe direct current (DC) and alternating current (AC) circuits.
03.05 Identify the advantages and disadvantages of alternating current (AC) and direct current (DC) motors for various applications.
03.06 Describe the use of programmable logic controllers (PLCs) in the industry.

04.0 PERFORM MATHEMATICAL CALCULATIONS--The student will be able to:

04.01 Make job-related decimal and fraction calculations.
04.02 Solve job-related problems by adding, subtracting, multiplying, and dividing numbers.
04.03 Solve job-related problems using a hand-held calculator.
04.04 Solve job-related problems using basic formulas.
04.05 Solve job-related problems using basic geometry.
04.06 Measure a workpiece and compare the measurements with blueprint specifications.
04.07 Solve job-related problems using mathematical handbooks, charts, and tables.
04.08 Convert measurements from English to metric and from metric to English units.
04.09 Solve job-related problems using proportions.
04.10 Solve job-related problems using statistics.

05.0 READ PLANS AND DRAWINGS--The student will be able to:

05.01 Identify dimensions.
05.02 Identify lists of materials and specifications.
05.03 Identify section and detail views.
05.04 Sketch and dimension a part.
05.05 Disassemble and assemble parts using an exploded-view drawing.
05.06 Interpret blueprint abbreviations.
05.07 Identify dimensioning of radii, round holes, fillets, and chamfers.
05.08 Identify screw threads and bolt types.
05.09 Apply dimensional tolerances.
05.10 Identify the metal-fabrication symbols used in blueprints.

06.0 PERFORM MEASURING AND LAYOUT OPERATIONS--The student will be able to:

06.01 Perform basic geometric-construction operations.
06.02 Safely use marking gauges, center punches, scribes, surface gauges, squares, dividers, dial indicators, protractors, surface plates, depth gauges, and circumference rules.

06.03 Develop patterns using parallel lines, radial lines, and triangulation.
06.04 Make metal-fabrication sketches.
06.05 Read and measure with steel rules.
06.06 Read and measure with micrometers.
06.07 Read and measure with vernier tools.

06.08 Read and measure with dial calipers.
06.09 Read and measure with dial indicators.

07.0 PERFORM COMPUTER APPLICATIONS--The student will be able to:

07.01 Explain the use of computers in plant operations.
07.02 Describe information processing.
07.03 Identify types of computers.
07.04 Identify keyboard functions.
07.05 Identify data input and output devices.
07.06 Describe computer programs.
07.07 Perform power-up and power-down procedures.
07.08 Back up data and save and print documents from a personal computer (PC).
07.09 Identify the effects of and the methods for checking for a virus in a PC system.

08.0 USE AND MAINTAIN HAND TOOLS--The student will be able to:

08.01 Demonstrate the safe use of hand tools such as screwdrivers, hammers, wrenches, pliers, hacksaws, punches, chisels, drills, files, tin snips, taps, and dies.
08.02 Use measuring devices.
08.03 Use wrenches and screwdrivers.
08.04 Use pipefitting tools.
08.05 Use sheet-metal tools.
08.06 Safely use ropes, slings, pulleys, and block and tackle.
08.07 Select the proper tool for each job application.
08.08 Select correct tools for metric and standard fasteners.
08.09 Identify state-of-the-art innovations and explore their uses.
08.10 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.
08.11 Describe the techniques and liability issues regarding retrofitting fasteners for ease of removal.

09.0 USE AND MAINTAIN PORTABLE POWER TOOLS--The student will be able to:

09.01 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.

09.02 Use and maintain light- and heavy-duty drills.
09.03 Use and maintain electric hammers.
09.04 Use and maintain pneumatic drills and hammers.
09.05 Use and maintain power screwdrivers and nut runners.
09.06 Use and maintain linear motion saws.
09.07 Use and maintain circular saws.
09.08 Use and maintain belt, pad, and disc sanders.
09.09 Use and maintain grinders and shears.

10.0 HANDLE AND APPLY LUBRICANTS--The student will be able to:

10.01 Explain the functions of lubrication.
10.02 Explain the properties of oil lubricants and the factors determining the selection of lubricants.
10.03 Identify the types, advantages, and functions of lubricant additives.
10.04 Explain the types of circulating oils and their purposes.
10.05 Identify grease application.
10.06 Identify lubricating systems and methods.
10.07 Explain lubricant storage and handling methods.
10.08 Explain the types of oil filters and their uses.
10.09 Lubricate a piece of industrial equipment.
10.10 Define the role of preventive maintenance in total equipment maintenance.
10.11 Describe the major tasks of preventive maintenance: cleaning, inspection, lubrication, minor repair, and information feedback.
10.12 Review a typical maintenance program.

11.0 PERFORM BENCHWORK SKILLS--The student will be able to:

11.01 Identify safety and shop rules.
11.02 Cut materials by using hand hacksaws.
11.03 Cut threads by using hand taps.
11.04 Cut threads by using dies.
11.05 Repair threads by chasing and thread inserts.
11.06 Install dowel pins using tapered and straight reamers.
11.07 Ream holes by using tapered and straight reamers.
11.08 Hand-sharpen cutting tools by using abrasive stones.
11.09 Hone and lap surfaces.
11.10 Remove damaged screws and other hardware.
11.11 Deburr workpieces.

12.0 PERFORM GAS-WELDING AND CUTTING OPERATIONS--The student will be able to:

12.01 Identify the properties of the most commonly used metals and alloys, including hardness and malleability.
12.02 Identify the processes and effects of tempering, annealing, and case hardening.
12.03 Identify welding cylinders, regulators, hoses, pressure gauges, and torches.
12.04 Describe welding-equipment safety procedures.
12.05 Demonstrate proper flame settings.

12.06 Demonstrate basic gas-welding skills.
12.07 Demonstrate procedures for adjusting and operating the oxyacetylene cutting torch.
12.08 Demonstrate freehand and guide cutting of various metal thickness'.
12.09 Identify the uses of the following welding techniques: laser, ultrasonic, resistance, and percussion.
12.10 Perform basic electric arc welding procedures.

13.0 PERFORM RIGGING FUNCTIONS--The student will be able to:

13.01 Demonstrate the safety procedures for performing rigging and lifting operations.
13.02 Identify and inspect fiber and wire rope.
13.03 Tie knots and hitches.
13.04 Identify and use the components of rigging hardware.
13.05 Perform rigging and lifting operations.
13.06 Demonstrate the proper operation of a forklift.

14.0 INSTALL AND REMOVE MACHINERY--The student will be able to:

14.01 Identify the safety procedures for installing and removing machinery.
14.02 Identify the equipment required for machine installation and removal.
14.03 Prepare an area for machine installation per the manufacturer's specifications.
14.04 Rig, lift, and transport machinery to the installation site.
14.05 Install electrical hookups to machinery.
14.06 Install air hydraulic hookups to machinery.
14.07 Perform an assigned machine retrofit per the manufacturer's specifications.
14.08 Perform an assigned machine removal and transport per specification requirements.
14.09 Explain the importance of vibration detection.

15.0 DEMONSTRATE CONVEYOR-MAINTENANCE TECHNIQUES--The student will be able to:

15.01 Identify the types of conveyors.
15.02 Identify the safety requirements and precautions for conveyor-maintenance operations.
15.03 Adjust the tracking of a belt.
15.04 Check a belt for wear.
15.05 Identify the types of splices.
15.06 Identify splicing equipment and procedures.
15.07 Demonstrate conveyor-maintenance techniques, including making splices with splicing equipment.

16.0 IDENTIFY COMMON TROUBLES AND BASIC TROUBLESHOOTING TECHNIQUES--The student will be able to:

16.01 Analyze the possible causes of common troubles in industrial machinery performance.
16.02 Identify basic troubleshooting techniques for bearings.
16.03 Identify basic troubleshooting techniques for pumps.
16.04 Identify basic troubleshooting techniques for drive systems.
16.05 Identify basic troubleshooting techniques for electrical circuits.
16.06 Identify basic troubleshooting techniques for hydraulics.
16.07 Identify basic troubleshooting techniques for pneumatics.
16.08 Identify basic troubleshooting techniques for PLCs.

17.0 DEMONSTRATE APPROPRIATE COMMUNICATION SKILLS--The student will be able to:

17.01 Write logical and understandable statements, or phrases, to accurately fill out forms and documents commonly used in business and industry.
17.02 Read and interpret graphs, charts, diagrams, and tables commonly used in business and industry.
17.03 Read and follow written and oral instructions.

17.04 Answer and ask questions coherently and concisely.
17.05 Read critically by recognizing assumptions and implications and by evaluating ideas.
17.06 Demonstrate appropriate communication skills, including telecommunications.

18.0 DEMONSTRATE EMPLOYABILITY SKILLS--The student will be able to:

18.01 Conduct a job search.
18.02 Secure information about a job.
18.03 Identify the documents that may be required for a job application.
18.04 Complete a resume.
18.05 Complete a job-application form correctly.
18.06 Demonstrate competence in job-interview techniques.
18.07 Identify or demonstrate appropriate responses to criticism from an employer, a supervisor, or other persons.
18.08 Identify acceptable work habits.
18.09 Describe how to make appropriate job changes.
18.10 Demonstrate acceptable employee health habits.
18.11 Describe the purpose of the Florida "Right-to-Know" law as recorded in the Florida Statutes, Chapter 442.

19.0 DESCRIBE THE ROLE OF JOB OWNERSHIP AND ENTREPRENEURSHIP--The student will be able to:

19.01 Define "entrepreneurship."
19.02 Describe the importance of entrepreneurship to the American economy.
19.03 List the advantages and disadvantages of business ownership and demonstrate ownership as an employee.
19.04 Identify the risks involved in the ownership of a business.
19.05 Identify the necessary personal characteristics and business skills of a successful entrepreneur.
19.06 Identify the need for teamwork, team roles when working in a factory or doing shift work, and team development.
19.07 Describe how attitudes toward work responsibilities, absences, and tardiness affect job success.

20.0 APPLY CUSTOMER-SERVICE SKILLS--The student will be able to:

20.01 Explain the need for customer satisfaction.
20.02 Prepare service orders properly.
20.03 Communicate solutions to customers.
20.04 Demonstrate methods of handling an irate customer.
20.05 Follow manufacturers' service manuals.
20.06 Locate parts in a printed or computerized catalog or on microfiche.

OCCUPATIONAL COMPLETION POINT - DATA CODE - B
MACHINERY MAINTENANCE MECHANIC - OES 85119632

21.0 PLAN AN ELEMENTARY PREDICTIVE-PREVENTIVE-MAINTENANCE (PPM) SCHEDULE--The student will be able to:

21.01 List the types of predictive-preventive maintenance.
21.02 Describe the purpose of preventive-maintenance schedules.
21.03 Create a preventive-maintenance schedule form using a machine manual or the manufacturer recommendations.

21.04 Identify troubles caused by the lack of preventive maintenance.
21.05 Create a maintenance log and make entries for a machine or equipment.
21.06 Create a preventive-maintenance schedule from a maintenance-failures log.

22.0 PERFORM GAS- AND ARC-WELDING PROCEDURES--The student will be able to:

22.01 Demonstrate the safety procedures for performing gas and arc welding and for transporting equipment.
22.02 Identify the components of an oxyfuel rig.
22.03 Set up and shut down an oxyfuel rig.
22.04 Weld beads in a flat position.
22.05 Weld an outside corner joint using a filler rod.
22.06 Cut metal of various thickness'.
22.07 Weld beads in a flat position using E-6010 and E-7018 electrodes.
22.08 Weld beads in horizontal and in vertical positions using E-6010 and E-7018 electrodes.
22.09 Weld beads in an overhead position using E-6010 and E-7018 electrodes.
22.10 Weld beads using a mig welder.
22.11 Weld beads using a tig welder.
22.12 Solder and braze metals.
22.13 Cut stainless steel and aluminum with a plasma-arc rig.

23.0 PERFORM MACHINE-SHOP OPERATIONS--The student will be able to:

23.01 Demonstrate safety in performing machine-shop operations.
23.02 Identify the types of cutting tools.
23.03 Bore a hole to a specified size.
23.04 Chase an external V-thread.
23.05 Identify the different types of work-holding devices.
23.06 Prepare metal for finishing.
23.07 Set up, use, and adjust an arbor press.
23.08 Set up, use, and adjust a hydraulic press.
23.09 Set up, use, and adjust broaching tools.
23.10 Cut keyways with an end mill.

24.0 MAINTAIN PIPING AND TUBING SYSTEMS--The student will be able to:

24.01 Identify the components of a piping system.
24.02 Explain the maintenance considerations of metallic and nonmetallic piping systems.
24.03 Describe the safety requirements for working with piping and tubing systems.
24.04 Join copper tubing.
24.05 Join common fittings.
24.06 Join metallic pipe.
24.07 Join plastic pipe.
24.08 Explain valve operation and maintenance.

24.09 Explain the importance of strainers, filters, and traps in piping systems.
24.10 Bend back-to-back, stub-ups, and doglegs in electrical metallic tubing (EMT).

25.0 TROUBLESHOOT ELECTRICAL AND ELECTRONIC CIRCUITS--The student will be able to:

25.01 Describe the safety requirements and precautions for troubleshooting electrical circuits.
25.02 Disconnect and reconnect electric motors.
25.03 Identify the parts and function of electrical control equipment.
25.04 Define digital devices and PLC logic/ladder logic to troubleshoot.
25.05 Identify the function of input and output devices and the controller.
25.06 Explain how to troubleshoot a sequence of events.
25.07 Use and maintain electrical test equipment for troubleshooting.

26.0 INSTALL AND MAINTAIN DRIVE COMPONENTS--The student will be able to:

26.01 Demonstrate safety procedures for installing and maintaining drive components.
26.02 Identify the types of bearings, their cross-referencing, and their uses.
26.03 Remove, inspect, and/or replace bearings.
26.04 Remove and replace seals.
26.05 Perform shaft alignment.
26.06 Identify the types of belts.
26.07 Identify the types of chains.
26.08 Perform tension adjustments and alignment on belt and chain drives.
26.09 Troubleshoot belt and chain drives.
26.10 Identify the types of gears.
26.11 Remove, replace, and align gears, sprockets, and couplings.
26.12 Remove, replace, or repair V-joints and jack shafts.
26.13 Adjust gear backlash.
26.14 Troubleshoot gear drives.
26.15 Disassemble, inspect, reassemble, and adjust clutches.
26.16 Identify the types of variable-speed drives.
26.17 Troubleshoot variable-speed drives.
26.18 Identify the types of cams and link mechanisms.
26.19 Troubleshoot cam-and-link mechanism problems.

27.0 MAINTAIN RECIPROCATING, POSITIVE-DISPLACEMENT, AND ROTARY AIR COMPRESSORS--The student will be able to:

27.01 Relate force, weight, mass, and density to a pneumatic system.

27.02 Demonstrate the safety procedures for maintaining reciprocating, positive-displacement, and rotary air compressors.
27.03 Demonstrate the operation of reciprocating compressors.
27.04 Demonstrate the operation of positive-displacement and rotary air compressors.
27.05 Demonstrate primary and secondary air treatment.
27.06 Demonstrate the operation of valves, cylinders, and motors.
27.07 Check oil level.
27.08 Change oil.
27.09 Drain water from tank.
27.10 Test for efficiency of compressor.

27.11 Inspect storage tank for quality.
27.12 Test pressure control switch.

28.0 MAINTAIN AND REPAIR HYDRAULIC-SYSTEM COMPONENTS--The student will be able to:

28.01 Explain the safety procedures for installing hydraulic lines.
28.02 Explain Pascal's law.
28.03 Explain Bernoulli's principle.
28.04 Explain how heat and pressure relate to power and transmission.
28.05 Describe the physical and chemical properties of a fluid.
28.06 Install and maintain a contaminant-removal system.
28.07 Determine reservoir requirements.
28.08 Classify and select pumps for specific applications.
28.09 Compute hose requirements.
28.10 Install hydraulic lines.
28.11 Select and install control valves.

29.0 TROUBLESHOOT HYDRAULIC SYSTEMS--The student will be able to:

29.01 Explain the safety procedures for troubleshooting hydraulic systems.
29.02 Read a hydraulic schematic.
29.03 Install hydraulic components.
29.04 Connect electrically controlled valves.
29.05 Explain hydraulic-system troubleshooting techniques.
29.06 Repair and replace valves.
29.07 Repair and replace cylinders.
29.08 Repair and replace pumps and motors.

30.0 MAINTAIN AND TROUBLESHOOT PNEUMATIC SYSTEMS--The student will be able to:

30.01 Explain the safety procedures for troubleshooting pneumatic systems.
30.02 Diagram an air supply system.
30.03 Install system components.
30.04 Demonstrate system-maintenance techniques.
30.05 Explain proper troubleshooting procedures.

30.06 Troubleshoot air compressors.
30.07 Troubleshoot, repair, and install control valves.
30.08 Troubleshoot air motors.

31.0 MAINTAIN AND TROUBLESHOOT FLUID-DRIVE SYSTEMS--The student will be able to:

31.01 Explain the safety procedures for maintaining and troubleshooting fluid-drive systems.
31.02 Install adjustable-speed drives.
31.03 Troubleshoot adjustable-speed drives.
31.04 Explain the operation of fluid couplings.
31.05 Install fluid couplings.
31.06 Install torque converters.
31.07 Perform preventive maintenance.
31.08 Apply a "dynamic" magnetic/mechanical braking device to a motor.
31.09 Mount the equipment.

32.0 MAINTAIN AND TROUBLESHOOT ROBOTIC SYSTEMS--The student will be able to:

32.01 Identify uses of robotics in industry.
32.02 Identify safety procedures related to robotic systems.
32.03 Identify mechanical, hydraulic, pneumatic, and electric/electronic components of robotic systems.
32.04 Perform routine maintenance and calibration of robotic systems.
32.05 Remove, replace and adjust robotic system components.

33.0 PERFORM PUMP MAINTENANCE AND REPAIR--The student will be able to:

33.01 Demonstrate the safety procedures for performing pump maintenance.
33.02 Determine pump capacity and system requirements.
33.03 Perform pump maintenance.
33.04 Identify packing and seal requirements.
33.05 Explain the operating principles of centrifugal, propeller and turbine rotary, reciprocating, diaphragm, positive placement, and vacuum pumps.
33.06 Disassemble and reassemble a pump.

34.0 EXPLAIN THE OPERATION OF INDUSTRIAL-POLLUTION CONTROL SYSTEMS--The student will be able to:

34.01 Explain the operation of air-pollution control systems.
34.02 Explain the operation of water-pollution control systems.
34.03 Explain the operation of solid-waste pollution control systems.
34.04 Explain the operation of noise-pollution control systems.

35.0 TROUBLESHOOT AIR-CONDITIONING AND REFRIGERATION SYSTEMS--The student will be able to:

35.01 Explain the principles of refrigeration.
35.02 Identify the major components.
35.03 Describe the functions of electrical systems.
35.04 Troubleshoot air-conditioning and refrigeration systems.
35.05 Explain the requirement for recovery of hazardous materials and related safety procedures.

36.0 IDENTIFY BOILERS--The student will be able to:

36.01 Identify the various types and components of heat exchangers.
36.02 Identify the various types and components of boilers.
36.03 Identify the various types and components of fractioning columns.
36.04 Identify the uses of steam.

37.0 MAINTAIN INTERNAL COMBUSTION ENGINES--The student will be able to:

37.01 Explain the basic principles of operation of the two-stroke-cycle combustion engine.
37.02 Identify the types of engines.
37.03 Locate engine serial and model numbers.
37.04 Identify engine assemblies and systems.
37.05 Troubleshoot and evaluate engine performance.
37.06 Perform routine maintenance on engine operating systems including air intake and exhaust, fuel, lubrication, ignition, starting and governing.
37.07 Perform engine tune-up and adjustment procedures.
37.08 Remove and replace engine assemblies.

OCCUPATIONAL COMPLETION POINT - DATA CODE - C
INDUSTRIAL MAINTENANCE SPECIALIST--INDUSTRY TITLE

38.0 PREPARE FOR MACHINERY STARTUP--The student will be able to:

38.01 Describe the requirements and precautions for machinery startup.
38.02 Align machinery using wire line, transit, dial indicators, a computer, and laser-alignment devices.
38.03 Position and secure machinery on a foundation.
38.04 Level machinery and install balance-vibration dampeners.
38.05 Identify pipe-stress standards for machine-maintenance applications.
38.06 Perform finish alignment and check for pipe stresses in machinery- maintenance applications.

39.0 APPLY VIBRATION-ANALYSIS SKILLS--The student will be able to:

39.01 Collect vibration data.
39.02 Interpret vibration data.
39.03 Determine velocity, acceleration, spike energy, frequency, amplitude, and other vibration sources.
39.04 Describe the safety requirements and precautions for vibration analysis.

39.05 Operate and use vibration software.
39.06 Predict and verify the condition of machinery in an industrial setting using vibration tools.
39.07 Explain the approximately 25 sources of vibration.
39.08 Explain the bearing frequency (BIFO) formulas.
39.09 Demonstrate proficiency in vibration detection.

40.0 PERFORM MACHINERY BALANCING--The student will be able to:

40.01 Describe the safety requirements and precautions for balancing procedures and equipment.
40.02 Identify the principles of static balancing.
40.03 Perform a vector balance in the classroom.
40.04 Identify balancing standards, ISO 1940 or equal.
40.05 Perform a stand balance in a shop.
40.06 Perform a field balance in an industrial setting.
40.07 Use portable or stationary balancing equipment.

41.0 DEMONSTRATE PREDICTIVE-PREVENTIVE-MAINTENANCE (PPM) TECHNOLOGIES--The student will be able to:

41.01 Explain the use of infrared thermography.
41.02 Explain the use of ultrasound technology.
41.03 Explain the use of advanced alignment techniques (optical and Essinger bars).
41.04 Explain the use of oil ferrography and the types of oil sampling.
41.05 Explain the use of shock pulse equipment.
41.06 Describe the safety requirements for PPM technologies.
41.07 Demonstrate the use of one of the above predictive-maintenance procedures.
41.08 Plan an advanced PPM schedule.

42.0 USE COMPUTER-MAINTENANCE-MANAGEMENT SYSTEMS (CMMS)--The student will be able to:

42.01 Operate CMMS software.
42.02 Enter and close a maintenance work order with CMMS.
42.03 Schedule a series of maintenance tasks.
42.04 Write a detailed maintenance job plan.
42.05 Order parts and supplies for a maintenance work order.
42.06 Determine the personnel resources needed for a maintenance job.

43.0 PERFORM FAILURE ANALYSIS--The student will be able to:

43.01 Conduct/lead a failure analysis meeting to determine the root cause of a failure.
43.02 Create a failure-analysis form and write a minimum of two different types of failure-analysis reports.
43.03 Explain the types of bearing failures.
43.04 Explain the types of shaft fatigues and failures.
43.05 Explain the types of lubrication breakdowns.

43.06 Estimate the cost and the impact on production of a specific failure.

44.0 IMPROVE ROTATING-EQUIPMENT PERFORMANCE--The student will be able to:

44.01 Calculate shaft-deflection ratios and use the results to improve shaft design.
44.02 Draw or sketch equipment bases and supports of sturdy construction.
44.03 Demonstrate and install advanced labyrinth-sealing devices.
44.04 Demonstrate and install advanced mechanical-sealing devices.
44.05 Run the Gates Belts or another interactive belt-design-and-tensioning computer program applied to various drives.
44.06 Explain the benefits of synthetic oils and greases.
44.07 Explain MTBF (mean time between equipment failure) and its cost impact when machinery life is extended.
44.08 List seven specific machinery-improvement ideas in detail.

45.0 GENERATE MACHINE IMPROVEMENTS AND MAINTENANCE MANAGEMENT--The student will be able to:

45.01 Review and critique machinery and base design for improvement, before the equipment is placed on order.
45.02 Identify the essential elements of effective maintenance management:
a. Reward system
b. Predictive-preventive maintenance
c. Planning
d. Work-order systems
e. Organizations
f. Goals and tracking
g. Facilities
h. Storerooms
I. Contractors
j. Shutdowns
45.03 Write a report on the design and effective use of at least two of the essential elements of management.

Florida Department of Education
STUDENT PERFORMANCE STANDARDS

Course Number: 8743210
Course Title: Maintenance Skills 1
Course Credit: 1

COURSE DESCRIPTION:

This course develops the competencies of applying safety rules and procedures, relating the basic elements of physics and of electricity and electronics to Industrial Machinery Maintenance and Repair, performing mathematical calculations, reading plans and drawings, performing measuring and layout operations, and performing computer applications in the industrial-machinery maintenance-technology industry. There is no occupational completion point associated with the completion of this course.

01.0 APPLY SAFETY RULES AND PROCEDURES--The student will be able to:

01.01 Practice shop safety rules and procedures.
01.02 Practice personal safety rules and procedures.
01.03 Practice fire safety rules and procedures.
01.04 Practice electrical safety rules and procedures.
01.05 Practice tool safety rules and procedures.
01.06 Practice ladder and scaffolding safety rules and procedures.
01.07 Maintain a clean work and shop area.
01.08 Perform tag lockout procedures.
01.09 Identify Occupational Safety and Health Administration (OSHA) requirements and procedures.
01.10 Use Materials Safety Data Sheets (MSDS).

02.0 EXPLAIN THE BASIC ELEMENTS OF PHYSICS AS RELATED TO INDUSTRIAL MACHINERY MAINTENANCE AND REPAIR--The student will be able to:

02.01 Explain the standards of measurement and the impact of action and working forces, including tension, compression, torque, and shear.
02.02 Identify the principles and laws of motion and explain how they affect acceleration and deceleration.
02.03 Explain the relationship of work, power, and energy to the types of collisions and the conservation of momentum.
02.04 Explain the operation of simple machines, including the lever, inclined plane, screw, wedge, wheel and axle, pulley, and jacking screws.
02.05 Identify the ways of producing power for mechanical efficiency, in terms of gear ratios, work forces, and types of work done by a crane hook, forklift truck, and screw or bolt.
02.06 Use linear, liquid, and weight units of measurement to measure areas, areas within areas, and volume.
02.07 Describe the mechanical and chemical properties of materials commonly used in industry.

02.08 Explain the laws and conditions governing static and kinetic friction, the problems caused by friction, and the effects of the angle of repose.
02.09 Explain molecular action as a result of temperature extremes, chemical reaction, and moisture content.
02.10 Draw conclusions or make inferences from data.
02.11 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.
02.12 Explain pressure measurement in terms of pounds per square inch (PSI), inches of mercury, and Kilopascal (KPa).

03.0 EXPLAIN BASIC ELECTRICITY AND ELECTRONICS--The student will be able to:

03.01 Define electrical/electronics terms.
03.02 Explain the theory and application of magnetism.
03.03 Explain Ohm's law.
03.04 Describe direct current (DC) and alternating current (AC) circuits.
03.05 Identify the advantages and disadvantages of alternating current (AC) and direct current (DC) motors for various applications.
03.06 Describe the use of programmable logic controllers (PLCs) in industry.

04.0 PERFORM MATHEMATICAL CALCULATIONS--The student will be able to:

04.01 Make job-related decimal and fraction calculations.
04.02 Solve job-related problems by adding, subtracting, multiplying, and dividing numbers.
04.03 Solve job-related problems using a hand-held calculator.
04.04 Solve job-related problems using basic formulas.
04.05 Solve job-related problems using basic geometry.
04.06 Measure a workpiece and compare the measurements with blueprint specifications.
04.07 Solve job-related problems using mathematical handbooks, charts, and tables.
04.08 Convert measurements from English to metric and from metric to English units.
04.09 Solve job-related problems using proportions.
04.10 Solve job-related problems using statistics.

05.0 READ PLANS AND DRAWINGS--The student will be able to:

05.01 Identify dimensions.
05.02 Identify lists of materials and specifications.
05.03 Identify section and detail views.
05.04 Sketch and dimension a part.
05.05 Disassemble and assemble parts using an exploded-view drawing.
05.06 Interpret blueprint abbreviations.

05.07 Identify dimensioning of radii, round holes, fillets, and chamfers.
05.08 Identify screw threads and bolt types.
05.09 Apply dimensional tolerances.
05.10 Identify the metal-fabrication symbols used in blueprints.

06.0 PERFORM MEASURING AND LAYOUT OPERATIONS--The student will be able to:

06.01 Perform basic geometric-construction operations.
06.02 Safely use marking gauges, center punches, scribes, surface gauges, squares, dividers, dial indicators, protractors, surface plates, depth gauges, and circumference rules.
06.03 Develop patterns using parallel lines, radial lines, and triangulation.
06.04 Make metal-fabrication sketches.
06.05 Read and measure with steel rules.
06.06 Read and measure with micrometers.
06.07 Read and measure with vernier tools.
06.08 Read and measure with dial calipers.
06.09 Read and measure with dial indicators.

07.0 PERFORM COMPUTER APPLICATIONS--The student will be able to:

07.01 Explain the use of computers in plant operations.
07.02 Describe information processing.
07.03 Identify types of computers.
07.04 Identify keyboard functions.
07.05 Identify data input and output devices.
07.06 Describe computer programs.
07.07 Perform power-up and power-down procedures.
07.08 Back up data and save and print documents from a personal computer (PC).
07.09 Identify the effects of and the methods for checking for a virus in a PC system.

Florida Department of Education
STUDENT PERFORMANCE STANDARDS

Course Number: 8743220
Course Title: Maintenance Skills 2
Course Credit: 1

COURSE DESCRIPTION:

This course develops the competencies of using and maintaining hand and portable power tools, handling and applying lubricants, applying basic benchwork skills, and performing basic gas-welding and cutting operations in the industrial-machinery maintenance-technology industry. There is no occupational completion point associated with the completion of this course.

08.0 USE AND MAINTAIN HAND TOOLS--The student will be able to:

- 08.01 Demonstrate the safe use of hand tools such as screwdrivers, hammers, wrenches, pliers, hacksaws, punches, chisels, drills, files, tin snips, taps, and dies.
- 08.02 Use measuring devices.
- 08.03 Use wrenches and screwdrivers.
- 08.04 Use pipefitting tools.
- 08.05 Use sheet-metal tools.
- 08.06 Safely use ropes, slings, pulleys, and block and tackle.
- 08.07 Select the proper tool for each job application.
- 08.08 Select correct tools for metric and standard fasteners.
- 08.09 Identify state-of-the-art innovations and explore their uses.
- 08.10 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.
- 08.11 Describe the techniques and liability issues regarding retrofitting fasteners for ease of removal.

09.0 USE AND MAINTAIN PORTABLE POWER TOOLS--The student will be able to:

- 09.01 Demonstrate the safe use of portable power tools such as 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.
- 09.02 Use and maintain light- and heavy-duty drills.
- 09.03 Use and maintain electric hammers.
- 09.04 Use and maintain pneumatic drills and hammers.
- 09.05 Use and maintain power screwdrivers and nut runners.
- 09.06 Use and maintain linear-motion saws.
- 09.07 Use and maintain circular saws.
- 09.08 Use and maintain belt, pad, and disc sanders.

09.09 Use and maintain grinders and shears.

10.0 HANDLE AND APPLY LUBRICANTS--The student will be able to:

10.01 Explain the functions of lubrication.
10.02 Explain the properties of oil lubricants and the factors determining the selection of lubricants.
10.03 Identify the types, advantages, and functions of lubricant additives.
10.04 Explain the types of circulating oils and their purposes.
10.05 Identify grease application.
10.06 Identify lubricating systems and methods.
10.07 Explain lubricant storage and handling methods.
10.08 Explain the types of oil filters and their uses.
10.09 Lubricate a piece of industrial equipment.
10.10 Define the role of preventive maintenance in total equipment maintenance.
10.11 Describe the major tasks of preventive maintenance: cleaning, inspection, lubrication, minor repair, and information feedback.
10.12 Review a typical maintenance program.

11.0 PERFORM BENCHWORK SKILLS--The student will be able to:

11.01 Identify safety and shop rules.
11.02 Cut materials by using hand hacksaws.
11.03 Cut threads by using hand taps.
11.04 Cut threads by using dies.
11.05 Repair threads by chasing and thread inserts.
11.06 Install dowel pins using tapered and straight reamers.
11.07 Ream holes by using tapered and straight reamers.
11.08 Hand-sharpen cutting tools by using abrasive stones.
11.09 Hone and lap surfaces.
11.10 Remove damaged screws and other hardware.
11.11 Deburr workpieces.

12.0 PERFORM BASIC GAS AND ELECTRIC ARC WELDING AND CUTTING OPERATIONS--The student will be able to:

12.01 Identify the properties of the most commonly used metals and alloys, including hardness and malleability.
12.02 Identify the processes and effects of tempering, annealing, and case hardening.
12.03 Identify welding cylinders, regulators, hoses, pressure gauges, and torches.
12.04 Describe welding-equipment safety procedures.
12.05 Demonstrate proper flame settings.
12.06 Demonstrate basic gas-welding skills.
12.07 Demonstrate procedures for adjusting and operating the oxyacetylene cutting torch.
12.08 Demonstrate freehand and guide cutting of various metal thicknesses.
12.09 Identify the uses of the following welding techniques: laser, ultrasonic, resistance, and percussion.

Florida Department of Education
STUDENT PERFORMANCE STANDARDS

Course Number: 8743230
Course Title: Maintenance Skills 3
Course Credit: 1

COURSE DESCRIPTION:

This course develops competencies in rigging and lifting, installing and removing machinery, conveyor maintenance, troubleshooting machinery performance, communicating, servicing customers, obtaining employment, and entrepreneurship skills in the industrial-machinery maintenance-technology industry. Completion of this course prepares the student for

OCCUPATIONAL COMPLETION POINT - DATA CODE A, INDUSTRIAL MACHINERY MAINTENANCE Assistant--Industry Title.

13.0 PERFORM RIGGING FUNCTIONS--The student will be able to:

13.01 Demonstrate the safety procedures for performing rigging and lifting operations.
13.02 Identify and inspect fiber and wire rope.
13.03 Tie knots and hitches.
13.04 Identify and use the components of rigging hardware.
13.05 Perform rigging and lifting operations.
13.06 Demonstrate the proper operation of a forklift.

14.0 INSTALL AND REMOVE MACHINERY--The student will be able to:

14.01 Identify the safety procedures for installing and removing machinery.
14.02 Identify the equipment required for machine installation and removal.
14.03 Prepare an area for machine installation per the manufacturer's specifications.
14.04 Rig, lift, and transport machinery to the installation site.
14.05 Install electrical hookups to machinery.
14.06 Install air hydraulic hookups to machinery.
14.07 Perform an assigned machine retrofit per manufacturer's specifications.
14.08 Perform an assigned machine removal and transport per specification requirements.
14.09 Explain the importance of vibration detection.
14.10 Identify the need for pipe supports to prevent pipe stress.

15.0 DEMONSTRATE CONVEYOR-MAINTENANCE TECHNIQUES--The student will be able to:

15.01 Identify the types of conveyors.
15.02 Identify the safety requirements and precautions for conveyor-maintenance operations.
15.03 Adjust the tracking of a belt.

15.04 Check a belt for wear.
15.05 Identify the types of splices.
15.06 Identify splicing equipment and procedures.
15.07 Demonstrate conveyor-maintenance techniques, including making splices with splicing equipment.

16.0 IDENTIFY COMMON TROUBLES AND BASIC TROUBLESHOOTING TECHNIQUES--The student will be able to:

16.01 Analyze the possible causes of common troubles in industrial-machinery performance.
16.02 Identify basic troubleshooting techniques for bearings.
16.03 Identify basic troubleshooting techniques for pumps.
16.04 Identify basic troubleshooting techniques for drive systems.
16.05 Identify basic troubleshooting techniques for electrical circuits.
16.06 Identify basic troubleshooting techniques for hydraulics.
16.07 Identify basic troubleshooting techniques for pneumatics.
16.08 Identify basic troubleshooting techniques for PLCs.

17.0 DEMONSTRATE APPROPRIATE COMMUNICATION SKILLS--The student will be able to:

17.01 Write logical and understandable statements, or phrases, to accurately fill out forms and documents commonly used in business and industry.
17.02 Read and interpret graphs, charts, diagrams, and tables commonly used in business and industry.
17.03 Read and follow written and oral instructions.
17.04 Answer and ask questions coherently and concisely.
17.05 Read critically by recognizing assumptions and implications and by evaluating ideas.
17.06 Demonstrate appropriate communication skills, including telecommunications.

18.0 DEMONSTRATE EMPLOYABILITY SKILLS--The student will be able to:

18.01 Conduct a job search.
18.02 Secure information about a job.
18.03 Identify the documents that may be required for a job application.
18.04 Complete a resume.
18.05 Complete a job-application form correctly.
18.06 Demonstrate competence in job-interview techniques.
18.07 Identify or demonstrate appropriate responses to criticism from an employer, a supervisor, or other persons.
18.08 Identify acceptable work habits.
18.09 Describe how to make appropriate job changes.
18.10 Demonstrate acceptable employee health habits.
18.11 Describe the purpose of the Florida "Right-to-Know" law, as recorded in the Florida Statutes, Chapter 442.

19.0 DESCRIBE THE ROLE OF JOB OWNERSHIP AND ENTREPRENEURSHIP--The student will be able to:

19.01 Define "entrepreneurship."
19.02 Describe the importance of entrepreneurship to the American economy.
19.03 List the advantages and disadvantages of business ownership and demonstrate ownership as an employee.
19.04 Identify the risks involved in the ownership of a business.
19.05 Identify the necessary personal characteristics and business skills of a successful entrepreneur.
19.06 Identify the need for teamwork, team roles when working in a factory or doing shift work, and team development.
19.07 Describe how attitudes toward work responsibilities, absences, and tardiness affect job success.

20.0 APPLY CUSTOMER-SERVICE SKILLS--The student will be able to:

20.01 Explain the need for customer satisfaction.
20.02 Prepare service orders properly.
20.03 Communicate solutions to customers.
20.04 Demonstrate methods of handling an irate customer.
20.05 Follow manufacturers' service manuals.
20.06 Locate parts in a printed or computerized catalog or on microfiche.

Florida Department of Education
STUDENT PERFORMANCE STANDARDS

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

COURSE DESCRIPTION:

This course develops the competencies of planning an elementary predictive- preventive-maintenance schedule, performing gas and arc welding, performing machine-shop operations, maintaining piping and tubing systems, troubleshooting electrical circuits, and maintaining and installing drive components in the industrial-machinery maintenance-technology industry. There is no occupational completion point associated with the completion of this course.

21.0 PLAN AN ELEMENTARY PREDICTIVE-PREVENTIVE-MAINTENANCE (PPM) SCHEDULE--The student will be able to:

21.01 List the types of predictive-preventive maintenance.
21.02 Describe the purpose of preventive-maintenance schedules.
21.03 Create a preventive-maintenance schedule form using a machine manual or the manufacturer's recommendations.
21.04 Identify troubles caused by the lack of preventive maintenance.
21.05 Create a maintenance log and make entries for a machine or equipment.
21.06 Create a preventive-maintenance schedule from a maintenance-failure log.

22.0 PERFORM GAS- AND ARC-WELDING PROCEDURES--The student will be able to:

22.01 Demonstrate the safety procedures for performing gas and arc welding and for transporting equipment.
22.02 Identify the components of an oxyfuel rig.
22.03 Set up and shut down an oxyfuel rig.
22.04 Weld beads in a flat position.
22.05 Weld an outside corner joint using a filler rod.
22.06 Cut metal of various thickness’.
22.07 Weld beads in a flat position using E-6010 and E-7018 electrodes.
22.08 Weld beads in horizontal and in vertical positions using E-6010 and E-7018 electrodes.
22.09 Weld beads in an overhead position using E-6010 and E-7018 electrodes.
22.10 Weld beads using a mig welder.
22.11 Weld beads using a tig welder.
22.12 Solder and braze metals.
22.13 Cut stainless steel and aluminum with a plasma-arc rig.

23.0 PERFORM MACHINE-SHOP OPERATIONS--The student will be able to:

23.01 Demonstrate safety in performing machine-shop operations.
23.02 Identify the types of cutting tools.
23.03 Bore a hole to a specified size.
23.04 Chase an external V-thread.
23.05 Identify the different types of work-holding devices.
23.06 Prepare metal for finishing.
23.07 Set up, use, and adjust an arbor press.
23.08 Set up, use, and adjust a hydraulic press.
23.09 Set up, use, and adjust broaching tools.
23.10 Cut keyways with an end mill.

24.0 MAINTAIN PIPING AND TUBING SYSTEMS--The student will be able to:

24.01 Identify the components of a piping system.
24.02 Explain the maintenance considerations of metallic and nonmetallic piping systems.
24.03 Describe the safety requirements for working with piping and tubing systems.
24.04 Join copper tubing.
24.05 Join common fittings.
24.06 Join metallic pipe.
24.07 Join plastic pipe.
24.08 Explain valve operation and maintenance.
24.09 Explain the importance of strainers, filters, and traps in piping systems.
24.10 Bend back-to-back, stub-ups, and doglegs in electrical metallic tubing (EMT).

25.0 TROUBLESHOOT ELECTRICAL CIRCUITS--The student will be able to:

25.01 Describe the safety requirements and precautions for troubleshooting electrical circuits.
25.02 Disconnect and reconnect electric motors.
25.03 Identify the parts and function of electrical control equipment.
25.04 Define digital devices and PLC logic/ladder logic to troubleshoot.
25.05 Identify the function of input and output devices and the controller.
25.06 Explain how to troubleshoot a sequence of events.
25.07 Use and maintain electrical test equipment for troubleshooting.

26.0 INSTALL AND MAINTAIN DRIVE COMPONENTS--The student will be able to:

26.01 Demonstrate safety procedures for installing and maintaining drive components.
26.02 Identify types of bearings, their cross-referencing, and their uses.
26.03 Remove, inspect, and/or replace bearings.
26.04 Remove and replace seals.
26.05 Perform shaft alignment.

26.06 Identify the types of belts.
26.07 Identify the types of chains.
26.08 Perform tension adjustments and alignment on belt and chain drives.
26.09 Troubleshoot belt and chain drives.
26.10 Identify the types of gears.
26.11 Remove, replace, and align gears, sprockets, and couplings.
26.12 Remove, replace, or repair V-joints and jack shafts.
26.13 Adjust gear backlash.
26.14 Troubleshoot gear drives.
26.15 Disassemble, inspect, reassemble, and adjust clutches.
26.16 Identify the types of variable-speed drives.
26.17 Troubleshoot variable-speed drives.
26.18 Identify the types of cams and link mechanisms.
26.19 Troubleshoot cam-and-link mechanism problems.

Florida Department of Education
STUDENT PERFORMANCE STANDARDS

Course Number: 8743250
Course Title: Machinery Maintenance 5
Course Credit: 1

COURSE DESCRIPTION:

This course develops the competencies of maintaining specific types of air compressors and maintaining, repairing, and troubleshooting fluid-drive systems in the industrial-machinery maintenance-technology industry. There is no occupational completion point associated with the completion of this course.

27.0 MAINTAIN RECIPROCATING, POSITIVE-DISPLACEMENT, AND ROTARY AIR COMPRESSORS--The student will be able to:

27.01 Relate force, weight, mass, and density to a pneumatic system.
27.02 Demonstrate safety procedures for maintaining reciprocating, positive-displacement, and rotary air compressors.
27.03 Demonstrate the operation of reciprocating compressors.
27.04 Demonstrate the operation of positive-displacement and rotary air compressors.
27.05 Demonstrate primary and secondary air treatment.
27.06 Demonstrate the operation of valves, cylinders, and motors.
27.07 Check oil level.
27.08 Change oil.
27.09 Drain water from tank.
27.10 Test for efficiency of compressor.
27.11 Inspect storage tank for quality.
27.12 Test pressure control switch.

28.0 MAINTAIN AND REPAIR HYDRAULIC-SYSTEM COMPONENTS--The student will be able to:

28.01 Explain the safety procedures for installing hydraulic lines.
28.02 Explain Pascal's law.
28.03 Explain Bernoulli's principle.
28.04 Explain how heat and pressure relate to power and transmission.
28.05 Describe the physical and chemical properties of a fluid.
28.06 Install and maintain a contaminant-removal system.
28.07 Determine reservoir requirements.
28.08 Classify and select pumps for specific applications.
28.09 Compute hose requirements.
28.10 Install hydraulic lines.
28.11 Select and install control valves.

29.0 TROUBLESHOOT HYDRAULIC SYSTEMS--The student will be able to:

29.01 Explain the safety procedures for troubleshooting hydraulic systems.
29.02 Read a hydraulic schematic.
29.03 Install hydraulic components.
29.04 Connect electrically controlled valves.
29.05 Explain hydraulic-system troubleshooting techniques.
29.06 Repair and replace valves.
29.07 Repair and replace cylinders.
29.08 Repair and replace pumps and motors.

30.0 MAINTAIN AND TROUBLESHOOT PNEUMATIC SYSTEMS--The student will be able to:

30.01 Explain the safety procedures for troubleshooting pneumatic systems.
30.02 Diagram an air-supply system.
30.03 Install system components.
30.04 Demonstrate system-maintenance techniques.
30.05 Explain proper troubleshooting procedures.
30.06 Troubleshoot air compressors.
30.07 Troubleshoot, repair, and install control valves.
30.08 Troubleshoot air motors.

31.0 MAINTAIN AND TROUBLESHOOT FLUID-DRIVE SYSTEMS--The student will be able to:

31.01 Explain the safety procedures for maintaining and troubleshooting fluid-drive systems.
31.02 Install adjustable speed drives.
31.03 Troubleshoot adjustable speed drives.
31.04 Explain the operation of fluid couplings.
31.05 Install fluid couplings.
31.06 Install torque converters.
31.07 Perform preventive maintenance.
31.08 Apply a "dynamic" magnetic/mechanical braking device to a motor.
31.09 Mount the equipment.

32.0 MAINTAIN AND TROUBLESHOOT ROBOTIC SYSTEMS--The student will be able to:

32.01 Identify uses of robotics in industry.
32.02 Identify safety procedures related to robotic systems.
32.03 Identify mechanical, hydraulic, pneumatic and electrical/electronic components of robotic systems.
32.04 Perform routine maintenance and calibration of robotic systems.
32.05 Remove, replace, and adjust robotic system components.

Florida Department of Education
STUDENT PERFORMANCE STANDARDS

Course Number: 8743260
Course Title: Machinery Maintenance 6
Course Credit: 1

COURSE DESCRIPTION:

This course develops the competencies for pump maintenance and repair and for pollution control along with knowledge of industrial-pollution control systems in industrial-machinery maintenance-technology operations. It may include the development of optional competencies related to air-conditioning and refrigeration, boilers, and small engines. Completion of this course prepares the student for

OCCUPATIONAL COMPLETION POINT - DATA CODE B, MACHINERY MAINTENANCE MECHANIC--OES 85119632.

33.0 PERFORM PUMP MAINTENANCE AND REPAIR--The student will be able to:

33.01 Demonstrate the safety procedures for performing pump maintenance.
33.02 Determine pump capacity and system requirements.
33.03 Perform pump maintenance.
33.04 Identify packing and seal requirements.
33.05 Explain the operating principles of centrifugal, propeller and turbine rotary, reciprocating, diaphragm, positive placement, and vacuum pumps.
33.06 Disassemble and reassemble a pump.

34.0 EXPLAIN THE OPERATION OF INDUSTRIAL-POLLUTION CONTROL SYSTEMS--The student will be able to:

34.01 Explain the operation of air-pollution control systems.
34.02 Explain the operation of water-pollution control systems.
34.03 Explain the operation of solid-waste pollution control systems.
34.04 Explain the operation of noise-pollution control systems.

35.0 TROUBLESHOOT AIR-CONDITIONING AND REFRIGERATION SYSTEMS--The student will be able to:

35.01 Explain the principles of refrigeration.
35.02 Identify the major components.
35.03 Describe the functions of electrical systems.
35.04 Troubleshoot air-conditioning and refrigeration systems.
35.05 Explain the requirement for recovery of hazardous materials and related safety procedures.

36.0 IDENTIFY BOILERS--The student will be able to:

36.01 Identify the various types and components of heat exchangers.
36.02 Identify the various types and components of boilers.
36.03 Identify the various types and components of fractioning columns.
36.04 Identify the uses of steam.

37.0 MAINTAIN INTERNAL COMBUSTION ENGINES--The student will be able to:

37.01 Explain the basic principles of operation of the two-stroke-cycle combustion engine.
37.02 Identify the types of engines.
37.03 Locate engine serial and model numbers.
37.04 Identify engine assemblies and systems.
37.05 Troubleshoot and evaluate engine performance..
37.06 Perform routine maintenance on engine operating systems including air intake and exhaust, fuel, lubrication, starting and governing.
37.07 Perform engine tune-up and adjustment procedures
37.08 Remove and replace engine assemblies.

Florida Department of Education
STUDENT PERFORMANCE STANDARDS

Course Number: 8743170
Course Title: Industrial Maintenance 7
Course Credits: 1

COURSE DESCRIPTION:

This course develops the competencies for preparing for machinery startup and performing vibration analysis and machine balancing for specialized operations in the industrial-machinery maintenance-technology industry. There is no occupational completion point associated with the completion of this course.

38.0 PREPARE FOR MACHINERY STARTUP--The student will be able to:

38.01 Perform the requirements and precautions for machinery startup.
38.02 Align machinery using wire line, transit, dial indicators, a computer, and laser-alignment devices.
38.03 Position and secure machinery on a foundation.
38.04 Level machinery and install balance-vibration dampers.
38.05 Identify pipe-stress standards for machine-maintenance applications.
38.06 Perform finish alignment and check for pipe stresses in machinery-maintenance applications

39.0 EXPLAIN THE OPERATION OF INDUSTRIAL-POLLUTION CONTROL SYSTEMS--The student will be able to:

39.01 Collect vibration data.
39.02 Interpret vibration data.
39.03 Determine velocity, acceleration, spike energy, frequency, amplitude, and other vibration sources.
39.04 Describe the safety requirements and precautions for vibration analysis.
39.05 Operate and use vibration software.
39.06 Predict and verify the condition of machinery in an industrial setting using vibration tools.
39.07 Explain the approximately 25 sources of vibration.
39.08 Explain the bearing frequency (BIFO) formulas.
39.09 Determine proficiency in vibration detection.

40.0 PERFORM MACHINERY BALANCING--The student will be able to:

40.01 Describe the safety requirements and precautions for balancing procedures and equipment.
40.02 Identify the principles of static balancing.
40.03 Perform a vector balance in the classroom.
40.04 Identify balancing standards, ISO 1940 or equal.
40.05 Perform a stand balance in a shop.
40.06 Perform a field balance in an industrial setting.

40.07 Use portable or stationary balancing equipment.

Florida Department of Education
STUDENT PERFORMANCE STANDARDS

Course Number: 8743180
Course Title: Industrial Maintenance 8
Course Credits: 1

COURSE DESCRIPTION:

This course develops the competencies for preparing for machinery startup and performing vibration analysis and machine balancing for specialized operations in the industrial-machinery maintenance-technology industry. There is no occupational completion point associated with the completion of this course.

41.0 DEMONSTRATE PREDICTIVE-PREVENTIVE-MAINTENANCE (PPM) TECHNOLOGIES--The student will be able to:

41.01 Explain the use of infrared thermography.
41.02 Explain the use of ultrasound technology.
41.03 Explain the use of advanced alignment techniques (optical and Essinger bars).
41.04 Explain the use of oil ferrography and the types of oil sampling.
41.05 Explain the use of shock pulse equipment.
41.06 Describe the safety requirements for PPM technologies.
41.07 Determine the use of one of the above predictive-maintenance procedures.
41.08 Plan an advanced PPM schedule.

42.0 USE COMPUTER-MAINTENANCE-MANAGEMENT SYSTEMS (CMMS)--The student will be able to:

42.01 Operate CMMS software.
42.02 Enter and close a maintenance work order with CMMS.
42.03 Schedule a series of maintenance tasks.
42.04 Write a detailed maintenance job plan.
42.05 Order parts and supplies for a maintenance work order.
42.06 Determine the personnel resources needed for a maintenance job.

43.0 PERFORM MACHINERY BALANCING--The student will be able to:

43.01 Conduct/lead a failure-analysis meeting to determine the root cause of a failure.
43.02 Create a failure-analysis form and write a minimum of two different types of failure-analysis reports.
43.03 Explain the types of bearing failure.
43.04 Explain the types of shaft fatigues and failures.
43.05 Explain the types of lubrication breakdowns.
43.06 Estimate the cost and the impact on production of a specific failure.

Florida Department of Education
STUDENT PERFORMANCE STANDARDS

Course Number: 8743190
Course Title: Industrial Maintenance 9
Course Credits: 1

COURSE DESCRIPTION:

This course develops the competencies for preparing for machinery startup and performing vibration analysis and machine balancing for specialized operations in the industrial-machinery maintenance-technology industry. There is no occupational completion point associated with the completion of this course.

44.0 IMPROVE ROTATING-EQUIPMENT PERFORMANCE--The student will be able to:

44.01 Calculate shaft-deflection ratios and use the results to improve shaft design.
44.02 Draw or sketch equipment bases and supports of sturdy construction.
44.03 Determine and install advanced labyrinth-sealing devices.
44.04 Determine and install advanced mechanical-sealing devices.
44.05 Run the Gates Belts or another interactive belt-design-and-tensioning computer program applied to various drives.
44.06 Explain the benefits of synthetic oils and greases.
44.07 Explain MTBF (Mean Time Between Equipment Failure) and its cost impact when machinery life is extended.
44.08 List seven specific machinery-improvement ideas in detail.

45.0 USE COMPUTER-MAINTENANCE-MANAGEMENT SYSTEMS (CMMS)--The student will be able to:

45.01 Review and critique machinery and base design for improvement, before the equipment is placed on order.
45.02 Identify the essential elements of effective maintenance management:
a. Reward system
B. Predictive-preventive maintenance
C. Planning
D. Work-order systems
E. Organizations
F. Goals and tracking
G. Facilities
H. Storerooms
I. Contractors
J. Shutdowns
45.03 Write a report on the design and effective use of at least two of the essential elements of management.

Florida Department of Education
INTENDED OUTCOMES

Program Title: **Millwright**

	Secondary	PSAV
Program Number:	**8743200**	**I470313**
CIP Number	0647.030302	0647.030302
Grade Level	9-12, 30, 31	30, 31
Length	9 Credits	1,350 Hours
Certification	TEC CONSTR @7 G	TEC CONSTR @7 G
	MILLWRIGHT @7 G	MILLWRIGHT @7 G
	BLDG CONST @7 G	BLDG CONST @7 G
	IND ENGR @7 G	IND ENGR @7 G

Basic-Skills Grade Level	
Math	9
Language	9
Reading	9

INTENDED OUTCOMES: After successfully completing the appropriate course(s) for each occupational completion point of this program, the student will be able to perform the following:

OCCUPATIONAL COMPLETION POINT - DATA CODE - A (450 Hours)
INDUSTRIAL MACHINERY MAINTENANCE ASSISTANT - INDUSTRY TITLE

01.0 Apply safety rules and procedures.
02.0 Explain the basic elements of physics as related to Industrial Machinery Maintenance and Repair.
03.0 Explain basic electricity and electronics.
04.0 Perform mathematical calculations.
05.0 Read plans and drawings.
06.0 Perform measuring and layout operations.
07.0 Perform computer applications.
08.0 Use and maintain hand tools.
09.0 Use and maintain portable power tools.
10.0 Handle and apply lubricants.
11.0 Perform benchwork skills.
12.0 Perform gas-welding and cutting operations.
13.0 Perform rigging functions.
14.0 Install and remove machinery.
15.0 Demonstrate conveyor-maintenance techniques.
16.0 Identify common troubles and basic troubleshooting techniques.
17.0 Demonstrate appropriate communication skills.
18.0 Demonstrate employability skills.
19.0 Describe the role of job ownership and entrepreneurship.
20.0 Apply customer-service skills.

OCCUPATIONAL COMPLETION POINT - DATA CODE - B (450 Hours)
MACHINERY MAINTENANCE MECHANIC - OES 85110

21.0 Plan an elementary predictive-preventive-maintenance (PPM) schedule.
22.0 Perform gas- and arc-welding procedures.
23.0 Perform machine-shop operations.
24.0 Maintain piping and tubing systems.
25.0 Troubleshoot electrical circuits.
26.0 Install and maintain drive components.
27.0 Maintain reciprocating, positive-displacement, and rotary air compressors.
28.0 Maintain and repair hydraulic-system components.
29.0 Troubleshoot hydraulic systems.
30.0 Maintain and troubleshoot pneumatic systems.
31.0 Maintain and troubleshoot fluid-drive systems.
32.0 Perform pump maintenance and repair.
33.0 Explain the operation of industrial-pollution control systems.
34.0 Explain the operation of industrial-pollution control systems.
35.0 Troubleshoot air-conditioning and refrigeration systems.
36.0 Identify boilers.
37.0 Maintain internal combustion engines.

OCCUPATIONAL COMPLETION POINT - DATA CODE - C (450 Hours)
MILLWRIGHT - OES 85123634

38.0 Perform metal fabrication.
39.0 Perform precision layout.
40.0 Install, remove and align machinery.
41.0 Install, remove and align machinery (ADVANCED).

Florida Department of Education
STUDENT PERFORMANCE STANDARDS

Program Title: Millwright
Secondary Number: 8743200
Postsecondary Number: I470313

OCCUPATIONAL COMPLETION POINT - DATA CODE - A
INDUSTRIAL MACHINERY MAINTENANCE ASSISTANT - INDUSTRY TITLE

01.0 APPLY SAFETY RULES AND PROCEDURES--The student will be able to:

01.01 Practice shop safety rules and procedures.
01.02 Practice personal safety rules and procedures.
01.03 Practice fire safety rules and procedures.
01.04 Practice electrical safety rules and procedures.
01.05 Practice tool safety rules and procedures.
01.06 Practice ladder and scaffolding safety rules and procedures.
01.07 Maintain a clean work and shop area.
01.08 Perform lock out/tag-out procedures.
01.09 Identify Occupational Safety and Health Administration (OSHA) requirements and procedures.
01.10 Use Materials Safety Data Sheets (MSDS).

02.0 EXPLAIN THE BASIC ELEMENTS OF PHYSICS AS RELATED TO INDUSTRIAL MACHINERY MAINTENANCE AND REPAIR--The student will be able to:

02.01 Explain the standards of measurement and the impact of action and working forces, including tension, compression, torque, and shear.
02.02 Identify the principles and laws of motion and explain how they affect acceleration and deceleration.
02.03 Explain the relationship of work, power, and energy to the types of collisions and the conservation of momentum.
02.04 Explain the operation of simple machines, including the lever, inclined plane, screw, wedge, wheel and axle, pulley, and jacking screws.
02.05 Identify the ways of producing power for mechanical efficiency, in terms of gear ratios, work forces, and types of work done by a crane hook, forklift truck, and screw or bolt.
02.06 Use linear, liquid, and weight units of measurement to measure areas, areas within areas, and volume.
02.07 Describe the mechanical and chemical properties of materials commonly used in industry.
02.08 Explain the laws and conditions governing static and kinetic friction, the problems caused by friction, and the effects of the angle of repose.
02.09 Explain molecular action as a result of temperature extremes, chemical reaction, and moisture content.
02.10 Draw conclusions or make inferences from data.
02.11 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.

02.12 Explain pressure measurement in terms of pounds per square inch (PSI), inches of mercury, and Kilopascal (Kpa).

03.0 EXPLAIN BASIC ELECTRICITY AND ELECTRONICS--The student will be able to:

03.01 Define electrical/electronics terms.
03.02 Explain the theory and application of magnetism.
03.03 Explain Ohm's law.
03.04 Describe direct current (DC) and alternating current (AC) circuits.
03.05 Identify the advantages and disadvantages of alternating current (AC) and direct current (DC) motors for various applications.
03.06 Describe the use of programmable logic controllers (PLCs) in the industry.

04.0 PERFORM MATHEMATICAL CALCULATIONS--The student will be able to:

04.01 Make job-related decimal and fraction calculations.
04.02 Solve job-related problems by adding, subtracting, multiplying, and dividing numbers.
04.03 Solve job-related problems using a hand-held calculator.
04.04 Solve job-related problems using basic formulas.
04.05 Solve job-related problems using basic geometry.
04.06 Measure a workpiece and compare the measurements with blueprint specifications.
04.07 Solve job-related problems using mathematical handbooks, charts, and tables.
04.08 Convert measurements from English to metric and from metric to English units.
04.09 Solve job-related problems using proportions.
04.10 Solve job-related problems using statistics.

05.0 READ PLANS AND DRAWINGS--The student will be able to:

05.01 Identify dimensions.
05.02 Identify lists of materials and specifications.
05.03 Identify section and detail views.
05.04 Sketch and dimension a part.
05.05 Disassemble and assemble parts using an exploded-view drawing.
05.06 Interpret blueprint abbreviations.
05.07 Identify dimensioning of radii, round holes, fillets, and chamfers.
05.08 Identify screw threads and bolt types.
05.09 Apply dimensional tolerances.
05.10 Identify the metal-fabrication symbols used in blueprints.

06.0 PERFORM MEASURING AND LAYOUT OPERATIONS--The student will be able to:

06.01 Perform basic geometric-construction operations.
06.02 Safely use marking gauges, center punches, scribes, surface gauges, squares, dividers, dial indicators, protractors, surface plates, depth gauges, and circumference rules.

06.03 Develop patterns using parallel lines, radial lines, and triangulation.
06.04 Make metal-fabrication sketches.
06.05 Read and measure with steel rules.
06.06 Read and measure with micrometers.
06.07 Read and measure with vernier tools.

06.08 Read and measure with dial calipers.
06.09 Read and measure with dial indicators.

07.0 PERFORM COMPUTER APPLICATIONS--The student will be able to:

07.01 Explain the use of computers in plant operations.
07.02 Describe information processing.
07.03 Identify types of computers.
07.04 Identify keyboard functions.
07.05 Identify data input and output devices.
07.06 Describe computer programs.
07.07 Perform power-up and power-down procedures.
07.08 Back up data and save and print documents from a personal computer (PC).
07.09 Identify the effects of and the methods for checking for a virus in a PC system.

08.0 USE AND MAINTAIN HAND TOOLS--The student will be able to:

08.01 Demonstrate the safe use of hand tools: screwdrivers, hammers, wrenches, pliers, hacksaws, punches, chisels, drills, files, tin snips, taps, and dies.
08.02 Use measuring devices.
08.03 Use wrenches and screwdrivers.
08.04 Use pipefitting tools.
08.05 Use sheet-metal tools.
08.06 Safely use ropes, slings, pulleys, and block and tackle.
08.07 Select the proper tool for each job application.
08.08 Select correct tools for metric and standard fasteners.
08.09 Identify state-of-the-art innovations and explore their uses.
08.10 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.
08.11 Describe the techniques and liability issues regarding retrofitting fasteners for ease of removal.

09.0 USE AND MAINTAIN PORTABLE POWER TOOLS--The student will be able to:

09.01 Demonstrate the safe use of portable power tools such as 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.

09.02 Use and maintain light- and heavy-duty drills.
09.03 Use and maintain electric hammers.
09.04 Use and maintain pneumatic drills and hammers.
09.05 Use and maintain power screwdrivers and nut runners.
09.06 Use and maintain linear-motion saws.
09.07 Use and maintain circular saws.
09.08 Use and maintain belt, pad, and disc sanders.
09.09 Use and maintain grinders and shears.

10.0 HANDLE AND APPLY LUBRICANTS--The student will be able to:

10.01 Explain the functions of lubrication.
10.02 Explain the properties of oil lubricants and the factors determining the selection of lubricants.
10.03 Identify the types, advantages, and functions of lubricant additives.
10.04 Explain the types of circulating oils and their purposes.
10.05 Identify grease application.
10.06 Identify lubricating systems and methods.
10.07 Explain lubricant storage and handling methods.
10.08 Explain the types of oil filters and their uses.
10.09 Lubricate a piece of industrial equipment.
10.10 Define the role of preventive maintenance in total equipment maintenance.
10.11 Describe the major tasks of preventive maintenance: cleaning, inspection, lubrication, minor repair, and information feedback.
10.12 Review a typical maintenance program.

11.0 PERFORM BENCHWORK SKILLS--The student will be able to:

11.01 Identify safety and shop rules.
11.02 Cut materials by using hand hacksaws.
11.03 Cut threads by using hand taps.
11.04 Cut threads by using dies.
11.05 Repair threads by chasing and thread inserts.
11.06 Install dowel pins using tapered and straight reamers.
11.07 Ream holes by using tapered and straight reamers.
11.08 Hand-sharpen cutting tools by using abrasive stones.
11.09 Hone and lap surfaces.
11.10 Remove damaged screws and other hardware.
11.11 Deburr workpieces.

12.0 PERFORM BASIC GAS AND ELECTRIC ARC WELDING AND CUTTING OPERATIONS--The student will be able to:

12.01 Identify the properties of the most commonly used metals and alloys, including hardness and malleability.
12.02 Identify the processes and effects of tempering, annealing, and case hardening.
12.03 Identify welding cylinders, regulators, hoses, pressure gauges, and torches.
12.04 Describe welding-equipment safety procedures.
12.05 Demonstrate proper flame settings.
12.06 Demonstrate basic gas-welding skills.
12.07 Demonstrate procedures for adjusting and operating the oxyacetylene cutting torch.
12.08 Demonstrate freehand and guide cutting of various metal thickness'.
12.09 Identify the uses of the following welding techniques: laser, ultrasonic, resistance, and percussion.

12.10 Perform basic electric arc welding procedures.

13.0 PERFORM RIGGING FUNCTIONS--The student will be able to:

13.01 Demonstrate the safety procedures for performing rigging and lifting operations.
13.02 Identify and inspect fiber and wire rope.
13.03 Tie knots and hitches.
13.04 Identify and use the components of rigging hardware.
13.05 Perform rigging and lifting operations.
13.06 Demonstrate the proper operation of a forklift.

14.0 INSTALL AND REMOVE MACHINERY--The student will be able to:

14.01 Identify the safety procedures for installing and removing machinery.
14.02 Identify the equipment required for machine installation and removal.
14.03 Prepare an area for machine installation per the manufacturer's specifications.
14.04 Rig, lift, and transport machinery to the installation site.
14.05 Install electrical hookups to machinery.
14.06 Install air hydraulic hookups to machinery.
14.07 Perform an assigned machine retrofit per the manufacturer's specifications.
14.08 Perform an assigned machine removal and transport per specification requirements.
14.09 Explain the importance of vibration detection.

15.0 DEMONSTRATE CONVEYOR-MAINTENANCE TECHNIQUES--The student will be able to:

15.01 Identify the types of conveyors.
15.02 Identify the safety requirements and precautions for conveyor-maintenance operations.
15.03 Adjust the tracking of a belt.
15.04 Check a belt for wear.
15.05 Identify the types of splices.
15.06 Identify splicing equipment and procedures.
15.07 Demonstrate conveyor-maintenance techniques, including making splices with splicing equipment.

16.0 IDENTIFY COMMON TROUBLES AND BASIC TROUBLESHOOTING TECHNIQUES--The student will be able to:

16.01 Analyze the possible causes of common troubles in industrial- machinery performance.
16.02 Identify basic troubleshooting techniques for bearings.
16.03 Identify basic troubleshooting techniques for pumps.
16.04 Identify basic troubleshooting techniques for drive systems.
16.05 Identify basic troubleshooting techniques for electrical circuits.
16.06 Identify basic troubleshooting techniques for hydraulics.
16.07 Identify basic troubleshooting techniques for pneumatics.

16.08 Identify basic troubleshooting techniques for PLCs.

17.0 DEMONSTRATE APPROPRIATE COMMUNICATION SKILLS--The student will be able to:

17.01 Write logical and understandable statements, or phrases, to accurately fill out forms and documents commonly used in business and industry.
17.02 Read and interpret graphs, charts, diagrams, and tables commonly used in business and industry.
17.03 Read and follow written and oral instructions.
17.04 Answer and ask questions coherently and concisely.
17.05 Read critically by recognizing assumptions and implications and by evaluating ideas.
17.06 Demonstrate appropriate communication skills, including telecommunications.

18.0 DEMONSTRATE EMPLOYABILITY SKILLS--The student will be able to:

18.01 Conduct a job search.
18.02 Secure information about a job.
18.03 Identify the documents that may be required for a job application.
18.04 Complete a resume.
18.05 Complete a job-application form correctly.
18.06 Demonstrate competence in job-interview techniques.
18.07 Identify or demonstrate appropriate responses to criticism from an employer, a supervisor, or other persons.
18.08 Identify acceptable work habits.
18.09 Describe how to make appropriate job changes.
18.10 Demonstrate acceptable employee health habits.
18.11 Describe the purpose of the Florida "Right-to-Know" law, as recorded in the Florida Statutes, Chapter 442.

19.0 DESCRIBE THE ROLE OF JOB OWNERSHIP AND ENTREPRENEURSHIP--The student will be able to:

19.01 Define "entrepreneurship."
19.02 Describe the importance of entrepreneurship to the American economy.
19.03 List the advantages and disadvantages of business ownership and demonstrate ownership as an employee.
19.04 Identify the risks involved in the ownership of a business.
19.05 Identify the necessary personal characteristics and business skills of a successful entrepreneur.
19.06 Identify the need for teamwork, team roles when working in a factory or doing shift work, and team development.
19.07 Describe how attitudes toward work responsibilities, absences, and tardiness affect job success.

20.0 APPLY CUSTOMER-SERVICE SKILLS--The student will be able to:

20.01 Explain the need for customer satisfaction.
20.02 Prepare service orders properly.

20.03 Communicate solutions to customers.
20.04 Demonstrate methods of handling an irate customer.
20.05 Follow manufacturers' service manuals.
20.06 Locate parts in a printed or computerized catalog or on microfiche.

OCCUPATIONAL COMPLETION POINT - DATA CODE - B
MACHINERY MAINTENANCE MECHANIC - OES 85110

21.0 PLAN AN ELEMENTARY PREDICTIVE-PREVENTIVE-MAINTENANCE (PPM) SCHEDULE--The student will be able to:

21.01 List the types of predictive-preventive maintenance.
21.02 Describe the purpose of preventive-maintenance schedules.
21.03 Create a preventive-maintenance schedule form using a machine manual or the manufacturer's recommendations.
21.04 Identify troubles caused by the lack of preventive maintenance.
21.05 Create a maintenance log and make entries for a machine or equipment.
21.06 Create a preventive-maintenance schedule from a maintenance-failures log.

22.0 PERFORM GAS- AND ARC-WELDING PROCEDURES--The student will be able to:

22.01 Demonstrate the safety procedures for performing gas and arc welding and for transporting equipment.
22.02 Identify the components of an oxyfuel rig.
22.03 Set up and shut down an oxyfuel rig.
22.04 Weld beads in a flat position.
22.05 Weld an outside corner joint using a filler rod.
22.06 Cut metal of various thickness’.
22.07 Weld beads in a flat position using E-6010 and E-7018 electrodes.
22.08 Weld beads in horizontal and in vertical positions using E-6010 and E-7018 electrodes.
22.09 Weld beads in an overhead position using E-6010 and E-7018 electrodes.
22.10 Weld beads using a mig welder.
22.11 Weld beads using a tig welder.
22.12 Solder and braze metals.
22.13 Cut stainless steel and aluminum with a plasma-arc rig.

23.0 PERFORM MACHINE-SHOP OPERATIONS--The student will be able to:

23.01 Demonstrate safety in performing machine-shop operations.
23.02 Identify the types of cutting tools.
23.03 Bore a hole to a specified size.
23.04 Chase an external V-thread.
23.05 Identify the different types of work-holding devices.
23.06 Prepare metal for finishing.
23.07 Set up, use, and adjust an arbor press.
23.08 Set up, use, and adjust a hydraulic press.

23.09 Set up, use, and adjust broaching tools.
23.10 Cut keyways with an end mill.

24.0 MAINTAIN PIPING AND TUBING SYSTEMS--The student will be able to:

24.01 Identify the components of a piping system.
24.02 Explain the maintenance considerations of metallic and nonmetallic piping systems.
24.03 Describe the safety requirements for working with piping and tubing systems.
24.04 Join copper tubing.
24.05 Join common fittings.
24.06 Join metallic pipe.
24.07 Join plastic pipe.
24.08 Explain valve operation and maintenance.
24.09 Explain the importance of strainers, filters, and traps in piping systems.
24.10 Bend back-to-back, stub-ups, and doglegs in electrical metallic tubing (EMT).

25.0 TROUBLESHOOT ELECTRICAL AND ELECTRONIC CIRCUITS--The student will be able to:

25.01 Describe the safety requirements and precautions for troubleshooting electrical circuits.
25.02 Disconnect and reconnect electric motors.
25.03 Identify the parts and function of electrical control equipment.
25.04 Define digital devices and PLC logic/ladder logic to troubleshoot.
25.05 Identify the function of input and output devices and the controller.
25.06 Explain how to troubleshoot a sequence of events.
25.07 Use and maintain electrical test equipment for troubleshooting.

26.0 INSTALL AND MAINTAIN DRIVE COMPONENTS--The student will be able to:

26.01 Demonstrate safety procedures for installing and maintaining drive components.
26.02 Identify the types of bearings, their cross-referencing, and their uses.
26.03 Remove, inspect, and/or replace bearings.
26.04 Remove and replace seals.
26.05 Perform shaft alignment.
26.06 Identify the types of belts.
26.07 Identify the types of chains.
26.08 Perform tension adjustments and alignment on belt and chain drives.
26.09 Troubleshoot belt and chain drives.
26.10 Identify the types of gears.
26.11 Remove, replace, and align gears, sprockets, and couplings.
26.12 Remove, replace, or repair V-joints and jack shafts.

26.13 Adjust gear backlash.
26.14 Troubleshoot gear drives.
26.15 Disassemble, inspect, reassemble, and adjust clutches.
26.16 Identify the types of variable-speed drives.
26.17 Troubleshoot variable-speed drives.
26.18 Identify the types of cams and link mechanisms.
26.19 Troubleshoot cam-and-link mechanism problems.

27.0 MAINTAIN RECIPROCATING, POSITIVE-DISPLACEMENT, AND ROTARY AIR COMPRESSORS--The student will be able to:

27.01 Relate force, weight, mass, and density to a pneumatic system.
27.02 Demonstrate safety procedures for maintaining reciprocating, positive-displacement, and rotary air compressors.
27.03 Demonstrate the operation of reciprocating compressors.
27.04 Demonstrate the operation of positive-displacement and rotary air compressors.
27.05 Demonstrate primary and secondary air treatment.
27.06 Demonstrate the operation of valves, cylinders, and motors.
27.07 Check oil level.
27.08 Change oil.
27.09 Drain water from tank.
27.10 Test for efficiency of compressor.
27.11 Inspect storage tank for quality.
27.12 Test pressure control switch.

28.0 MAINTAIN AND REPAIR HYDRAULIC SYSTEM COMPONENTS--The student will be able to:

28.01 Explain the safety procedures for installing hydraulic lines.
28.02 Explain Pascal's law.
28.03 Explain Bernoulli's principle.
28.04 Explain how heat and pressure relate to power and transmission.
28.05 Describe the physical and chemical properties of a fluid.
28.06 Install and maintain a contaminant-removal system.
28.07 Determine reservoir requirements.
28.08 Classify and select pumps for specific applications.
28.09 Compute hose requirements.
28.10 Install hydraulic lines.
28.11 Select and install control valves.

29.0 TROUBLESHOOT HYDRAULIC SYSTEMS--The student will be able to:

29.01 Explain the safety procedures for troubleshooting hydraulic systems.
29.02 Read a hydraulic schematic.
29.03 Install hydraulic components.
29.04 Connect electrically controlled valves.
29.05 Explain hydraulic-system troubleshooting techniques.
29.06 Repair and replace valves.
29.07 Repair and replace cylinders.
29.08 Repair and replace pumps and motors.

30.0 MAINTAIN AND TROUBLESHOOT PNEUMATIC SYSTEMS--The student will be able to:

30.01 Explain the safety procedures for troubleshooting pneumatic systems.
30.02 Diagram an air-supply system.
30.03 Install system components.
30.04 Demonstrate system-maintenance techniques.
30.05 Explain proper troubleshooting procedures.
30.06 Troubleshoot air compressors.
30.07 Troubleshoot, repair, and install control valves.
30.08 Troubleshoot air motors.

31.0 MAINTAIN AND TROUBLESHOOT FLUID-DRIVE SYSTEMS--The student will be able to:

31.01 Explain the safety procedures for maintaining and troubleshooting fluid-drive systems.
31.02 Install adjustable speed drives.
31.03 Troubleshoot adjustable speed drives.
31.04 Explain the operation of fluid couplings.
31.05 Install fluid couplings.
31.06 Install torque converters.
31.07 Perform preventive maintenance.
31.08 Apply a "dynamic" magnetic/mechanical braking device to a motor.

32.0 MAINTAIN AND TROUBLESHOOT ROBOTIC SYSTEMS--The student will be Able to:

32.01 Identify uses of robotics in industry.
32.02 Identify safety procedures related to robotic systems.
32.03 Identify mechanical, hydraulic, pneumatic and electrical/electronic components of robotic systems.
32.04 Perform routine maintenance and calibration of robotic systems.
32.05 Remove, replace and adjust robotic system components.

33.0 PERFORM PUMP MAINTENANCE AND REPAIR--The student will be able to:

33.01 Demonstrate the safety procedures for performing pump maintenance.
33.02 Determine pump capacity and system requirements.
33.03 Perform pump maintenance.
33.04 Identify packing and seal requirements.
33.05 Explain the operating principles of centrifugal, propeller and turbine rotary, reciprocating, diaphragm, positive-placement, and vacuum pumps.
33.06 Disassemble and reassemble a pump.

34.0 EXPLAIN THE OPERATION OF INDUSTRIAL-POLLUTION CONTROL SYSTEMS--The student will be able to:

34.01 Explain the operation of air-pollution control systems.
34.02 Explain the operation of water-pollution control systems.
34.03 Explain the operation of solid-waste pollution control systems.
34.04 Explain the operation of noise-pollution control systems.

35.0 TROUBLESHOOT AIR-CONDITIONING AND REFRIGERATION SYSTEMS--The student will be able to:

35.01 Explain the principles of refrigeration.
35.02 Identify the major components.
35.03 Describe the functions of electrical systems.
35.04 Troubleshoot air-conditioning and refrigeration systems.
35.05 Explain the requirement for recovery of hazardous materials and related safety procedures.

36.0 IDENTIFY BOILERS--The student will be able to:

36.01 Identify the various types and components of heat exchangers.
36.02 Identify the various types and components of boilers.
36.03 Identify the various types and components of fractioning columns.
36.04 Identify the uses of steam.

37.0 MAINTAIN INTERNAL COMBUSTION ENGINES--The student will be able to:

37.01 Explain the basic principles of operation of the two-stroke-cycle combustion engine.
37.02 Identify the types of engines.
37.03 Locate engine serial and model numbers.
37.04 Identify engine assemblies and systems.
37.05 Troubleshoot and evaluate engine performance.
37.06 Perform routine maintenance on engine operating systems including air intake and exhaust, fuel, lubrication, ignition, starting and governing.
37.07 Perform engine tune-up and adjustment procedures.
37.08 Remove and replace engine assemblies.

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38.0 PERFORM METAL FABRICATION--The student will be able to:

38.01 Field sketch equipment supports for applications in the millwright industry.
38.02 Read and interpret requirements in an OSHA 1910.211-219 and ANSI B15.1.
38.03 Create, design, draw, fabricate, and paint an OSHA-approved guard.
38.04 Use a Cut-A-Matic to make precision cuts.

39.0 PERFORM PRECISION LAYOUT--The student will be able to:

39.01 Locate an existing benchmark and transfer it to various positions around a work area or site.
39.02 Use the triangle procedure to check established benchmarks with an optical level and a transit.
39.03 Identify and establish centerlines of equipment related to building columns.

40.0 INSTALL, REMOVE, AND ALIGN MACHINERY--The student will be able to:

40.01 Perform and interpret all rigging hand signals.
40.02 Interpret and apply load charts for slings, chokers, and cables.
40.03 Determine the weight of a load.
40.04 Determine the method of lifting.
40.05 Identify crane capacity, including the boom angle and load-swing radius.
40.06 Identify and take the necessary precautions to accommodate weather conditions, load capacity, equipment, and safety factors.
40.07 Balance different types of loads.

41.0 INSTALL, REMOVE, AND ALIGN MACHINERY (ADVANCED)--The student will be able to:

41.01 Identify the equipment required for machine installation and removal in millwright applications.
41.02 Operate levers, inclined planes, screws, wedges, wheel and axle assemblies, pulleys, and jacking screws.
41.03 Perform site-clearance operations and demolition and salvage procedures.
41.04 Explain the principles of machine alignment.
41.05 Explain the principles of shaft alignment.
41.06 Explain the relationship of structural problems to misalignment.
41.07 Explain the use of thermal growth by calculation and field-growth techniques such as Essinger bars.
41.08 Align machinery using wire line, transit, dial indicators, a computer, and laser-alignment devices.

41.09 Perform laser horizontal and vertical alignment.
41.10 Perform the train alignment of three or more machines and graph the results.
41.11 Prepare an area for machine installation according to the manufacturer’s specifications for selected applications.
41.12 Position and secure machinery on a foundation.
41.13 Level machinery and install balance-vibration dampeners.
41.14 Identify pipe-stress standards for millwright applications.
41.15 Perform finish alignment and check for pipe stresses in millwright applications.

Florida Department of Education
STUDENT PERFORMANCE STANDARDS

Course Number: 8743210
Course Title: Maintenance Skills 1
Course Credit: 1

COURSE DESCRIPTION:

This course develops the competencies of applying safety rules and procedures, relating the basic elements of physics and of electricity and electronics to Industrial Machinery Maintenance and Repair, performing mathematical calculations, reading plans and drawings, performing measuring and layout operations, and performing computer applications in the industrial-machinery maintenance-technology industry. There is no occupational completion point associated with the completion of this course.

01.0 APPLY SAFETY RULES AND PROCEDURES--The student will be able to:

01.01 Practice shop safety rules and procedures.
01.02 Practice personal safety rules and procedures.
01.03 Practice fire safety rules and procedures.
01.04 Practice electrical safety rules and procedures.
01.05 Practice tool safety rules and procedures.
01.06 Practice ladder and scaffolding safety rules and procedures.
01.07 Maintain a clean work and shop area.
01.08 Perform tag lockout procedures.
01.09 Identify Occupational Safety and Health Administration (OSHA) requirements and procedures.
01.10 Use Materials Safety Data Sheets (MSDS).

02.0 EXPLAIN THE BASIC ELEMENTS OF PHYSICS AS RELATED TO INDUSTRIAL MACHINERY MAINTENANCE AND REPAIR--The student will be able to:

02.01 Explain the standards of measurement and the impact of action and working forces, including tension, compression, torque, and shear.
02.02 Identify the principles and laws of motion and explain how they affect acceleration and deceleration.
02.03 Explain the relationship of work, power, and energy to the types of collisions and the conservation of momentum.
02.04 Explain the operation of simple machines, including the lever, inclined plane, screw, wedge, wheel and axle, pulley, and jacking screws.
02.05 Identify the ways of producing power for mechanical efficiency, in terms of gear ratios, work forces, and types of work done by a crane hook, forklift truck, and screw or bolt.
02.06 Use linear, liquid, and weight units of measurement to measure areas, areas within areas, and volume.
02.07 Describe the mechanical and chemical properties of materials commonly used in industry.

02.08 Explain the laws and conditions governing static and kinetic friction, the problems caused by friction, and the effects of the angle of repose.
02.09 Explain molecular action as a result of temperature extremes, chemical reaction, and moisture content.
02.10 Draw conclusions or make inferences from data.
02.11 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.
02.12 Explain pressure measurement in terms of pounds per square inch (PSI), inches of mercury, and Kilopascal (KPa).

03.0 EXPLAIN BASIC ELECTRICITY AND ELECTRONICS--The student will be able to:

03.01 Define electrical/electronics terms.
03.02 Explain the theory and application of magnetism.
03.03 Explain Ohm's law.
03.04 Describe direct current (DC) and alternating current (AC) circuits.
03.05 Identify the advantages and disadvantages of alternating current (AC) and direct current (DC) motors for various applications.
03.06 Describe the use of programmable logic controllers (PLCs) in industry.

04.0 PERFORM MATHEMATICAL CALCULATIONS--The student will be able to:

04.01 Make job-related decimal and fraction calculations.
04.02 Solve job-related problems by adding, subtracting, multiplying, and dividing numbers.
04.03 Solve job-related problems using a hand-held calculator.
04.04 Solve job-related problems using basic formulas.
04.05 Solve job-related problems using basic geometry.
04.06 Measure a workpiece and compare the measurements with blueprint specifications.
04.07 Solve job-related problems using mathematical handbooks, charts, and tables.
04.08 Convert measurements from English to metric and from metric to English units.
04.09 Solve job-related problems using proportions.
04.10 Solve job-related problems using statistics.

05.0 READ PLANS AND DRAWINGS--The student will be able to:

05.01 Identify dimensions.
05.02 Identify lists of materials and specifications.
05.03 Identify section and detail views.
05.04 Sketch and dimension a part.
05.05 Disassemble and assemble parts using an exploded-view drawing.
05.06 Interpret blueprint abbreviations.

05.07 Identify dimensioning of radii, round holes, fillets, and chamfers.
05.08 Identify screw threads and bolt types.
05.09 Apply dimensional tolerances.
05.10 Identify the metal-fabrication symbols used in blueprints.

06.0 PERFORM MEASURING AND LAYOUT OPERATIONS--The student will be able to:

06.01 Perform basic geometric-construction operations.
06.02 Safely use marking gauges, center punches, scribes, surface gauges, squares, dividers, dial indicators, protractors, surface plates, depth gauges, and circumference rules.
06.03 Develop patterns using parallel lines, radial lines, and triangulation.
06.04 Make metal-fabrication sketches.
06.05 Read and measure with steel rules.
06.06 Read and measure with micrometers.
06.07 Read and measure with vernier tools.
06.08 Read and measure with dial calipers.
06.09 Read and measure with dial indicators.

07.0 PERFORM COMPUTER APPLICATIONS--The student will be able to:

07.01 Explain the use of computers in plant operations.
07.02 Describe information processing.
07.03 Identify types of computers.
07.04 Identify keyboard functions.
07.05 Identify data input and output devices.
07.06 Describe computer programs.
07.07 Perform power-up and power-down procedures.
07.08 Back up data and save and print documents from a personal computer (PC).
07.09 Identify the effects of and the methods for checking for a virus in a PC system.

Florida Department of Education
STUDENT PERFORMANCE STANDARDS

Course Number: 8743220
Course Title: Maintenance Skills 2
Course Credit: 1

COURSE DESCRIPTION:

This course develops the competencies of using and maintaining hand and portable power tools, handling and applying lubricants, applying basic benchwork skills, and performing basic gas-welding and cutting operations in the industrial-machinery maintenance-technology industry. There is no occupational completion point associated with the completion of this course.

08.0 USE AND MAINTAIN HAND TOOLS--The student will be able to:

- 08.01 Demonstrate the safe use of hand tools such as screwdrivers, hammers, wrenches, pliers, hacksaws, punches, chisels, drills, files, tin snips, taps, and dies.
- 08.02 Use measuring devices.
- 08.03 Use wrenches and screwdrivers.
- 08.04 Use pipefitting tools.
- 08.05 Use sheet-metal tools.
- 08.06 Safely use ropes, slings, pulleys, and block and tackle.
- 08.07 Select the proper tool for each job application.
- 08.08 Select correct tools for metric and standard fasteners.
- 08.09 Identify state-of-the-art innovations and explore their uses.
- 08.10 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.
- 08.11 Describe the techniques and liability issues regarding retrofitting fasteners for ease of removal.

09.0 USE AND MAINTAIN PORTABLE POWER TOOLS--The student will be able to:

- 09.01 Demonstrate the safe use of portable power tools such as 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.
- 09.02 Use and maintain light- and heavy-duty drills.
- 09.03 Use and maintain electric hammers.
- 09.04 Use and maintain pneumatic drills and hammers.
- 09.05 Use and maintain power screwdrivers and nut runners.
- 09.06 Use and maintain linear-motion saws.
- 09.07 Use and maintain circular saws.
- 09.08 Use and maintain belt, pad, and disc sanders.

09.09 Use and maintain grinders and shears.

10.0 HANDLE AND APPLY LUBRICANTS--The student will be able to:

10.01 Explain the functions of lubrication.
10.02 Explain the properties of oil lubricants and the factors determining the selection of lubricants.
10.03 Identify the types, advantages, and functions of lubricant additives.
10.04 Explain the types of circulating oils and their purposes.
10.05 Identify grease application.
10.06 Identify lubricating systems and methods.
10.07 Explain lubricant storage and handling methods.
10.08 Explain the types of oil filters and their uses.
10.09 Lubricate a piece of industrial equipment.
10.10 Define the role of preventive maintenance in total equipment maintenance.
10.11 Describe the major tasks of preventive maintenance: cleaning, inspection, lubrication, minor repair, and information feedback.
10.12 Review a typical maintenance program.

11.0 PERFORM BENCHWORK SKILLS--The student will be able to:

11.01 Identify safety and shop rules.
11.02 Cut materials by using hand hacksaws.
11.03 Cut threads by using hand taps.
11.04 Cut threads by using dies.
11.05 Repair threads by chasing and thread inserts.
11.06 Install dowel pins using tapered and straight reamers.
11.07 Ream holes by using tapered and straight reamers.
11.08 Hand-sharpen cutting tools by using abrasive stones.
11.09 Hone and lap surfaces.
11.10 Remove damaged screws and other hardware.
11.11 Deburr workpieces.

12.0 PERFORM BASIC GAS AND ELECTRIC ARC WELDING AND CUTTING OPERATIONS--The student will be able to:

12.01 Identify the properties of the most commonly used metals and alloys, including hardness and malleability.
12.02 Identify the processes and effects of tempering, annealing, and case hardening.
12.03 Identify welding cylinders, regulators, hoses, pressure gauges, and torches.
12.04 Describe welding-equipment safety procedures.
12.05 Demonstrate proper flame settings.
12.06 Demonstrate basic gas-welding skills.
12.07 Demonstrate procedures for adjusting and operating the oxyacetylene cutting torch.
12.08 Demonstrate freehand and guide cutting of various metal thickness'.

12.09 Identify the uses of the following welding techniques:laser, ultrasonic, resistance, and percussion.

Florida Department of Education
STUDENT PERFORMANCE STANDARDS

Course Number: 8743230
Course Title: Maintenance Skills 3
Course Credit: 1

COURSE DESCRIPTION:

This course develops competencies in rigging and lifting, installing and removing machinery, conveyor maintenance, troubleshooting machinery performance, communicating, servicing customers, obtaining employment, and entrepreneurship skills in the industrial-machinery maintenance-technology industry. Completion of this course prepares the student for

OCCUPATIONAL COMPLETION POINT - DATA CODE A, INDUSTRIAL MACHINERY MAINTENANCE Assistant--Industry Title.

13.0 PERFORM RIGGING FUNCTIONS--The student will be able to:

13.01 Demonstrate the safety procedures for performing rigging and lifting operations.
13.02 Identify and inspect fiber and wire rope.
13.03 Tie knots and hitches.
13.04 Identify and use the components of rigging hardware.
13.05 Perform rigging and lifting operations.
13.06 Demonstrate the proper operation of a forklift.

14.0 INSTALL AND REMOVE MACHINERY--The student will be able to:

14.01 Identify the safety procedures for installing and removing machinery.
14.02 Identify the equipment required for machine installation and removal.
14.03 Prepare an area for machine installation per the manufacturer's specifications.
14.04 Rig, lift, and transport machinery to the installation site.
14.05 Install electrical hookups to machinery.
14.06 Install air hydraulic hookups to machinery.
14.07 Perform an assigned machine retrofit per manufacturer's specifications.
14.08 Perform an assigned machine removal and transport per specification requirements.
14.09 Explain the importance of vibration detection.
14.10 Identify the need for pipe supports to prevent pipe stress.

15.0 DEMONSTRATE CONVEYOR-MAINTENANCE TECHNIQUES--The student will be able to:

15.01 Identify the types of conveyors.
15.02 Identify the safety requirements and precautions for conveyor-maintenance operations.
15.03 Adjust the tracking of a belt.

15.04 Check a belt for wear.
15.05 Identify the types of splices.
15.06 Identify splicing equipment and procedures.
15.07 Demonstrate conveyor-maintenance techniques, including making splices with splicing equipment.

16.0 IDENTIFY COMMON TROUBLES AND BASIC TROUBLESHOOTING TECHNIQUES--The student will be able to:

16.01 Analyze the possible causes of common troubles in industrial-machinery performance.
16.02 Identify basic troubleshooting techniques for bearings.
16.03 Identify basic troubleshooting techniques for pumps.
16.04 Identify basic troubleshooting techniques for drive systems.
16.05 Identify basic troubleshooting techniques for electrical circuits.
16.06 Identify basic troubleshooting techniques for hydraulics.
16.07 Identify basic troubleshooting techniques for pneumatics.
16.08 Identify basic troubleshooting techniques for PLCs.

17.0 DEMONSTRATE APPROPRIATE COMMUNICATION SKILLS--The student will be able to:

17.01 Write logical and understandable statements, or phrases, to accurately fill out forms and documents commonly used in business and industry.
17.02 Read and interpret graphs, charts, diagrams, and tables commonly used in business and industry.
17.03 Read and follow written and oral instructions.
17.04 Answer and ask questions coherently and concisely.
17.05 Read critically by recognizing assumptions and implications and by evaluating ideas.
17.06 Demonstrate appropriate communication skills, including telecommunications.

18.0 DEMONSTRATE EMPLOYABILITY SKILLS--The student will be able to:

18.01 Conduct a job search.
18.02 Secure information about a job.
18.03 Identify the documents that may be required for a job application.
18.04 Complete a resume.
18.05 Complete a job-application form correctly.
18.06 Demonstrate competence in job-interview techniques.
18.07 Identify or demonstrate appropriate responses to criticism from an employer, a supervisor, or other persons.
18.08 Identify acceptable work habits.
18.09 Describe how to make appropriate job changes.
18.10 Demonstrate acceptable employee health habits.
18.11 Describe the purpose of the Florida "Right-to-Know" law, as recorded in the Florida Statutes, Chapter 442.

19.0 DESCRIBE THE ROLE OF JOB OWNERSHIP AND ENTREPRENEURSHIP--The student will be able to:

19.01 Define "entrepreneurship."
19.02 Describe the importance of entrepreneurship to the American economy.
19.03 List the advantages and disadvantages of business ownership and demonstrate ownership as an employee.
19.04 Identify the risks involved in the ownership of a business.
19.05 Identify the necessary personal characteristics and business skills of a successful entrepreneur.
19.06 Identify the need for teamwork, team roles when working in a factory or doing shift work, and team development.
19.07 Describe how attitudes toward work responsibilities, absences, and tardiness affect job success.

20.0 APPLY CUSTOMER-SERVICE SKILLS--The student will be able to:

20.01 Explain the need for customer satisfaction.
20.02 Prepare service orders properly.
20.03 Communicate solutions to customers.
20.04 Demonstrate methods of handling an irate customer.
20.05 Follow manufacturers' service manuals.
20.06 Locate parts in a printed or computerized catalog or on microfiche.

Florida Department of Education
STUDENT PERFORMANCE STANDARDS

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

COURSE DESCRIPTION:

This course develops the competencies of planning an elementary predictive- preventive-maintenance schedule, performing gas and arc welding, performing machine-shop operations, maintaining piping and tubing systems, troubleshooting electrical circuits, and maintaining and installing drive components in the industrial-machinery maintenance-technology industry. There is no occupational completion point associated with the completion of this course.

21.0 PLAN AN ELEMENTARY PREDICTIVE-PREVENTIVE-MAINTENANCE (PPM) SCHEDULE--The student will be able to:

21.01 List the types of predictive-preventive maintenance.
21.02 Describe the purpose of preventive-maintenance schedules.
21.03 Create a preventive-maintenance schedule form using a machine manual or the manufacturer's recommendations.
21.04 Identify troubles caused by the lack of preventive maintenance.
21.05 Create a maintenance log and make entries for a machine or equipment.
21.06 Create a preventive-maintenance schedule from a maintenance-failures log.

22.0 PERFORM GAS- AND ARC-WELDING PROCEDURES--The student will be able to:

22.01 Demonstrate the safety procedures for performing gas and arc welding and for transporting equipment.
22.02 Identify the components of an oxyfuel rig.
22.03 Set up and shut down an oxyfuel rig.
22.04 Weld beads in a flat position.
22.05 Weld an outside corner joint using a filler rod.
22.06 Cut metal of various thickness’.
22.07 Weld beads in a flat position using E-6010 and E-7018 electrodes.
22.08 Weld beads in horizontal and in vertical positions using E-6010 and E-7018 electrodes.
22.09 Weld beads in an overhead position using E-6010 and E-7018 electrodes.
22.10 Weld beads using a mig welder.
22.11 Weld beads using a tig welder.
22.12 Solder and braze metals.
22.13 Cut stainless steel and aluminum with a plasma-arc rig.

23.0 PERFORM MACHINE-SHOP OPERATIONS--The student will be able to:

23.01 Demonstrate safety in performing machine-shop operations.
23.02 Identify the types of cutting tools.
23.03 Bore a hole to a specified size.
23.04 Chase an external V-thread.
23.05 Identify the different types of work-holding devices.
23.06 Prepare metal for finishing.
23.07 Set up, use, and adjust an arbor press.
23.08 Set up, use, and adjust a hydraulic press.
23.09 Set up, use, and adjust broaching tools.
23.10 Cut keyways with an end mill.

24.0 MAINTAIN PIPING AND TUBING SYSTEMS--The student will be able to:

24.01 Identify the components of a piping system.
24.02 Explain the maintenance considerations of metallic and nonmetallic piping systems.
24.03 Describe the safety requirements for working with piping and tubing systems.
24.04 Join copper tubing.
24.05 Join common fittings.
24.06 Join metallic pipe.
24.07 Join plastic pipe.
24.08 Explain valve operation and maintenance.
24.09 Explain the importance of strainers, filters, and traps in piping systems.
24.10 Bend back-to-back, stub-ups, and doglegs in electrical metallic tubing (EMT).

25.0 TROUBLESHOOT ELECTRICAL CIRCUITS--The student will be able to:

25.01 Describe the safety requirements and precautions for troubleshooting electrical circuits.
25.02 Disconnect and reconnect electric motors.
25.03 Identify the parts and function of electrical control equipment.
25.04 Define digital devices and PLC logic/ladder logic to troubleshoot.
25.05 Identify the function of input and output devices and the controller.
25.06 Explain how to troubleshoot a sequence of events.
25.07 Use and maintain electrical test equipment for troubleshooting.

26.0 INSTALL AND MAINTAIN DRIVE COMPONENTS--The student will be able to:

26.01 Demonstrate safety procedures for installing and maintaining drive components.
26.02 Identify types of bearings, their cross-referencing, and their uses.
26.03 Remove, inspect, and/or replace bearings.
26.04 Remove and replace seals.
26.05 Perform shaft alignment.

26.06 Identify the types of belts.
26.07 Identify the types of chains.
26.08 Perform tension adjustments and alignment on belt and chain drives.
26.09 Troubleshoot belt and chain drives.
26.10 Identify the types of gears.
26.11 Remove, replace, and align gears, sprockets, and couplings.
26.12 Remove, replace, or repair V-joints and jack shafts.
26.13 Adjust gear backlash.
26.14 Troubleshoot gear drives.
26.15 Disassemble, inspect, reassemble, and adjust clutches.
26.16 Identify the types of variable-speed drives.
26.17 Troubleshoot variable-speed drives.
26.18 Identify the types of cams and link mechanisms.
26.19 Troubleshoot cam-and-link mechanism problems.

Florida Department of Education
STUDENT PERFORMANCE STANDARDS

Course Number: 8743250
Course Title: Machinery Maintenance 5
Course Credit: 1

COURSE DESCRIPTION:

This course develops the competencies of maintaining specific types of air compressors and maintaining, repairing, and troubleshooting fluid-drive systems in the industrial-machinery maintenance-technology industry. There is no occupational completion point associated with the completion of this course.

27.0 MAINTAIN RECIPROCATING, POSITIVE-DISPLACEMENT, AND ROTARY AIR COMPRESSORS--The student will be able to:

27.01 Relate force, weight, mass, and density to a pneumatic system.
27.02 Demonstrate safety procedures for maintaining reciprocating, positive-displacement, and rotary air compressors.
27.03 Demonstrate the operation of reciprocating compressors.
27.04 Demonstrate the operation of positive-displacement and rotary air compressors.
27.05 Demonstrate primary and secondary air treatment.
27.06 Demonstrate the operation of valves, cylinders, and motors.
27.07 Check oil level.
27.08 Change oil.
27.09 Drain water from tank.
27.10 Test for efficiency of compressor.
27.11 Inspect storage tank for quality.
27.12 Test pressure control switch.

28.0 MAINTAIN AND REPAIR HYDRAULIC-SYSTEM COMPONENTS--The student will be able to:

28.01 Explain the safety procedures for installing hydraulic lines.
28.02 Explain Pascal's law.
28.03 Explain Bernoulli's principle.
28.04 Explain how heat and pressure relate to power and transmission.
28.05 Describe the physical and chemical properties of a fluid.
28.06 Install and maintain a contaminant-removal system.
28.07 Determine reservoir requirements.
28.08 Classify and select pumps for specific applications.
28.09 Compute hose requirements.
28.10 Install hydraulic lines.
28.11 Select and install control valves.

29.0 TROUBLESHOOT HYDRAULIC SYSTEMS--The student will be able to:

29.01 Explain the safety procedures for troubleshooting hydraulic systems.
29.02 Read a hydraulic schematic.
29.03 Install hydraulic components.
29.04 Connect electrically controlled valves.
29.05 Explain hydraulic-system troubleshooting techniques.
29.06 Repair and replace valves.
29.07 Repair and replace cylinders.
29.08 Repair and replace pumps and motors.

30.0 MAINTAIN AND TROUBLESHOOT PNEUMATIC SYSTEMS--The student will be able to:

30.01 Explain the safety procedures for troubleshooting pneumatic systems.
30.02 Diagram an air-supply system.
30.03 Install system components.
30.04 Demonstrate system-maintenance techniques.
30.05 Explain proper troubleshooting procedures.
30.06 Troubleshoot air compressors.
30.07 Troubleshoot, repair, and install control valves.
30.08 Troubleshoot air motors.

31.0 MAINTAIN AND TROUBLESHOOT FLUID-DRIVE SYSTEMS--The student will be able to:

31.01 Explain the safety procedures for maintaining and troubleshooting fluid-drive systems.
31.02 Install adjustable speed drives.
31.03 Troubleshoot adjustable speed drives.
31.04 Explain the operation of fluid couplings.
31.05 Install fluid couplings.
31.06 Install torque converters.
31.07 Perform preventive maintenance.
31.08 Apply a "dynamic" magnetic/mechanical braking device to a motor.
31.09 Mount the equipment.

32.0 MAINTAIN AND TROUBLESHOOT ROBOTIC SYSTEMS--The student will be able to:

32.01 Identify uses of robotics in industry.
32.02 Identify safety procedures related to robotic systems.
32.03 Identify mechanical, hydraulic, pneumatic and electrical/electronic components of robotic systems.
32.04 Perform routine maintenance and calibration of robotic systems.
32.05 Remove, replace, and adjust robotic system components.

Florida Department of Education
STUDENT PERFORMANCE STANDARDS

Course Number: 8743260
Course Title: Machinery Maintenance 6
Course Credit: 1

COURSE DESCRIPTION:

This course develops the competencies for pump maintenance and repair and for pollution control along with a knowledge of industrial-pollution control systems in industrial-machinery maintenance-technology operations. It may include the development of optional competencies related to air-conditioning and refrigeration, boilers, and small engines. Completion of this course prepares the student for

OCCUPATIONAL COMPLETION POINT - DATA CODE B, MACHINERY MAINTENANCE MECHANIC--OES 85119632.

33.0 PERFORM PUMP MAINTENANCE AND REPAIR--The student will be able to:

33.01 Demonstrate the safety procedures for performing pump maintenance.
33.02 Determine pump capacity and system requirements.
33.03 Perform pump maintenance.
33.04 Identify packing and seal requirements.
33.05 Explain the operating principles of centrifugal, propeller and turbine rotary, reciprocating, diaphragm, positive placement, and vacuum pumps.
33.06 Disassemble and reassemble a pump.

34.0 EXPLAIN THE OPERATION OF INDUSTRIAL-POLLUTION CONTROL SYSTEMS--The student will be able to:

34.01 Explain the operation of air-pollution control systems.
34.02 Explain the operation of water-pollution control systems.
34.03 Explain the operation of solid-waste pollution control systems.
34.04 Explain the operation of noise-pollution control systems.

35.0 TROUBLESHOOT AIR-CONDITIONING AND REFRIGERATION SYSTEMS--The student will be able to:

35.01 Explain the principles of refrigeration.
35.02 Identify the major components.
35.03 Describe the functions of electrical systems.
35.04 Troubleshoot air-conditioning and refrigeration systems.
35.05 Explain the requirement for recovery of hazardous materials and related safety procedures.

36.0 IDENTIFY BOILERS--The student will be able to:

36.01 Identify the various types and components of heat exchangers.
36.02 Identify the various types and components of boilers.
36.03 Identify the various types and components of fractioning columns.
36.04 Identify the uses of steam.

37.0 MAINTAIN INTERNAL COMBUSTION ENGINES--The student will be able to:

37.01 Explain the basic principles of operation of the two-stroke-cycle combustion engine.
37.02 Identify the types of engines.
37.03 Locate engine serial and model numbers.
37.04 Identify engine assemblies and systems.
37.05 Troubleshoot and evaluate engine performance..
37.06 Perform routine maintenance on engine operating systems including air intake and exhaust, fuel, lubrication, starting and governing.
37.07 Perform engine tune-up and adjustment procedures
37.08 Remove and replace engine assemblies.

Florida Department of Education
STUDENT PERFORMANCE STANDARDS

Course Number: 8743270
Course Title: Millwright 7
Course Credit: 1

COURSE DESCRIPTION:

This course develops competencies in metal fabrication and precision layout for operations in the millwright industry. There is no occupational completion point associated with the completion of this course.

38.0 PERFORM METAL FABRICATION--The student will be able to:

38.01 Field sketch equipment supports for applications in the millwright industry.
38.02 Read and interpret requirements in OSHA 1910.211-219 and ANSI B15.1.
38.03 Create, design, draw, fabricate, and paint an OSHA-approved guard.
38.04 Use a Cut-A-Matic to make precision cuts.

39.0 PERFORM PRECISION LAYOUT--The student will be able to:

39.01 Locate an existing benchmark and transfer it to various positions around a work area or site.
39.02 Use the triangle procedure to check established benchmarks with an optical level and a transit.
39.03 Identify and establish center lines of equipment related to building columns.

Florida Department of Education
STUDENT PERFORMANCE STANDARDS

Course Number: 8743280
Course Title: Millwright 8
Course Credit: 1

COURSE DESCRIPTION:

This course develops the competencies in advanced rigging operations in the millwright industry. There is no occupational completion point associated with the completion of this course.

40.0 PERFORM ADVANCED RIGGING--The student will be able to:

40.01 Perform and interpret all rigging hand signals.
40.02 Interpret and apply load charts for slings, chokers, and cables.
40.03 Determine the weight of a load.
40.04 Determine the method of lifting.
40.05 Identify crane capacity, including the boom angle and load-swing radius.
40.06 Identify and take the necessary precautions to accommodate weather conditions, load capacity, equipment, and safety factors.
40.07 Balance different types of loads.

Florida Department of Education
STUDENT PERFORMANCE STANDARDS

Course Number: 8743290
Course Title: Millwright 9
Course Credit: 1

COURSE DESCRIPTION:

This course develops the competencies in installing, removing, and aligning machinery for operations in the millwright industry. Completion of this course prepares the student for

OCCUPATIONAL COMPLETION POINT - DATA CODE - C, INDUSTRIAL MACHINERY MAINTENANCE AND REPAIR SPECIALIST--Industry Title.

41.0 INSTALL, REMOVE, AND ALIGN MACHINERY--The student will be able to:

41.01 Identify the equipment required for machine installation and removal in millwright applications.
41.02 Operate levers, inclined planes, screws, wedges, wheel and axle assemblies, pulleys, and jacking screws.
41.03 Perform site-clearance operations and demolition and salvage procedures.
41.04 Explain the principles of machine alignment.
41.05 Explain the principles of shaft alignment.
41.06 Explain the relationship of structural problems to misalignment.
41.07 Explain the use of thermal growth by calculation and field-growth techniques such as Essinger bars.
41.08 Align machinery using wire line, transit, dial indicators, a computer, and laser-alignment devices.
41.09 Perform laser horizontal and vertical alignment.
41.10 Perform the train alignment of three or more machine and graph the results.
41.11 Prepare an area for machine installation according to the manufacturer’s specifications for selected applications.
41.12 Position and secure machinery on a foundation.
41.13 Level machinery and install balance-vibration dampers.
41.14 Identify pipe-stress standards for millwright applications.
41.15 Perform finish alignment and check for pipe stresses in millwright applications.