

Degree/Diploma: Diversified Manufacturing Technology																																					
Course: Introduction to Maintenance Technology																																					
Session 1	Lesson Plan for: Welding Fundamentals																																				
Session Summary:	This session will introduce basic types of welding, their applications and operation during the welding process.																																				
Objectives:	Define welding and how it is used in industry Describe the various welding processes used to join materials. Explain the welding process of oxy-acetylene, gas metal arc, shielded metal arc and spot welding and provide situations when they are used.																																				
Learning	<table border="1"> <thead> <tr> <th><u>Description</u></th> <th><u>Delivery Method</u></th> <th><u>Activity</u></th> <th><u>Materials</u></th> </tr> </thead> <tbody> <tr> <td>ToolingU Reading Assignment</td> <td>Online learning</td> <td>Welding - What is Arc Welding? 110 Lessons 1-18. Arc Welding Processes 120 Lessons 1-16. Overview of Weld Types 130 Lessons 1-17. GMAW Applications 220 Lessons 1-20. Arc Welding Symbols and Codes 250 Lessons 1-15. Spot welding will be discussed in class.</td> <td>ToolingU</td> </tr> <tr> <td>Discuss different welding processes and review each type of operation.</td> <td>Lecture</td> <td>Review the welding processes, identify each type, match their application and equipment and discuss where in industry each might be used.</td> <td>www.youtube.com/watch?v=uFX_RvWrzaQ</td> </tr> <tr> <td>Present the purpose of welding, types, materials and equipment used.</td> <td>Web-Enhanced Lecture</td> <td>Read/Review What is Arc Welding? 110, Arc Welding Processes 120 Lesson 6.</td> <td>ToolingU</td> </tr> <tr> <td>Identify types of joints and welds performed, positions and proper welding procedures.</td> <td>Web-Enhanced Lecture</td> <td>Read/Review Overview of Weld Types 130</td> <td>ToolingU</td> </tr> <tr> <td>Define GMAW process and how it compares to other weld operations.</td> <td>Web-Enhanced Lecture</td> <td>Read/Review GMAW Applications 220</td> <td>ToolingU</td> </tr> <tr> <td>Introduce different types of welding symbols, codes used for delivered instruction and identity of a weld.</td> <td>Web-Enhanced Lecture</td> <td>Read/Review Arc Welding Symbols and Codes 250</td> <td>ToolingU</td> </tr> <tr> <td>Identify equipment, setup and operation performed for a GMAW.</td> <td>Hands on lab</td> <td>Run through a setup for GMAW, identify equipment needed and the process performed.</td> <td>Gas cylinder, pressure gauge, flowmeter, welder, filler meta, wire feeder, weld gun, cables, work piece and clamp for operation.</td> </tr> <tr> <td>Present a spot weld.</td> <td>Hands on lab</td> <td>Provide an example or review the process of spot welding.</td> <td>www.youtube.com/watch?v=66-RK0DPXfU</td> </tr> </tbody> </table>	<u>Description</u>	<u>Delivery Method</u>	<u>Activity</u>	<u>Materials</u>	ToolingU Reading Assignment	Online learning	Welding - What is Arc Welding? 110 Lessons 1-18. Arc Welding Processes 120 Lessons 1-16. Overview of Weld Types 130 Lessons 1-17. GMAW Applications 220 Lessons 1-20. Arc Welding Symbols and Codes 250 Lessons 1-15. Spot welding will be discussed in class.	ToolingU	Discuss different welding processes and review each type of operation.	Lecture	Review the welding processes, identify each type, match their application and equipment and discuss where in industry each might be used.	www.youtube.com/watch?v=uFX_RvWrzaQ	Present the purpose of welding, types, materials and equipment used.	Web-Enhanced Lecture	Read/Review What is Arc Welding? 110, Arc Welding Processes 120 Lesson 6.	ToolingU	Identify types of joints and welds performed, positions and proper welding procedures.	Web-Enhanced Lecture	Read/Review Overview of Weld Types 130	ToolingU	Define GMAW process and how it compares to other weld operations.	Web-Enhanced Lecture	Read/Review GMAW Applications 220	ToolingU	Introduce different types of welding symbols, codes used for delivered instruction and identity of a weld.	Web-Enhanced Lecture	Read/Review Arc Welding Symbols and Codes 250	ToolingU	Identify equipment, setup and operation performed for a GMAW.	Hands on lab	Run through a setup for GMAW, identify equipment needed and the process performed.	Gas cylinder, pressure gauge, flowmeter, welder, filler meta, wire feeder, weld gun, cables, work piece and clamp for operation.	Present a spot weld.	Hands on lab	Provide an example or review the process of spot welding.	www.youtube.com/watch?v=66-RK0DPXfU
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Evaluation	Instructor observations, assign homework or quiz.																																				

Degree/Diploma: Diversified Manufacturing Technology**Course: Introduction to Maintenance Technology****Session 2 Lesson Plan for:** Welding Procedures**Session Summary:** This session will discuss safety procedures for welding and general practices all welders must follow to stay safe.**Objectives:**
Identify proper safety procedures for welding.
Explain safety regulations for handling and storing welding cylinders.
Describe the importance of maintained valve caps, hoses and cylinders.
Demonstrate how to operate and adjust regulator valves on a fuel gas cylinder.
Demonstrate how to properly set up a portable oxyacetylene station.

Explain safety procedures used when performing a shielded metal arc weld.

	<u>Description</u>	<u>Delivery Method</u>	<u>Activity</u>	<u>Materials</u>
Learning	ToolingU Reading Assignment	Online learning	Welding - Oxyfuel Welding Safety 105 Lessons 1-16. Arc Welding Safety 115 Lessons 1-16.	ToolingU
	Explain personal protection and safety rules for welding	Lecture	Review welding safety, list personal protective equipment (PPE) required for welding, identify general safety rules pertaining to a welding shop such as inspection of equipment, care, cleaning and ventilation of the work area.	General Welding Safety
	Present how to safely transport, store and use welding cylinders.	Lecture	Observe welding cylinders safely check the caps and hoses are in place for transport, stored in a secure and upright position, and regulators are turned down before the cylinder valve is opened.	Welding Cylinder Safety
	Identify the necessary PPE and proper safety procedures one should take when operating welding equipment.	Web-Enhanced Lecture	Read/Review Oxyfuel Welding Safety 105	ToolingU
	Define workplace safety and welding hazards.	Web-Enhanced Lecture	Read/Review Arc Welding Safety 115	ToolingU
	Check your knowledge, how well do you understand the information.	Hands on lab	Complete the review questions in a group or as an individual activity.	Handout and answer Key provided loaded as pdf Titled: Session 2 Welding Safety in the Workplace
Evaluation	Instructor observations, assign homework or quiz.			

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Session 3 Lesson Plan for: Principles of Electricity

Session Summary: This session will introduce electricity, how it's created, its units of measure, different types of electricity and where it comes from. As well as risks associated with electrical work.

Objectives: Define electricity and methods for producing it.
Explain the physical relationship between atomic structure and electrical theory.

Describe the "Law of Charges".
Describe properties of direct and alternating current.
Discuss the properties and uses of insulators, conductors, and semiconductors.

	<u>Description</u>	<u>Delivery Method</u>	<u>Activity</u>	<u>Materials</u>
Learning	ToolingU Reading Assignment	Online learning	Electrical Systems - Electrical Units 110 Lessons 1-20. Safety for Electric Work 115 Lesson 1-16. NEC Overview 150 Lessons 1-17.	ToolingU
	Define the operation of electricity and how it is produced through different methods.	Web-Enhanced Lecture	Read/Review Electrical Units 110 Lessons 2-9 and 18-20.	ToolingU
	Identify electrical safety precautions and potential risks when working with electricity.	Web-Enhanced Lecture	Read/Review Safety for Electric Work 115	ToolingU
	Explain the purpose of the National Electrical Code (NEC) handbook, why it was developed and how it is managed today.	Web-Enhanced Lecture	Read/Review NEC Overview 150	ToolingU
	State the use of a GFCI (ground-fault circuit interrupter).	Web-Enhanced Lecture	Review what a GFCI safety outlet is, its purpose and how it's different from a fuse. GFCI Outlet: How it works and how to test video example	www.youtube.com/watch?v=Vkd43t2y2to
	Demonstrate how to perform an electricity check using a circuit test light	Hands on lab	Perform an electrical test. Use a circuit test light in an electrical test kit, plug each of the legs into an outlet and test the outlet for an active current, electricity is flowing through the reciprocal if light is displayed	Circuit Test Light
	Demonstrate how to perform an electricity check using a circuit tester	Hands on lab	Perform a circuit test. Obtain a circuit tester in an electrical test kit, apply the tester to several outlets in the lab, read the tester to check for both current and polarity.	Circuit Tester

Evaluation Instructor observations, assign homework or quiz.

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Session 4 Lesson Plan for: Elements of Operational Electrical Circuits

Session Summary: This session will identify basic electrical circuit components, the operation of power supply, and match each component to their schematic symbol.

Objectives:

- Define an operational electrical circuit.
- Explain power sources and identify their related schematic symbols.
- Define path and identify its schematic symbol.
- Explain basic control components and identify their schematic symbols.
- Define load, provide examples, and identify the related schematic symbols for each type of load.

	<u>Description</u>	<u>Delivery Method</u>	<u>Activity</u>	<u>Materials</u>
Learning	ToolingU Reading Assignment	Online learning	Electrical Systems - Electrical Units 110 Lessons 1-20 (assigned). Intro to Circuits 120 Lessons 1-19.	ToolingU
	Define the components of an electrical circuit and identify their schematic symbol.	Web-Enhanced Lecture	Read/Review Electrical Units 110 Lessons 10-11; Intro to Circuits 120	ToolingU
	Demonstrate the operation of a power supply	Hands on lab	Perform a power supply test check. Apply and set each type of current, use a test light to identify power.	Electrical power supply
	Demonstrate the operation of a manual switch	Hands on lab	Build an electrical circuit with a manual switch. Perform the operation and others of different types of manual switch operators	Electrical kit and a electrical switch operator
Evaluation	Instructor observations, assign homework or quiz.			

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Session 5 Lesson Plan for: Analyze Electrical Circuits

Session Summary: This session will introduce Ohm's Law, how it is used to calculate the current, voltage and resistance in a circuit. This session will also discuss the importance of the NEC handbook and standards for electrical operation.

Objectives: Explain the electrical properties of voltage, current, resistance, and power.
Define volt, ampere, ohm, and watt.
Define Ohm's Law.
Describe the relationship between electrical quantities using Ohm's Law.

	<u>Description</u>	<u>Delivery Method</u>	<u>Activity</u>	<u>Materials</u>
Learning	ToolingU Reading Assignment	Online learning	Electrical Systems - Electrical Units 110 Lessons 1-20 (assigned). Conductor Selection 240 Lessons 1-15. DC Circuit Components Unit 140 Lessons 1-15. DC Power Sources 230 Lessons 1-18.	ToolingU
	Explain Ohms law, how it is interpreted and how you can use it to calculate different measurements in a circuit.	Web-Enhanced Lecture	Read/Review Electrical Units 110 Lessons 12-17.	ToolingU
	Define electrical conductors, what material they are made from, how they are insulated and measured.	Web-Enhanced Lecture	Read/Review Conductor Selection 240	ToolingU
	Identify circuit components, controls and devices used to convert and manage the output of energy.	Web-Enhanced Lecture	Read/Review DC Circuit Components Unit 140	ToolingU
	Explain the production and flow of direct current, alternative power sources, and different techniques for delivering this energy.	Web-Enhanced Lecture	Read/Review DC Power Sources 230	ToolingU
	Calculate resistance using Ohms Law	Hands on lab	Using Ohm's Law, calculate the resistance of a component with given measurements in several different scenarios.	Resistance problems and a calculator
Calculate series resistance using a multimeter and Ohms Law	Hands on lab	Connect the circuit shown in the schematic diagram, test and measure the current flowing through the circuit, with the set voltage and the measured current calculate the amount of resistance in the circuit.	Electrical kit, multimeter and a calculator	

Evaluation Instructor observations, assign homework or quiz.

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Session 6 Lesson Plan for: Use of the Multimeter

Session Summary: This session will introduce how to use and install a voltmeter, ammeter, and ohmmeter in an electrical circuit. It will also cover how to properly measure voltage, current, and resistance.

Objectives:

- Explain the safe operation of a multimeter when measuring voltage, current, resistance, and continuity.
- State the displayed values on analog and digital meters.
- Apply proper procedures to make a voltage measurement.
- Apply proper procedures to make a current measurement.
- Apply proper procedures to make a resistance measurement.
- Apply proper procedures to check ohm values.
- Apply proper procedures to check continuity.

Learning	Description	Delivery Method	Activity	Materials
	ToolingU Reading Assignment	Online learning	Electrical Systems - Electrical Instruments 220 Lessons 1-16.	ToolingU
	Explain voltage, current and resistance in a circuit, how each is measured and the instruments used.	Web-Enhanced Lecture	Read/Review Electrical Instruments 220	ToolingU
	Demonstrate how to operate and install a voltmeter	Hands on lab	Apply a power supply and connect the leads of a voltmeter, measure the voltage, build a circuit from the schematic diagram that has a voltmeter in the electrical circuit.	Electrical kit and a voltmeter
	Demonstrate how to operate an analog and or digital multimeter	Hands on lab	Apply a power supply and connect the leads of analog or digital multimeter to the power supply and measure the voltage.	Electrical kit and an analog or digital multimeter
	Demonstrate the operation and installation of ammeters	Hands on lab	Apply a power supply and connect the leads of a ammeter, measure the current, build a circuit from the schematic diagram that has a ammeter in the electrical circuit.	Electrical kit and a ammeter
	Demonstrate how to operate a multimeter to measure resistance	Hands on lab	Connect leads of the ohmmeter to several different size resistors and measure the resistance of each	Electrical kit and a digital multimeter and different size resistors
	Demonstrate how to operate a multimeter to check for continuity	Hands on lab	Connect leads of the multimeter to each end of a wire and check for continuity	Electrical kit and a digital multimeter and different pieces of electrical wire
	Demonstrate how to operate and install a ohmmeter	Hands on lab	Connect leads of the ohmmeter to a circuit, measure the resistance in the electrical circuit.	Electrical kit and a ohmmeter
Evaluation	Instructor observations, assign homework or quiz.			

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Session 7 Lesson Plan for: Electrical Circuit Protection

Session Summary: This session will identify circuit protection devices, their schematic symbols, why they are used and proper installation and operation.

Objectives: Describe circuit breaker types and be able to identify their schematic symbols.
Describe the purpose of a fuse and be able to identify its schematic symbol.

Learning	<u>Description</u>	<u>Delivery Method</u>	<u>Activity</u>	<u>Materials</u>
	ToolingU Reading Assignment Explain the importance of a circuit protection device and the devices available	Online learning Lecture	Electrical Systems - Intro to Circuits 120 Lessons 1-19 (assigned). Present each type of circuit protectors along with their symbol located on a schematic diagram.	ToolingU Fuse, multimeter and a electrical breaker
	Identify protective devices used to prevent injuries and damages.	Web-Enhanced Lecture	Read/Review Intro to Circuits 120 Lessons 10-14.	ToolingU
	Demonstrate how to test a fuse for continuity	Hands on lab	Set the multimeter for continuity and connect the leads of the multimeter to each end of the fuse, check if the fuse is good or burned out.	Digital multimeter and fuses
	Demonstrate how to test a circuit breaker for continuity	Hands on lab	Set the multimeter for continuity and connect the leads of the multimeter to each end of the breaker, check if the breaker is disconnecting and resetting.	Digital multimeter and circuit breakers
	Demonstrate the construction of a circuit that has circuit protection.	Hands on lab	Following an electrical schematic, construct a circuit and install a fuse, protect the circuit, replace the fuse with a circuit breaker then test each circuit for the proper protection.	Electrical kit with fuses and circuit breakers
Evaluation	Instructor observations, assign homework or quiz.			

Session 8 Lesson Plan for: Use of Series Rules to Calculate Circuit Values

Session Summary: This session will discuss the components of circuits, rules of electrical flow and how to properly solve for the unknown values in a series circuit.

Objectives:

- List the rules for series circuits.
- Recognize components used in real series applications.
- Calculate total voltage, current, resistance and power values in series circuits
- Apply Ohm's Law to solve unknown series quantities.
- Recognize the presence of an open condition in series circuits.
- Recognize the presence of a short condition in series circuits.

	<u>Description</u>	<u>Delivery Method</u>	<u>Activity</u>	<u>Materials</u>
Learning	ToolingU Reading Assignment	Online learning	Electrical Systems - Intro to Circuits 120 Lessons 1-19 (assigned). Series Circuit Calculations 200 Lessons 1-18.	ToolingU
	Explain the differences between a series and parallel circuit, how they operate, components and use.	Web-Enhanced Lecture	Read/Review Intro to Circuits 120 Lessons 16-18.	ToolingU
	Define electrical flow, capacity and proper calculation for applied use.	Web-Enhanced Lecture	Read/Review Series Circuit Calculations 200	ToolingU
	Demonstrate how to measure the voltage drops in series with a digital multimeter	Hands on lab	Connect a series circuit together as shown on a schematic diagram, measure the voltage across each component and record each reading.	Electrical kit, a digital multimeter, pencil and paper
	Demonstrate how to measure the current in a series circuit with a digital multimeter	Hands on lab	Connect a series circuit together as shown on a schematic diagram, measure the current flowing into each component and record each.	Electrical kit, a digital multimeter, pencil and paper
	Demonstrate how to measure the resistance in a series circuit with a digital multimeter	Hands on lab	Connect series circuit together as shown on a schematic diagram, measure the resistance of each component and record the readings.	Electrical kit, a digital multimeter, pencil and paper
Evaluation	Explain how to construct a circuit with normally open and normally closed contacts	Hands on lab	Build an electrical circuit that has a main switch, different types of switch operators, normally closed and open contacts and test for correct operation.	Electrical kit with an electrical switch, switch operator and normally closed and normally open contactors
	Instructor observations, assign homework or quiz.			

Use of Parallel Rules to Calculate Circuit Values

This session will discuss parallel circuits, rules of electrical flow and how to properly solve for the unknown values in a parallel circuit.

Session Summary:

Objectives:

- List the rules for parallel circuits.
- Recognize components used in real parallel applications.
- Calculate total voltage, current, resistance and power values in parallel circuits.
- Apply Ohm's Law to solve unknown parallel quantities.
- Recognize the presence of an open condition in parallel circuits.
- Recognize the presence of a short condition in parallel circuits.

	<u>Description</u>	<u>Delivery Method</u>	<u>Activity</u>	<u>Materials</u>
Learning	ToolingU Reading Assignment	Online learning	Electrical Systems - Parallel Circuit Calculations 205 Lessons 1-16. Electrical Print Reading 225 Lessons 1-15.	ToolingU
	Define electrical flow, proper use and applied calculations for parallel circuits.	Web-Enhanced Lecture	Read/Review Parallel Circuit Calculations 205	ToolingU
	Explain the use of electrical prints, different print types and representing symbols for circuit identification.	Web-Enhanced Lecture	Read/Review Electrical Print Reading 225	ToolingU
	Demonstrate how to measure voltage drops in a parallel circuit with a digital multimeter	Hands on lab	Connect a parallel circuit together as shown on a schematic diagram, measure the voltage across each component and record each reading.	Electrical kit, a digital multimeter, pencil and paper
	Demonstrate how to measure current in a parallel circuit with a digital multimeter	Hands on lab	Connect a parallel circuit together as shown on a schematic diagram, measure the current flowing into each component and record each.	Electrical kit, a digital multimeter, pencil and paper
	Demonstrate how to measure resistance in a parallel circuit with a digital multimeter	Hands on lab	Connect parallel circuit together as shown on a schematic diagram, measure the resistance of each component and record the readings.	Electrical kit, a digital multimeter, pencil and paper
	Explain how to construct a comparison chart from data collected	Hands on lab	Create a chart from the recorded data and compare the voltage drops between series and parallel circuits.	Pencil, paper and a sample of a bar chart
Construct a circuit with a resistor, buzzer, solenoid, and or motor as an output	Hands on lab	Find the electrical components from the electric kit and build an electrical circuit that has a main switch and a resistor, buzzer, solenoid, and or motor as the output. Draw a schematic diagram of the circuit and test for correct operation.	Electrical kit with different types of output devices	
Evaluation	Instructor observations, assign homework or quiz.			

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Session 10 Lesson Plan for: Elements of AC Electricity use with Motors

Session Summary: This session will define magnetism and its connection to electricity, the advantages, characteristics and common applications of alternating current. As well as explain the proper connection of a single and three-phase motor in an electrical circuit.

Objectives:

- Describe the advantages of using AC motors.
- Describe what occurs during a complete charge and discharge of an electromagnetic cycle.
- Review the key terms used when explaining magnetic induction.
- Describe how to connect a single-phase motor in an electrical circuit.
- Describe how to connect a three-phase motor in an electrical circuit.

	<u>Description</u>	<u>Delivery Method</u>	<u>Activity</u>	<u>Materials</u>
Learning	ToolingU Reading Assignment	Online learning	Electrical Systems - Intro to Magnetism 130 Lessons 1-16. AC Fundamentals 210 lessons 1-15. AC Power Sources 235 Lessons 1-19. Motor Controls - AC Motor Applications 240 Lessons 1-15.	ToolingU
	Define magnetism, the process of electricity and use of this exchange.	Web-Enhanced Lecture	Read/Review Intro to Magnetism 130	ToolingU
	Describe the advantages of using alternating current, flow and measurement of values.	Web-Enhanced Lecture	Read/Review AC Fundamentals 210	ToolingU
	Describe electrical prints, different types and symbols used to identify electrical circuits.	Web-Enhanced Lecture	Read/Review Electrical Print Reading 225	ToolingU
	Describe how alternating current is produced, transformed and shared to end users.	Web-Enhanced Lecture	Read/Review AC Power Sources 235	ToolingU
	Identify standard components used in AC motors, different types and common applications.	Web-Enhanced Lecture	Read/Review AC Motor Applications 240	ToolingU
	Identify the leads on a single-phase motor and the connection in an electrical circuit	Hands on lab	Using the nameplate on a motor, identify the type of motor and using a diagram identify the electrical connections that connect it to a circuit.	Single-phase motor
	Identify the leads on a multiphase motor and the connection in an electrical circuit	Hands on lab	Using the nameplate on a motor, identify the type of motor and using a diagram identify the electrical connections that connect it to a circuit.	Three-phase motor
	Construct a circuit that has circuit protection.	Hands on lab	Following an electrical schematic construct both a circuit with a single-phase motor and a three-phase motor, test both for proper connection and operate the motors.	Electrical kit, single phase motor and a three phase motor
A single-phase induction motor explanation with animation	Web presentation	Observe a working single-phase induction motor from the video. Single Phase Induction Motor, How it works? video example	www.youtube.com/watch?v=awrUxv7B-a8	
Evaluation	Instructor observations, assign homework or quiz.			

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Session 11 **Lesson Plan for:** Motor Controls

Session Summary: This session will study the importance of motor control circuits, available protection devices, and how to replace them.

Objectives: Explain the purpose of a motor control circuit.
Describe the purpose of relays, contactors, and motor starters in a motor control circuit.
Explain protection devices required to safely operate a motor control circuit.
Explain the purpose of overload relays.
Explain the steps to safely wire a motor in an industrial environment.

	<u>Description</u>	<u>Delivery Method</u>	<u>Activity</u>	<u>Materials</u>
Learning	ToolingU Reading Assignment	Online learning	Motor Controls - Intro to Electric Motors 200 Lessons 1-14. DC Motor Applications 230 Lessons 1-16. Contactors and Motors Starters 250 Lessons 1-19. Reversing Motor Circuits 310 Lessons 1-15.	ToolingU
	Describe the purpose, types and operation of electric motors	Web-Enhanced Lecture	Read/Review Intro to Electric Motors 200	ToolingU
	Define DC motors, their components of construction and the advantages and disadvantages of operation.	Web-Enhanced Lecture	Read/Review DC Motor Applications 230	ToolingU
	Identify the different types of contactors and motor starters used to prevent excessive current and overload conditions.	Web-Enhanced Lecture	Read/Review Contactors and Motors Starters 250	ToolingU
	Explain the purpose and proper use of reversing motor circuits	Web-Enhanced Lecture	Read/Review Reversing Motor Circuits 310	ToolingU
	Construct a motor circuit with current and overload protection.	Hands on lab	Following an electrical schematic, construct a circuit with a motor, and install a current and overload protector to the circuit, test for proper connection and operate the motor. Apply unwanted current and overload to the circuit to test its functioning properly.	Electrical kit, motors, current and overload protectors and multimeter

Evaluation Instructor observations, assign homework or quiz.

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Session 12 Lesson Plan for: Fundamentals of Pneumatics

Session Summary: This session will examine the basic components in a pneumatic system, their functions, known safety hazards, and how to calculate pressure. As well as introduce symbols used to identify fluid power components found on a print.

Objectives:

- Describe the physical fundamentals of a pneumatic system
- Identify safety hazards associated with a pneumatic system.
- Explain the importance of pneumatics used in industry.
- Use correct formulas to perform pneumatic calculations

	<u>Description</u>	<u>Delivery Method</u>	<u>Activity</u>	<u>Materials</u>
Learning	ToolingU Reading Assignment	Online learning	Hydraulics and Pneumatics - Intro to Fluid Systems 100 Lessons 1-14. Safety for Hydraulics and Pneumatics 105 Lessons 1-17. Intro to Pneumatic Components 125 Lessons 1-17. Fluid System Print Reading 220 Lessons 1-19.	ToolingU
	Describe the different types of power transmission systems, how a pneumatic system operates and conducts energy to generate power.	Web-Enhanced Lecture	Read/Review Intro to Fluid Systems 100 Lessons 2-4, 6, 7, 9, 11-14.	ToolingU
	Identify potential safety hazards and precautionary measures one should take when working with power transmission systems.	Web-Enhanced Lecture	Read/Review Safety for Hydraulics and Pneumatics 105	ToolingU
	Explain the importance of pneumatic power, its components, and the many applications it currently uses.	Web-Enhanced Lecture	Read/Review Intro to Pneumatic Components 125	ToolingU
	Introduce symbols that identify fluid power components found on a print.	Web-Enhanced Lecture	Read/Review Fluid System Print Reading 220	ToolingU
	Calculate pressure using the correct mathematical formulas	Hands on lab	Using a calculator, calculate area of a cylinder and the pressure in a system using the correct formulas.	Provide mathematical formulas
	Read a pneumatic schematic and identify the component symbols.	Hands on lab	Read and understand pneumatic schematics, including single and double acting cylinders, flow controls, meter out, sensors, solenoid valves, ways, ports, and positions.	Handout provided on pneumatic schematic print and symbols chart loaded as pdf Titled: Session 12 Pneumatic Symbols
Evaluation	Instructor observations, assign homework or quiz.			

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Session 13 Lesson Plan for: Pneumatic Components

Session Summary: This session will identify types of pneumatic control valves and actuators, the air filtering system used in a pneumatic system, what the function of each component does in the system and how they are shown on a pneumatic diagram.

Objectives:

- Identify different components of a pneumatic system
- Demonstrate how to match components to symbols on a schematic
- Identify various types of air compressors and regulators
- Identify various types of control valves and directional control valves
- Identify various types of pneumatic cylinders and motors

<u>Description</u>	<u>Delivery Method</u>	<u>Activity</u>	<u>Materials</u>
ToolingU Reading Assignment	Online learning	Hydraulics and Pneumatics - The Forces of Fluid Power 110 Lessons 1-16. Pneumatic Power Variables 205 Lessons 1-17. Pneumatic Power Sources 215 Lessons 1-14. Actuator Applications 240 Lessons 1-16. Basic Pneumatic Circuit Design 315 Lessons 1-12.	ToolingU
Learning			
List the benefits and operations of fluid power systems	Web-Enhanced Lecture	Read/Review The Forces of Fluid Power 110	ToolingU
Identify pneumatic power variables found in a pneumatic system and how they relate the utility of selected components.	Web-Enhanced Lecture	Read/Review Pneumatic Power Variables 205	ToolingU
Define the use of compressors, different types of the devices and determine an appropriate device for an intended purpose and operating condition.	Web-Enhanced Lecture	Read/Review Pneumatic Power Sources 215	ToolingU
Explain the basic function and operation of pneumatic actuators	Web-Enhanced Lecture	Read/Review Actuator Applications 240	ToolingU
Identify three pneumatic circuit components, the various types of DCVs, determine how each one performs its function and why they are used in a pneumatic system.	Web-Enhanced Lecture	Read/Review Basic Pneumatic Circuit Design 315 Match each type to its correct schematic symbol.	ToolingU
Demonstrate how to adjust the pneumatic pressure with a pressure regulator, set a drip oiler to a certain amount per minute and how to drain water from the pneumatic filter.	Hands on lab	Locate the pressure regulator, the drip oiler and the pneumatic air filter on a pneumatic system, adjust the pressure to a set amount, the dripper to a set count. Find the valve located on the bottom of the air filter and press the spring-loaded plug on the bottom of the filter to drain the water trapped by the filter.	Pneumatic system with a pressure gauge, pressure regulator, oil dripper, air filter and a schematic diagram
Connect and operate a pneumatic system containing a single or double acting cylinder and a control valve.	Hands on lab	Following a pneumatic schematic diagram, connect the pneumatic components together using the poly air line and quick connect fittings, set pressure and operate the system.	Pneumatic system with the needed components shown on a schematic diagram
Connect and operate a pneumatic system containing a pneumatic motor and a control valve.	Hands on lab	Following a pneumatic schematic diagram, connect the pneumatic components together using the poly air line and quick connect fittings, set pressure and operate the system.	Pneumatic system with the needed components shown on a schematic diagram

Evaluation Instructor observations, assign homework or quiz.

Degree/Diploma: Diversified Manufacturing Technology

Course: Introduction to Maintenance Technology

Session 14 Lesson Plan for: Pneumatic Circuits

Session Summary: This session will describe the use of fittings, seals, filters and lubricators in a pneumatic system and how to connect several circuits together.

Objectives:

- Describe common maintenance procedures on a pneumatic circuit
- Identify different fittings used in a circuit.
- Explain the different types of filters used in circuits.
- Create schematic diagrams for pneumatic circuits
- Demonstrate how to build pneumatic circuits

	<u>Description</u>	<u>Delivery Method</u>	<u>Activity</u>	<u>Materials</u>
Learning	ToolingU Reading Assignment	Online learning	Hydraulics and Pneumatics - Fittings for Fluid Systems 135 Lessons 1-17. Pneumatic Control Valves 235 Lessons 1-16.	ToolingU
	Identify types of fittings and seals used in fluid systems, their purpose and the need for continued maintenance and precautionary procedures.	Web-Enhanced Lecture	Read/Review Fittings for Fluid Systems 135	ToolingU
	Describe different types of valves used in a pneumatic system, their functions and why they are used.	Web-Enhanced Lecture	Read/Review Pneumatic Control Valves 235	ToolingU
	Connect two single branch circuits together using a tee connector	Hands on lab	Following a pneumatic diagram, connect the components together using the poly air line and quick connect fittings, set pressure and operate the system.	Pneumatic system with the needed components shown on the schematic, and a diagram
	Connect three single branch circuits together using a cross connector	Hands on lab	Following a pneumatic diagram, connect the components together using the poly air line and quick connect fittings, set pressure and operate the system.	Pneumatic system with the needed components shown on the schematic, and a diagram
Evaluation	Instructor observations, assign homework or quiz.			

Degree/Diploma: Diversified Manufacturing Technology

Course: Introduction to Maintenance Technology

Session 15 Lesson Plan for: Fundamentals of Hydraulics

Session Summary: This session will examine the basic components in a hydraulic system. The conductors used to transmit fluid power, as well as the functions and capability of hydraulic system pumps.

Objectives:
Define the function of a hydraulic system
Describe the importance of hydraulic pressure
Explain the relationship between force and pressure
Describe how to calculate the force of a cylinder
Describe how to calculate torque of a motor
Demonstrate how to measure and control flow rates and how it relates to operational speed.

Description

ToolingU Reading Assignment

Delivery Method

Online learning

Activity

Hydraulics and Pneumatics - Intro to Fluid Systems 100 Lessons 1-14 (assigned). Intro to Hydraulic Components 120 Lessons 1-15. Intro to Fluid Conductors 130 Lessons 1-16. Hydraulic Power Variables 200 Lessons 1-16. Hydraulic Power Sources 210 Lessons 1-14.
Read/Review Intro to Fluid Systems 100

Materials

[ToolingU](#)

Describe how a hydraulic system operates and conducts energy to generate power. The purpose of lubricant oil and water based products, and the primary components in a fluid power transmission system.

Web-Enhanced Lecture

Explain the importance of hydraulic power, its components, and the many applications it is currently

Web-Enhanced Lecture

Read/Review Intro to Hydraulic Components 120

[ToolingU](#)

Learning

used for
Identify different types of conductors used to transmit fluid power and explain the importance for proper fit, installation and maintenance of these conductors.

Web-Enhanced Lecture

Read/Review Intro to Fluid Conductors 130

[ToolingU](#)

Identify hydraulic power variables found in a hydraulic system and how they relate the utility of selected components.

Web-Enhanced Lecture

Read/Review Hydraulic Power Variables 200

[ToolingU](#)

Describe the use and types of hydraulic pumps, their functions and capability for efficient operation.

Web-Enhanced Lecture

Read/Review Hydraulic Power Sources 210

[ToolingU](#)

Calculate pressure using the correct mathematical formulas

Hands on lab

Using a calculator, calculate area of a cylinder and the pressure in a system using the correct formulas.

Provide mathematical formulas

Evaluation Instructor observations, assign homework or quiz.

Degree/Diploma: Diversified Manufacturing Technology**Course: Introduction to Maintenance Technology****Session 16 Lesson Plan for:** Hydraulic Components**Session Summary:** This session will identify different types of hydraulic components used in a hydraulic system. The control valves and basic hydraulic cylinders will be covered along with the identification of their hydraulic schematic symbols.**Objectives:**
 Demonstrate how to match components to symbols on a schematic
 Identify hydraulic pumps and reservoirs
 Identify hydraulic conductors, connectors and filters and their locations
 Identify various types of hydraulic valves
 Identify various types of hydraulic cylinders and motors

<u>Description</u>	<u>Delivery Method</u>	<u>Activity</u>	<u>Materials</u>
ToolingU Reading Assignment	Online learning	Hydraulics and Pneumatics - Hydraulic Control Valves 230 Lessons 1-17. Basic Hydraulic Circuit Design 310 Lessons 1-18. Hydraulic Principles and System Design 340 Lessons 1-12.	ToolingU
Describe the different types of valves used in a hydraulic system, their functions and why they are used.	Web-Enhanced Lecture	Read/Review Hydraulic Control Valves 230	ToolingU
Identify three hydraulic circuit components, the various types of DCVs, determine how each one performs its function and why they are used in a hydraulic system.	Web-Enhanced Lecture	Read/Review Basic Hydraulic Circuit Design 310	ToolingU
Explain how to determine the appropriate size and force of components within a system for design and operation and how to determine pressure, area and force within a hydraulic system using Pascal's Law.	Web-Enhanced Lecture	Read/Review Hydraulic Principles and System Design 340	ToolingU
Read a hydraulic schematic and identify the component symbols.	Hands on lab	Match hydraulic components to the symbols shown in a schematic.	Handout provided on hydraulic schematic print and symbols chart loaded as pdf Titled: Session 16 Hydraulic Symbols

Evaluation Instructor observations, assign homework or quiz.

Degree/Diploma: Diversified Manufacturing Technology

Course: Introduction to Maintenance Technology

Session 17 Lesson Plan for: Hydraulic Circuits and Filtration

Session Summary: This session will discuss different types of hydraulic motors and filtration systems used. Their function, operation and preventive maintenance will be covered along with the identification and proper placement of their schematic symbols.

Objectives:
Explain the importance of a hydraulic cylinder circuit
Explain the importance of a hydraulic motor circuit
Create a schematic diagram for a hydraulic circuit
Describe the functions of a filtration system

Description

ToolingU Reading Assignment

Delivery Method

Online learning

Activity

Hydraulics and Pneumatics - Preventive Maintenance for Fluid Systems 140 Lessons 1-19. Hydraulic Fluid Selection 320 Lessons 1-18. Contamination and Filter Selection 330 Lessons 1-16.

Materials

[ToolingU](#)

Learning

Describe the need and actions taken for preventive maintenance, proper installation and cleaning of fluid power systems. In addition discuss the associated benefits for using correct fittings and seals in a fluid system.

Web-Enhanced Lecture

Read/Review Preventive Maintenance for Fluid Systems 140

[ToolingU](#)

Define the primary roles of hydraulic fluids, different types of fluids and how they are chosen and used in a hydraulic system.

Web-Enhanced Lecture

Read/Review Hydraulic Fluid Selection 320

[ToolingU](#)

Explain the use of hydraulic filters, the importance of reduced contamination and continued fluid maintenance.

Web-Enhanced Lecture

Read/Review Contamination and Filter Selection 330

[ToolingU](#)

Filtration component identification and placement in a hydraulic system

Hands on lab

Identify each filters type and schematic symbol. Understand their placement on a schematic diagram and in the hydraulic system.

Identification and placement group activity

Evaluation Instructor observations, assign homework or quiz.

Degree/Diploma: Diversified Manufacturing Technology

Course: Introduction to Maintenance Technology

Session 18 Lesson Plan for: Continued Maintenance

Session Summary: This session will discuss the primary benefits associated with Total Productive Maintenance (TPM). We will review the importance of routine maintenance, quality assurance and the reduction of lost time, money and materials wasted.

Objectives:
Describe the purpose of Total Productive Maintenance (TPM)
Identify preventative maintenance procedures for mechanical systems
Describe adjustment techniques.
Explain preventative maintenance documentation.

<u>Description</u>	<u>Delivery Method</u>	<u>Activity</u>	<u>Materials</u>
ToolingU Reading Assignment	Online learning	Quality - Total Productive Maintenance Overview 150 Lessons 1-18.	ToolingU
Identify various types of maintenance activities performed in industry.	Lecture	List types of maintenance performed	ToolingU
Discuss the benefits associated with Total Productive Maintenance (TPM).	Web-Enhanced Lecture	Read/Review Total Productive Maintenance Overview 150	ToolingU
Learning Identification and proper use of tools during the performance of maintenance	Hands on lab	Lay out several types of tools used to monitor or check equipment such as alignment, vibration analysis, thermometers, and electrical meters. Provide any additional tools available and have the student use these tools on an electric motor. Demonstrate both good and bad diagnostic results so questions can be asked.	Monitoring tools and small electric motors.
Have each student provide an explanation to the purpose of TPM processes.	Individual assignment	In your own words, write a few paragraphs explaining the importance of total productive maintenance.	Individual assignment pencil and paper or electronic copy
Evaluation	Instructor observations, assign homework or quiz.		

Degree/Diploma: Diversified Manufacturing Technology

Course: Introduction to Maintenance Technology

Session 19 **Lesson Plan for:** Lubricant Fundamentals

Session Summary: This session will discuss the various functions of lubricants, different types, where and what application they are used for, proper maintenance and safety procedures.

Objectives: Describe the primary purpose of lubricants
Identify the appropriate lubricant base for an application.

	<u>Description</u>	<u>Delivery Method</u>	<u>Activity</u>	<u>Materials</u>
	ToolingU Reading Assignment	Online learning	Mechanical Systems - Lubrication Fundamentals 130 Lessons 1-18.	ToolingU
	Identify the various benefits, functions, and types of lubricants used in industry.	Web-Enhanced Lecture	Read/Review Lubrication Fundamentals 130 Lessons 1-6 and 9-18.	ToolingU
Learning	Demonstrate how to check for oil levels using multiple devices.	Hands on lab	Check the oil levels using three different systems, including an oil site gauge, a dip stick and an oil flow gauge.	Oil reservoir with the three types of checking devices
	Demonstrate how to remove an oil sample from a gear reducer	Hands on lab	Using a hand pump, show students where the oil reservoir is on the gear reducer and have them pump the oil into a pan or bucket. This is a good time to talk about viscosity and how you can make the oil easier to pump by warming it up.	Hand pump, gear reducer, and a pan or bucket to pump into.

Evaluation Instructor observations, assign homework or quiz.

Degree/Diploma: Diversified Manufacturing Technology

Course: Introduction to Maintenance Technology

Session 20 Lesson Plan for: Oil Applications

Session Summary: This session will identify different types of oils, determine the correct measure and oil type for specific applications. We will also review advantages and disadvantages of oils and how it can withstand extreme temperatures.

Objectives:
Describe the importance of oil viscosity
Explain how to read a viscosity index chart.
Identify different types of oils for application

<u>Description</u>	<u>Delivery Method</u>	<u>Activity</u>	<u>Materials</u>
ToolingU Reading Assignment	Online learning	Mechanical Systems - Lubrication Fundamentals 130 Lessons 1-18 (assigned).	ToolingU
Identify different types of oils used for lubrication, the benefits and disadvantages when using these products.	Web-Enhanced Lecture	Read/Review Lubrication Fundamentals 130 Lesson 7.	ToolingU
Demonstrate how to measure oil viscosity	Hands on lab	Use a viscometer to measure viscosity from different types of oils and compare them to an oil chart.	Viscometer and several different industrial oils and oil chart
Oil selections for different industrial applications	Hands on lab	Match the appropriate oil with their specifications to a given application	Oil chart

Evaluation Instructor observations, assign homework or quiz.

Degree/Diploma: Diversified Manufacturing Technology**Course: Introduction to Maintenance Technology****Session 21** Lesson Plan for: Lubricants for Rotation Devices**Session Summary:** This session will discuss why grease is used as a lubricant. Identify various types of greases, where and what application they are used in and review the operation of a grease gun.**Objectives:**
Identify types of lubricant greases used in manufacturing.
Describe how greases are applied.
Explain how to select the grade and type of a grease
Differentiate the proper applications for greases and oils**Description**

ToolingU Reading Assignment

Delivery Method

Online learning

Activity

Mechanical Systems - Lubrication Fundamentals 130 Lessons 1-18 (assigned).

Materials[ToolingU](#)**Learning**

Discuss how a grease compound is formed, the benefits of using grease over an oil lubricant, the disadvantages of using grease as a lubricant, different types of greases and how they are applied.

Web-Enhanced Lecture

Read/Review Lubrication Fundamentals 130 Lesson 8.

[ToolingU](#)

Demonstrate how to perform a lubrication with a grease gun

Hands on lab

Complete the process of loading a grease tube into a grease gun and pump the necessary amount of grease into the grease zerk, which transfers the grease to the bearing.

Grease gun, grease tube, grease zerk (fittings tool) and a bearing in a pillow block

Evaluation Instructor observations, assign homework or quiz.

Degree/Diploma: Diversified Manufacturing Technology

Course: Introduction to Maintenance Technology

Session 22 Lesson Plan for: Power Train System

Session Summary: This session will cover personal and machine safety along with types of mechanical power transmission systems and how they can be safely maintained and operated.

Objectives:
Identify industrial equipment that uses mechanical power.
Describe parts of a power transmission system
Describe personal safety precautions that apply to operators of mechanical systems.
Identify mechanical system safety for machine operations

Description	Delivery Method	Activity	Materials
ToolingU Reading Assignment	Online learning	Mechanical Systems - Intro to Mechanical Systems 100 Lessons 1-20. Safety for Mechanical Work 105 Lessons 1-12. Power Transmission Components 120 Lessons 1-17. Mechanical Power Variables 200 Lessons 1-14. Clutch and Brake Applications 250 Lessons 1-18.	ToolingU
Identify machines, applied mechanical advantages, and main components of the mechanical systems.	Web-Enhanced Lecture	Read/Review Intro to Mechanical Systems 100	ToolingU
Define associated safety risks and precautionary procedures for working around and performing mechanical maintenance.	Web-Enhanced Lecture	Read/Review Safety for Mechanical Work 105	ToolingU
Describe power transmission systems, how energy is carried through the system, different systems and parts used to transmit energy.	Web-Enhanced Lecture	Read/Review Power Transmission Components 120	ToolingU
Learning Describe the importance for known machine specifications, how speed and mechanical power are measured and used for adequate machine selection and operation.	Web-Enhanced Lecture	Read/Review Mechanical Power Variables 200	ToolingU
Identify the use of clutches and brakes, different types and determine the appropriate device based on their design factors for the intended operation.	Web-Enhanced Lecture	Read/Review Clutch and Brake Applications 250	ToolingU
Demonstrate how to properly install a lockout/tagout on a machine and discuss the rules for removing the device.	Hands on lab	Perform with documentation the procedures for locking out a mechanical power transmission system and then complete the procedures and documentation for releasing the system back to production.	Lockout/tagout kit and zero energy documents
Describe and present proper protective equipment used in industry for related occupational activities.	Hands on lab	Identify the types of proper protective equipment (PPE) used in certain situations. Have students identify the appropriate PPE needed to perform a task. Evaluate the known hazards and assess for safety.	Evaluate and respond to safety assessment.
Evaluation	Instructor observations, assign homework or quiz.		

Degree/Diploma: Diversified Manufacturing Technology

Course: Introduction to Maintenance Technology

Session 23 Lesson Plan for: Bearings and Couplings

Session Summary: This session will introduce various types of bearings and couplings, their functions, and how to install and maintain them for optimal use.

Objectives:
Define the purpose of a bearing and its relationship to its direction on a load.
Identify different types and classes of bearings.
Explain how various types of bearings are used.
Explain how to select the appropriate bearing for its application.
Define the purpose of a coupling.
Identify different types of couplings and how they are used.
Demonstrate how to align two components with a coupler.

Description

ToolingU Reading Assignment

Delivery Method

Online learning

Activity

Mechanical Systems - Bearing Applications 210 Lessons 1-20.
Power Transmission Components 120 Lessons 1-17 (assigned).

Materials

[ToolingU](#)

Identify several types of bearings, their function and type of load associated with each.

Web-Enhanced Lecture

Read/Review Bearing Applications 210

[ToolingU](#)

Explain the different types of couplers used in drive systems, how each type connects one shaft to another, and review types of bearings and how they are used in manufacturing.

Web-Enhanced Lecture

Read/Review Power Transmission Components 120 Lessons 13-17.

[ToolingU](#)

Identification of bearings

Hands on lab

Identify and record each type of bearing and explain where the load would be for each bearing type.

Types of bearings

Learning

Install a bearing onto a drive shaft and into a pillow block. Discuss the importance of alignment

Hands on lab

Perform different methods for mounting a bearing onto a shaft and pressing a bearing into a pillow block, complete the installation of pressing a bearing into the block and pressing the shaft into the bearing and holding it into place.

Pillow block, antifriction bearing and a drive shaft

Install and align a rigid coupling.

Hands on lab

Properly install and align a rigid coupling (e.g. motor to a gear reducer).

Rigid coupling, motor and a gear reducer

Install and align a flexible jaw coupling.

Hands on lab

Properly install and align a flexible jaw coupling. Discuss the tolerances the coupling has to the alignment compared to a rigid coupling.

Flexible jaw coupling

Demonstrate how to align two drive shafts using the appropriate tools

Hands on lab

Align two shafts using aligning tools

Drive system with two shafts, various styles of couplers and aligning tools include, square, dial indicator with mounting bracket, tube to fit over shafts, straight edge and two-foot steel rule.

Evaluation Instructor observations, assign homework or quiz.

Degree/Diploma: Diversified Manufacturing Technology

Course: Introduction to Maintenance Technology

Session 24 **Lesson Plan for:** Gear Operation and Maintenance

Session Summary: This session will examine different types, operations, and applications of gears, calculate gear ratio, and adjust the speed, torque, and rotation between two gears.

Objectives:
Define the purpose of a gear.
Identify different types of gears.
Determine speed using gear ratios.
Describe proper installation and adjustment of gears in a train system.
Identify different types of lubrications for system maintenance.

<u>Description</u>	<u>Delivery Method</u>	<u>Activity</u>	<u>Materials</u>
ToolingU Reading Assignment	Online learning	Mechanical Systems - Power Transmission Components 120 Lessons 1-17 (assigned). Gear Geometry 240 Lessons 1-14. Gear Applications 245 Lessons 1-18.	ToolingU
Identify different types of gears and gear drives, how they function and transmit power for operation.	Web-Enhanced Lecture	Read/Review Power Transmission Components 120 Lessons 5-7.	ToolingU
Describe how gear design can alter the speed, torque, and direction of rotation.	Web-Enhanced Lecture	Read/Review Gear Geometry 240	ToolingU
Learning Identify gear types, use and performance for proper operation and maintenance.	Web-Enhanced Lecture	Read/Review Gear Applications 245	ToolingU
Demonstrate a gear drive system.	Hands on lab	Identify the components on a drive system	Gear Drive System
Calculate the ratio of two gears	Hands on lab	Count the differences in revolutions of each gear, determine its ratio, and if it increases in speed or increases the force.	Gear Drive System
Demonstrate how to install gears in a drive system	Hands on lab	Properly remove and remount the gears in the drive system.	Gear drive systems and correct size wrenches

Evaluation Instructor observations, assign homework or quiz.

Degree/Diploma: Diversified Manufacturing Technology

Course: Introduction to Maintenance Technology

Session 25 Lesson Plan for: Belt Operation and Maintenance

Session Summary: This session will discuss the operation of a belt drive system, its components, how to properly maintain and operate a drive system. We will also discuss the design and use of springs, different types and proper selection for tension support.

- Objectives:**
- Describe the advantages of a belt drive system.
 - Identify different types of belt drives
 - Demonstrate how to calculate the required speed and torque for a belt drive.
 - Understand the use of various pulleys for speed control
 - Describe how to measure correct belt tension for maximum efficiency
 - Describe the effects of belt wear with belt tension
 - Describe how to install and adjust a belt drive system.

	<u>Description</u>	<u>Delivery Method</u>	<u>Activity</u>	<u>Materials</u>
	ToolingU Reading Assignment	Online learning	Mechanical Systems - Power Transmission Components 120 Lessons 1-17 (assigned). Belt Drive Applications 230 Lessons 1-15. Spring Applications 220 Lessons 1-18.	ToolingU
Learning	Describe the use of belts and pulleys, different types of belts used and the operation of a belt drive system.	Web-Enhanced Lecture	Read/Review Power Transmission Components 120 Lessons 8-9, also available in Mechanical Power Variables 200 Lesson 6 and 8 and Gear Geometry 240 Lessons 3 and 8-9.	ToolingU
	Discuss the cause and effects of improper tensioning of a belt, methods for testing and adjusting belt tension, proper selection and maintenance for service and safety procedures for belt drive systems.	Web-Enhanced Lecture	Read/Review Belt Drive Applications 230	ToolingU
	Identify the use of springs, different types and designs, and when and where they are used to support a load.	Web-Enhanced Lecture	Read/Review Spring Applications 220	ToolingU
	Demonstrate how to install V-belt pulley	Hands on lab	Install V-belt pulleys onto shafts mounted in pillow blocks and align them with a straight edge and adjust proper tension with the belt tension devise. Have students observe or participate in the set up.	Belt drive system mounted in pillow blocks, tension meter and straight edge
	Demonstrate how to measure the differences in diameters of each pulley	Hands on lab	Measure the differences in diameters of each pulley, determine its ratio, and if it increases in speed or increases the force.	Belt Drive System
Demonstrate how to measure the belt tension by deflection and evaluate the force needed to achieve a proper belt tension.	Hands on lab	Determine the belt deflection force for a given application	A tensiometer, tape measure, and straight edge is needed.	
Demonstrate how springs are used in a machine.	Hands on lab	Select a spring for a particular application. Consider the direction of load, type of load, spring rate, and tensile strength when making this selection. Have each student give a reason for this selection.	Example coil spring	
Evaluation	Instructor observations, assign homework or quiz.			

Degree/Diploma: Diversified Manufacturing Technology

Course: Introduction to Maintenance Technology

Session 26 **Lesson Plan for:** Chain Operation and Maintenance

Session Summary: This session will describe the operation of chain drive systems, installation, alignment and tension adjustment of chains, different types and use of each.

Objectives:
Describe the operation of a chain drive system.
Identify the components of a chain drive system.
Describe common types of chains and the environment in which they are used.
Explain how to select a sprocket and calculate its ratio for proper speed and torque.
Identify proper chain alignment and tension for various types of chain drive systems.
Demonstrate proper installation and adjustment of a roller chain drive.

<u>Description</u>	<u>Delivery Method</u>	<u>Activity</u>	<u>Materials</u>
ToolingU Reading Assignment	Online learning	Mechanical Systems - Power Transmission Components 120 Lessons 1-17 (assigned).	ToolingU
Define a chain drive system, why they are used, different types of chains and how they function.	Web-Enhanced Lecture	Read/Review Power Transmission Components 120 Lessons 10-11.	ToolingU
Demonstrate how to calculate a sprocket ratio	Hands on lab	Calculate sprocket ratio and provide an example (difference in the number of teeth to turns). Go faster by changing sprockets video example	www.youtube.com/watch?v=O35AwCp-6b8
Demonstrate how to calculate the shaft speed and torque of a chain drive system	Hands on lab	Calculate the shaft speed and torque of a chain to drive system (use the original drive ratio of the old sprocket set and the drive ratio of the new sprocket set) A positive change is an increase in torque, and a negative change is a loss in torque.	Chain drive system mounted in pillow blocks.
Demonstrate how to connect a roller chain with a master link on a chain drive system.	Hands on lab	Install a chain with a master link using sprocket tooth	Roller chain drive system mounted in pillow blocks.
Alternative example to performing a master link installation	Web presentation	Master link installation with a secondary adhesive is explained in listed video. Master link installation video example.	www.youtube.com/watch?v=OITMKMk2Clo
Alternative example to installing an o-ring chain	Web presentation	How To Install O-Ring Chain is explained in listed video. How to install an O-ring chain video example.	www.youtube.com/watch?v=eOa7mxdG4B0

Evaluation Instructor observations, assign homework or quiz.

Degree/Diploma: Diversified Manufacturing Technology

Course: Introduction to Maintenance Technology

Session 27 Lesson Plan for: Control Circuit Logic

Session Summary: This session will introduce diagrams and symbols used in control devices. Cover control circuits with AND, OR, NOT, NOR, NAND and MEMORY logic functions and review PLCs; their numbering system and program control instructions.

Objectives:
Explain the importance of control circuit logic devices
Identify logic functions in control circuits
Explain the different between AND and OR circuit logic
Explain NOT circuit logic
Explain the different between NAND and NOR circuit logic
Explain the operation of a memory circuit

Description

ToolingU Reading Assignment

Delivery Method

Online learning

Activity

Motor Controls - Symbols and Diagrams for Motors 210 Lessons 1-16. Logic and Line Diagrams 220 Lessons 1-15. PLCs - Numbering Systems and Codes 230 Lessons 1-15. Basic Programming 250 Lessons 1-15. PLC Program Control Instructions 310 Lessons 1-14.

Materials

[ToolingU](#)

Identify diagrams and symbols used to represent motor control devices, their functions and intended applications.

Web-Enhanced Lecture

Read/Review Symbols and Diagrams for Motors 210

[ToolingU](#)

Introduce control circuits, the purpose of control circuit logic, and how each circuit is represented on a line diagram.

Web-Enhanced Lecture

Read/Review Logic and Line Diagrams 220 Lessons 10-13.

[ToolingU](#)

Describe the numbering system and necessary system conversions used in PLCs.

Web-Enhanced Lecture

Read/Review Numbering Systems and Codes 230

[ToolingU](#)

Discuss programmable logic controllers (PLCs), devices used, functions performed, and how programmed instruction is used to carry out system tasks.

Web-Enhanced Lecture

Read/Review Basic Programming 250

[ToolingU](#)

Discuss the purpose of program control instructions used in PLCs, different options and advantages for set specification in system programming.

Web-Enhanced Lecture

Read/Review PLC Program Control Instructions 310

[ToolingU](#)

Demonstrate the operation of a control system with AND and OR logic

Hands on lab

Observe and operate an AND and OR logic control circuit

Select a machine that uses AND and OR logic and demonstrate its control options

Demonstrate the operation of a control system with NOT, NAND or NOR logic

Hands on lab

Connect and operate a NOT, NAND or NOR logic control circuit

Control systems electronic test kit with components and breadboard

Demonstrate the operation of a control system with memory logic

Hands on lab

Observe and operate a control system that uses a memory logic circuit

Select a machine that uses memory logic and demonstrate its function

Evaluation Instructor observations, assign homework or quiz.

Degree/Diploma: Diversified Manufacturing Technology

Course: Introduction to Maintenance Technology

Session 28 Lesson Plan for: Electrical Schematic Diagrams

Session Summary: This session will explain ladder logic, how it is used in industrial control systems, converted diagrams and represented symbols.

Objectives:
Explain the basic rules for ladder logic.
Describe the basic sections of a ladder rung.
Identify symbols used in ladder diagrams.
Create a ladder diagram using the correct placement and use of symbols.

<u>Description</u>	<u>Delivery Method</u>	<u>Activity</u>	<u>Materials</u>
ToolingU Reading Assignment	Online learning	Motor Controls - Logic and Line Diagrams 220 Lessons 1-15 (assigned). PLCs - Basic of Ladder Logic 220 Lessons 1-15. PLC Diagrams and Programs 300 Lessons 1-12.	ToolingU
Describe the primary principles, components and layout of line diagrams.	Web-Enhanced Lecture	Read/Review Logic and Line Diagrams 220 Lessons 1-9, 14-15.	ToolingU
Discuss the use of ladder logic, its symbols and how it is interpreted on a line diagram.	Web-Enhanced Lecture	Read/Review Basic of Ladder Logic 220	ToolingU
Learning Discuss the purpose for using PLC systems as well as the advantages for converting set diagrams to programming diagrams.	Web-Enhanced Lecture	Read/Review PLC Diagrams and Programs 300	ToolingU
Provide a ladder diagram for a scenario	Hands on lab	Design a ladder diagram using one or more logic elements from a given scenario. Have students created their own ladder logic example.	Example of a ladder diagram
Connect and operate PLCs from a ladder diagram.	Hands on lab	Connect and operate a logic circuit given a ladder diagram.	Ladder diagram and PLC components
Evaluation	Instructor observations, assign homework or quiz.		

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Session 29 Lesson Plan for: Electromagnetic Solenoids

Session Summary: This session will identify the design and operation of solenoids, their components, different types and frequent applications in which they are used for.

Objectives: Describe the purpose and operation of a solenoid.
Identify several places where solenoids found and used.
Identify different positional control valves using solenoids.

<u>Description</u>	<u>Delivery Method</u>	<u>Activity</u>	<u>Materials</u>
ToolingU Reading Assignment	Online learning	Motor Controls - Solenoids 235 Lessons 1-14.	ToolingU
Learning Describe the use of solenoids, its operation and components, types of solenoids, and common applications used.	Web-Enhanced Lecture	Read/Review Solenoids 235	ToolingU
	Hands on lab	Connect and operate a circuit using a solenoid valve given a ladder diagram.	PLC with components and a solenoid valve
	Hands on lab	Design a control circuit in a ladder diagram format to operate a solenoid valve.	PLC with components and a solenoid valve

Evaluation Instructor observations, assign homework or quiz.

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Session 30 Lesson Plan for: Relay System Overview

Session Summary: This session will introduce relays and starters, their functions and the appropriate applications for use. We will also discuss the purpose, connection and operation of PLCs.

Objectives:
Define the operation of an electromechanical relay.
Define solid state relays and motor starters and provide examples where they are used.
Describe the number of poles, throws and breaks on given relay types.
Explain advantages and limitations of electromechanical relay and solid state relay.

	<u>Description</u>	<u>Delivery Method</u>	<u>Activity</u>	<u>Materials</u>
	ToolingU Reading Assignment	Online learning	Motor Controls - Timers and Counters 340 Lessons 1-18. Solid State Relays and Starters 375 Lessons 1-20. PLCs - Intro to PLCs 200 Lessons 1-17. Hardware for PLCs 210 Lessons 1-17. PLC Inputs and Outputs 240 Lessons 1-15.	ToolingU
	Define the use of electromechanical counters, actions performed, and common applications for use.	Web-Enhanced Lecture	Read/Review Timers and Counters 340 Lesson 16.	ToolingU
	Describe solid state relays and motor starters, device functions, and common applications for device use.	Web-Enhanced Lecture	Read/Review Solid State Relays and Starters 375	ToolingU
	Explain the primary reason for PLCs, its components, advantages of the device, working process and the need for a consistent programming language.	Web-Enhanced Lecture	Read/Review Intro to PLCs 200	ToolingU
Learning	Explain the purpose of programmable devices and how input and output modules are used.	Web-Enhanced Lecture	Read/Review Hardware for PLCs 210 Lessons 8 and 11. PLC Inputs and Outputs 240	ToolingU
	Demonstrate how to perform a simple on-off test on a solid state relay	Web presentation	Crydom TechLab Video Series shows the basic connections necessary to install a Solid State Relay as well as the step by step process on how to perform an operational on-off test. How does one perform a simple operational, on-off test on a solid state relay? video example.	http://www.youtube.com/watch?v=bzrsE4tJP8
	Demonstrate how to correctly install a panel mounted solid state relay to a panel or heat sink.	Web presentation	Crydom TechLab Video Series shows how to correctly install a panel mounted solid state relay or contactor to a panel or heat sink focusing on some basic rules to ensure their reliability. How to correctly install a panel mounted solid state relay to a panel or heat sink. video example.	http://www.youtube.com/watch?v=Jkx4lRff1c
Evaluation	Instructor observations, assign homework or quiz.			

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Course: Introduction to Maintenance Technology

Session 31 Lesson Plan for: Manual and Automated Switches

Session Summary: This session will identify the use of control devices, functions of each and the intended applications for operation.

Objectives:
Identify common switching devices used in a control system.
Explain the purpose and components of timers and counters.
Explain the difference between on-delay and off-delay timers.
Identify the symbols used in on-delay and off-delay control circuits.
Create circuit diagrams using the correct placement and use of symbols.

	<u>Description</u>	<u>Delivery Method</u>	<u>Activity</u>	<u>Materials</u>
	ToolingU Reading Assignment	Online learning	Motor Controls - Control Devices 260 Lessons 1-18. Limit Switches and Proximity Sensors 360 Lessons 1-16. Timers and Counters 340 Lessons 1-18 (assigned).	ToolingU
Learning	Identify different types of control devices, the design and operation of these devices for system operations.	Web-Enhanced Lecture	Read/Review Control Devices 260	ToolingU
	Describe limit switches and sensors, how they operate, common applications, influencing factors and appropriate placement for use.	Web-Enhanced Lecture	Read/Review Limit Switches and Proximity Sensors 360	ToolingU
	Define different types of timers and counters used for control devices, their components and the functions they operate.	Web-Enhanced Lecture	Read/Review Timers and Counters 340	ToolingU
	Design a circuit with a limit switch to create a sequence	Hands on lab	Design a logic circuit that uses a limit switch to sequence an event.	PLC, solenoid limit switch and a ladder diagram
	Connect contacts on time delay and PLC, set the relay and operate the circuit.	Hands on lab	Connect and operate a control circuit through a timer relay.	PLC, solenoids time delay relays and a ladder diagram
Evaluation	Instructor observations, assign homework or quiz.			