

COURSE SYLLABUS

Course Number: TBD

Course Title: Introduction to Maintenance Technology

Course Pre-requisites: None

Course Credit Hours: 3 credit hours

Structure of Course: 30/45/0/0

Textbook: Tooling U-SME Online resource

Course Description: This course is designed to introduce the fundamentals of preventive maintenance, routine repairs, production monitoring, and corrective operations, including a working knowledge of electrical, pneumatic and hydraulic power systems, lubrication concepts, bearings and couplings, belts and chain drives, machine control systems and devices.

Competencies: Upon completion of this course, the student will be able to:

- A. Interpret the basic types of welding, applications, operation of the welding process, and welding safety.
- B. Explain the components and operation of basic electrical circuits and electrical measurement.
- C. Identify the circuits and components of electrical power.
- D. Demonstrate the basic components and operation of fluid power and pneumatic devices.
- E. Demonstrate the basic components and operation of fluid power and hydraulic devices.
- F. Determine the appropriate Total Productive Maintenance schedule and lubrication concepts for maximum machine performance.
- G. Identify the purpose, function, and use of basic mechanical components and concepts.
- H. Interpret the basic machine control concepts.
- I. Identify the basic control devices.

Course Outline:

INTRODUCTION TO WELDING

1. Welding Fundamentals
 - a. Define welding and how it is used in industry.
 - b. Describe the various welding processes used to join materials.
 - c. Explain the welding process of oxy-acetylene, gas metal arc, shielded metal arc and spot welding and provide situations when they are used.

2. Welding Procedures

- a. Identify proper safety procedures for welding.
- b. Explain safety regulations for handling and storing welding cylinders.
- c. Describe the importance of maintained valve caps, hoses and cylinders.
- d. Demonstrate how to operate and adjust regulator valves on a fuel gas cylinder.
- e. Demonstrate how to properly set up a portable oxyacetylene station.
- f. Explain safety procedures used when performing a shielded metal arc weld.

ELECTRICAL THEORY

3. Principles of Electricity

- a. Define electricity and methods for producing it.
- b. Explain the physical relationship between atomic structure and electrical theory.
- c. Describe the "Law of Charges".
- d. Describe properties of direct and alternating current.
- e. Discuss the properties and uses of insulators, conductors, and semiconductors.

4. Elements of Operational Electrical Circuits

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

5. Analyze Electrical Circuits

- a. Explain the electrical properties of voltage, current, resistance, and power.
- b. Define volt, ampere, ohm, and watt.
- c. Define Ohm's Law.
- d. Describe the relationship between electrical quantities using Ohm's Law.

DETERMINING ELECTRICAL CIRCUIT VALUES

6. Use of the Multimeter

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

7. Electrical Circuit Protection

- a. Describe circuit breaker types and identify their schematic symbols.
- b. Describe the purpose of a fuse and identify its schematic symbol.

8. Use of Series Rules to Calculate Circuit Values
 - a. List the rules for series circuits.
 - b. Recognize components used in real series applications.
 - c. Calculate total voltage, current, resistance and power values in series circuits.
 - d. Apply Ohm's Law to solve unknown series quantities.
 - e. Recognize the presence of an open condition in series circuits.
 - f. Recognize the presence of a short condition in series circuits.

9. Use of Parallel Rules to Calculate Circuit Values
 - a. List the rules for series circuits.
 - b. Recognize components used in real parallel applications.
 - c. Calculate total voltage, current, resistance and power values in parallel circuits.
 - d. Apply Ohm's Law to solve unknown parallel quantities.
 - e. Recognize the presence of an open condition in parallel circuits.
 - f. Recognize the presence of a short condition in parallel circuits.

FUNDAMENTALS OF MOTORS AND MOTOR CONTROLS

10. Elements of AC Electricity use with Motors
 - a. Describe the advantages of using AC motors.
 - b. Describe what occurs during a complete charge and discharge of an electromagnetic cycle.
 - c. Review the key terms used when explaining magnetic induction.
 - d. Describe how to connect a single-phase motor in an electrical circuit.
 - e. Describe how to connect a three-phase motor in an electrical circuit.

11. Motor Controls
 - a. Explain the purpose of a motor control circuit.
 - b. Describe the purpose of relays, contactors, and motor starters in a motor control circuit.
 - c. Explain protection devices required to safely operate a motor control circuit.
 - d. Explain the purpose of overload relays.
 - e. Explain the steps to safely wire a motor in an industrial environment.

PNEUMATIC SYSTEMS

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

13. Pneumatic Components
 - a. Identify different components of a pneumatic system.
 - b. Demonstrate how to match components to symbols on a schematic.

- c. Identify various types of air compressors and regulators.
- d. Identify various types of control valves and directional control valves.
- e. Identify various types of pneumatic cylinders and motors.

14. Pneumatic Circuits

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

HYDRAULIC SYSTEMS

15. Fundamentals of Hydraulics

- a. Define the function of a hydraulic system.
- b. Describe the importance of hydraulic pressure.
- c. Explain the relationship between force and pressure.
- d. Describe how to calculate the force of a cylinder.
- e. Describe how to calculate torque of a motor.
- f. Demonstrate how to measure and control flow rates and how it relates to operational speed.

16. Hydraulic Components

- a. Demonstrate how to match components to symbols on a schematic.
- b. Identify hydraulic pumps and reservoirs.
- c. Identify hydraulic conductors, connectors and filters and their locations.
- d. Identify various types of hydraulic valves.
- e. Identify various types of hydraulic cylinders and motors.

17. Hydraulic Circuits and Filtration

- a. Explain the importance of a hydraulic cylinder circuit.
- b. Explain the importance of a hydraulic motor circuit.
- c. Create a schematic diagram for a hydraulic circuit.
- d. Describe the functions of a filtration system.

LUBRICANTS

18. Continued Maintenance

- a. Describe the purpose of Total Productive Maintenance (TPM).
- b. Identify preventative maintenance procedures for mechanical systems.
- c. Describe adjustment techniques.
- d. Explain preventative maintenance documentation.

19. Lubricant Fundamentals

- a. Describe the primary purpose of lubricants.
- b. Identify the appropriate lubricant based on the application.

20. Oil Applications

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

21. Lubricants for Rotation Devices

- a. Identify types of lubricant greases used in manufacturing.
- b. Describe how greases are applied.
- c. Explain how to select the grade and type of a grease.
- d. Differentiate the proper applications for greases and oils.

MECHANICAL COMPONENTS

22. Power Train System

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

23. Bearings and Couplings

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

DRIVE SYSTEMS

24. Gear Operation and Maintenance

- a. Define the purpose of a gear.
- b. Identify different types of gears.
- c. Determine speed using gear ratios.
- d. Describe proper installation and adjustment of gears in a train system.
- e. Identify different types of lubrications for system maintenance.

25. Belt Operation and Maintenance

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

26. Chain Operation and Maintenance

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

CONTROL SYSTEMS

27. Control Circuit Logic

- a. Explain the importance of control circuit logic devices.
- b. Identify logic functions in control circuits.
- c. Explain the difference between AND and OR circuit logic.
- d. Explain NOT circuit logic.
- e. Explain the difference between NAND and NOR circuit logic.
- f. Explain the operation of a memory circuit.

28. Electrical Schematic Diagrams

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

29. Electromagnetic Solenoids

- a. Describe the purpose and operation of a solenoid.
- b. Identify several places where solenoids are found and used.
- c. Identify different positional control valves using solenoids.

CONTROL DEVICES

30. Relay System Overview

- a. Define the operation of an electromechanical relay.
- b. Define solid state relays and motor starters and give examples where they are used.
- c. Describe the number of poles, throws and breaks on given relay types.
- d. Explain advantages and limitations of electromechanical relay and solid state relay.

31. Manual and Automated Switches

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