# ALAMO COLLEGES DISTRICT
## Workforce Training Network
### Corporate College



## Alamo Colleges District Technical Institute

# ACTI Mechatronics

# Catalog

Alamo Colleges District Technical Institute

# Mechatronics Catalog

## TABLE OF CONTENTS

**ALAMO COLLEGES DISTRICT**
Workforce Training Network
Corporate College

# OSHA

*General industry workers need information about their rights, employer responsibilities, and how to file a complaint as well as how to identify, abate, avoid and prevent job related hazards on a job site. Learn a variety of general industry safety and health hazards which a worker may encounter as well as an emphasis on hazard identification, avoidance, control and prevention, to OSHA standards.*

**Topics covered will include:**

OSHA Required (7 hours):
- Introduction to OSHA
- Walking and Working Surfaces
- Electrical Safety
- Hazard Communication
- Exit Routes, Emergency Action Plans, Fire Prevention Plans, and Fire Protection
- Personal Protective Equipment

OSHA Elective (3 hours) – Recommended:
- Hazardous Materials (Flammable and Combustible Liquids)
- Ergonomics
- Fall Protection

OSHA Optional:
- Forklift Familiarization Safety

**By the completion of the training participants will be able to:**

Have a working knowledge of basic general industry safety requirements in the workplace

Have general knowledge of OSHA rules and what OSHA is about

Have a working knowledge of potential hazards in general industry

Know proper use and care of personnel protective equipment

Knowledge on how to locate safety information and stay abreast of current safety information

**12 hours**

# Technical Mathematics & Blueprint Reading

*Technical math and blueprint reading go hand-in-hand. Get skills training with an emphasis on numbering systems, calculations, and problem solving skills needed to solve for electronic circuit parameters and to read blueprints.*

### Topics covered will include:

Math Operations

Exponents and Radicals

Basic Geometry

Basic Trigonometry

Measurement Tools
- Caliper (Vernier, Digital and Dial)
- Micrometer
- Height Gauge

Introduction to Blueprint Reading

View and Sectioning Conventions

Dimensioning Practices

Tolerance as a Method of Control

Interpreting Special Applications

*" It was helpful to refresh my knowledge on what I don't use everyday and reinforce what I already know."*

*—Jeffrey*
*Caterpillar*

## 40 hours

### By the completion of the training participants will be able to:

Demonstrate basic math operations

Demonstrate geometry and trigonometry

Perform math conversions

Interpret basic blueprint drawings

# Electricity DC Fundamentals

*Gain fundamental knowledge of electrical theory and skills required in the industrial or manufacturing industry. Learn Direct Current (DC) including Ohm's law, Kirchhoff's laws, and circuit analysis techniques. Emphasis is on circuit analysis of resistive networks and DC voltage measurements.*
*(Prerequisite: Technical Math and Blueprint Reading)*

*" I've been working with DC electricity for years and this course closed a lot of gaps I've had."*

*—John Arconic*

## Topics covered will include:

Introduction to Electricity

Metric Prefixes

Scientific and Engineering Notation

Current/Amperage

Voltage/Volts

Resistor/Resistance

DC Circuit Problem Solving

DC Series Circuits

DC Parallel Circuits

Combinational Circuits (Series-Parallel)
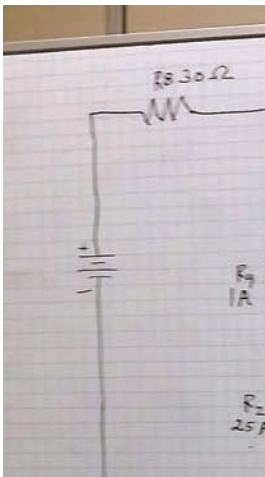
Wheatstone Bridge

Metering Circuits (multi-meter)

## By the completion of the training participants will be able to:

Understand the fundamentals of DC circuits

Understand how Direct Current works

Understand Ohm's law

Understand Kirchhoff's Voltage Law and Kirchhoff's Current Law

Understand DC series/parallel/combination circuits

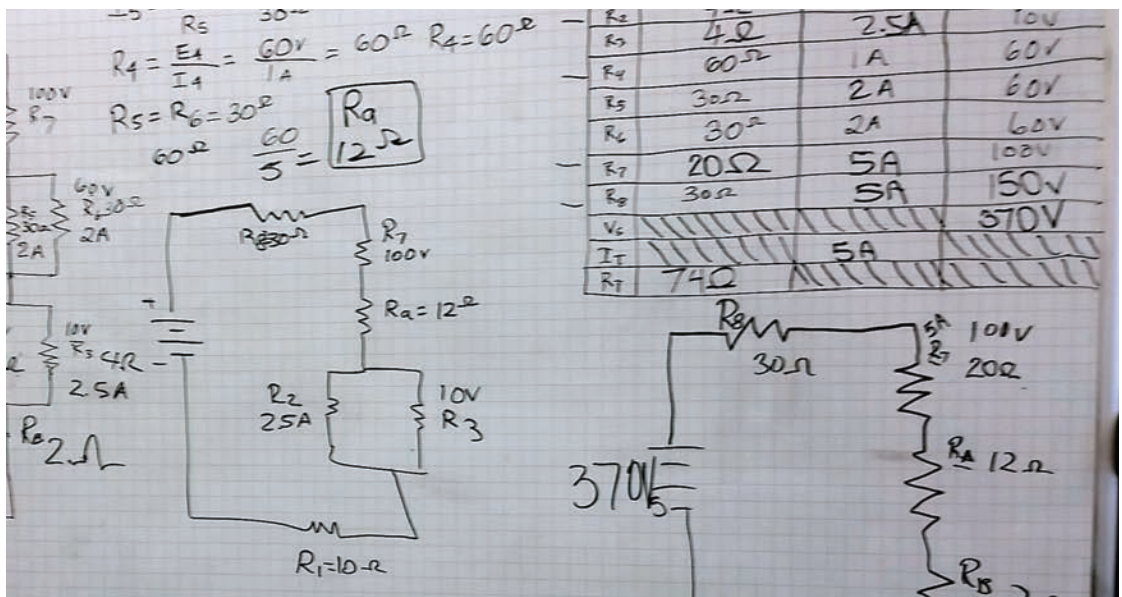**40 hours**

# Electricity AC Fundamentals

*Understanding Alternating Current (AC) circuits is a required skill. Learn the fundamentals of Alternating Current (AC), Capacitance, Inductance, Power, transformers, and fundamentals of DC/AC motors.*
*(Prerequisite: Technical Math and Blueprint Reading; DC Fundamentals)*

## Topics covered will include:

Principles of Alternating Current

Oscilloscope

Function Generator

Capacitor/Capacitance

Inductor/Inductance

Power in AC Circuits

RLC Circuits

Single-Phase Transformers

Three-Phase Systems

Fundamentals of DC/AC Motors

*" Great class and the instructor made us feel comfortable. This will be something I can use every day."*

*—Steven*
*H-E-B*
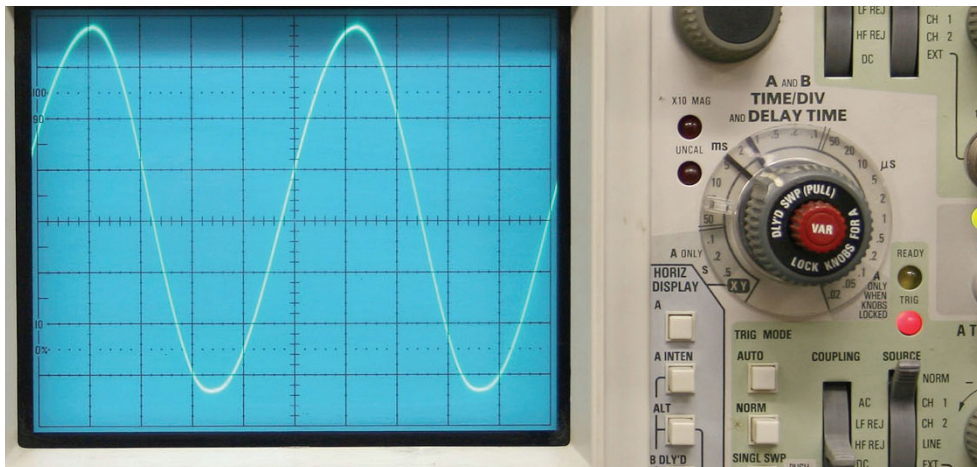
## By the completion of the training participants will be able to:

Understand the fundamentals of AC/DC circuits, how they differ and how they are similar

Demonstrate how electrical energy is turned into heat energy

Understand the difference in AC circuits: resistance versus impedance

Understand how oscilloscope and function generators work

Understand how AC works

Understand phase shift

Understand how transformers work

Demonstrate a basic knowledge of AC Inductive and AC Capacitive circuits

Demonstrate a fundamental knowledge of DC/AC motors

## 40 hours

# DC/AC Motor Controls

*Get skilled in the fundamentals of electric motors with an emphasis on starting, and speed control as well as braking systems. Understand the various concepts of motor controls, circuits and components that are needed to accomplish different controls.*
*(Prerequisite: Technical Math and Blueprint Reading; DC Fundamentals and AC Fundamentals)*

*"Excellent material covered over classroom time and hands-on practice. The instructor made it easy to understand."*

*– Marco*
*Caterpillar*

## Topics covered will include:

DC Power Supplies

DC Generators

DC Armatures

DC Motors

Single Phase AC Motors

Control Pilot Devices

Circuit Layout

Connections and Symbols

Basic Control Circuits

Jogging (Inching) Control Circuits

Basic motor troubleshooting skills

Multi-meters

## By the completion of the training participants will be able to:

Understand the different types of motors (DC vs AC)

Identify types of motor maintenance

Identify characteristics of a motor maintenance program

Identify safety procedures to use during motor maintenance

Understand motor control components

Demonstrate knowledge of different theories of operation

Interpret electrical diagrams

Demonstrate industrial motor control knowledge through "hands-on" learning lab experience

Troubleshoot a failed component during learning lab practical assignments

**80 hours**

# Mechanical Drives

*Get the necessary knowledge and hands-on experience for initial entry into machine drive maintenance and repair.*
*(Prerequisite: Technical Math and Blueprint Reading)*

## Topics covered will include:

Introduction to Mechanical Drive Systems

Belt Drives

Chain Drives

Gear Drives

Lubrication

Couplings

Shaft Alignment

Bearings

Ball Screws

Linear Bearings

Gaskets and Seals

Clutches

Brakes

### By the completion of the training participants will be able to:

Identify the characteristics of seals, bearings, lubricants, and fasteners

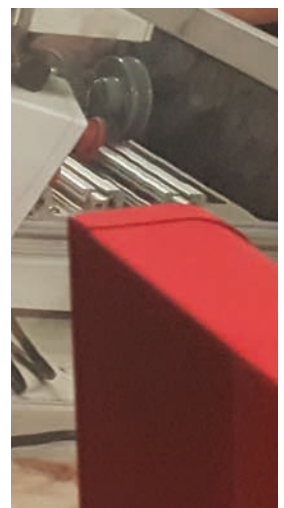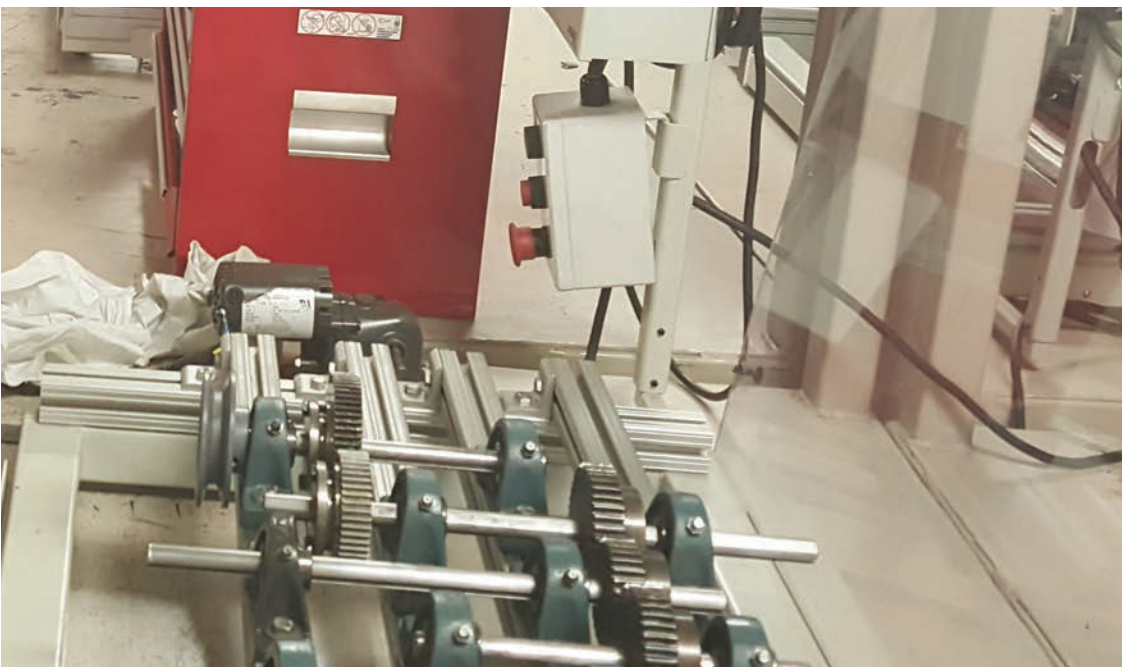Install seals, bearings, fasteners and gear drives

Apply various lubricants in accordance with preventive and corrective maintenance requirements

Operate hand and power tools, belt and chain drive systems, and gear drive systems

*"The labs were the most useful part of the class. I learn better with hands-on practice."*

*– Juan*
*Alcoa San Antonio Works*

page 6

40 hours

# Electro-Mechanical Devices

*This course is a study of electro-mechanical devices for manufacturing including motion control systems, process control systems, components of motors, various switches, sensors, photo eyes and electromagnetic relays.*
*(Prerequisite: Technical Math and Blueprint Reading; DC Fundamentals; AC Fundamentals)*

## Topics covered will include:

Classification and characteristics of motion control systems and process control systems Open-loop systems and closed-loop systems and how they differ

Four control modes

Major components of DC motors

Motor action, main field, commutation, torque, and other characteristics of motors

How heat and pressure affects a process

Different types of standard electronic and pneumatic transmission signals

Control valves

Limit switches

Inductive and capacitive proximity senors

Photo electric sensors and photo eyes

Electro-magnetic relay

Feedback devices

> *" The class helped me understand the right function and proper use for sensors."*
>
> *—Juan Toyotetsu*

## By the completion of the training participants will be able to:

Understand two classifications of control systems, three common characteristics of motion control systems, and two categories of process control systems

Identify the differences between open-loop and closed-loop systems, and describe the elements of a closed-loop system

Understand the four control modes used by industrial controllers

Describe how varying heat and pressure levels affect a process

Provide the different types of standard electronic and pneumatic transmission signals and their numerical signs

Understand types of control valves, describe their characteristics and applications

Describe the operation of a limit switch

Explain operations of an inductive proximity sensor

Describe the operation of a capacitive proximity detector; and Hall Effect proximity sensor; photo electric sensor; and various photo eyes; electromagnetic relay

Describe the operations of an Electromagnetic Relay

## 40 hours

# Hydraulic Fundamentals

*Many manufacturing systems use the power of fluids. Learn the principles of fluid power energy and its controlled applications in this modularized entry level course.*
*(Prerequisite: Technical Math and Blueprint Reading)*

## Topics covered will include:

Hydraulic systems safety

Various hydraulic components including power unit, relief valve, flow control valve, directional control valve

Pascal's Law

Flow rate and velocity

Meter-in, meter-out and bypass flow control circuit

Force, work, power and efficiency of a hydraulic system

Cylinders in series

Cylinders in parallel

Regenerative circuit

Accumulators, hydraulic motors, pressure reducing valves and remotely controlled relief valves

## By the completion of the training participants will be able to:

Identify hydraulic symbols

Identify hydraulic components and schematics drawings

Understand the basic physical concepts

Understand and build basic lab applications

Demonstrate knowledge of the advantages/disadvantages of hydraulic components

Understand basic electrical hydraulic circuits

*" The hands-on and schematics has helped me understand how hydraulics operate."*

*– Bruno*
*City of San Antonio*

page 8
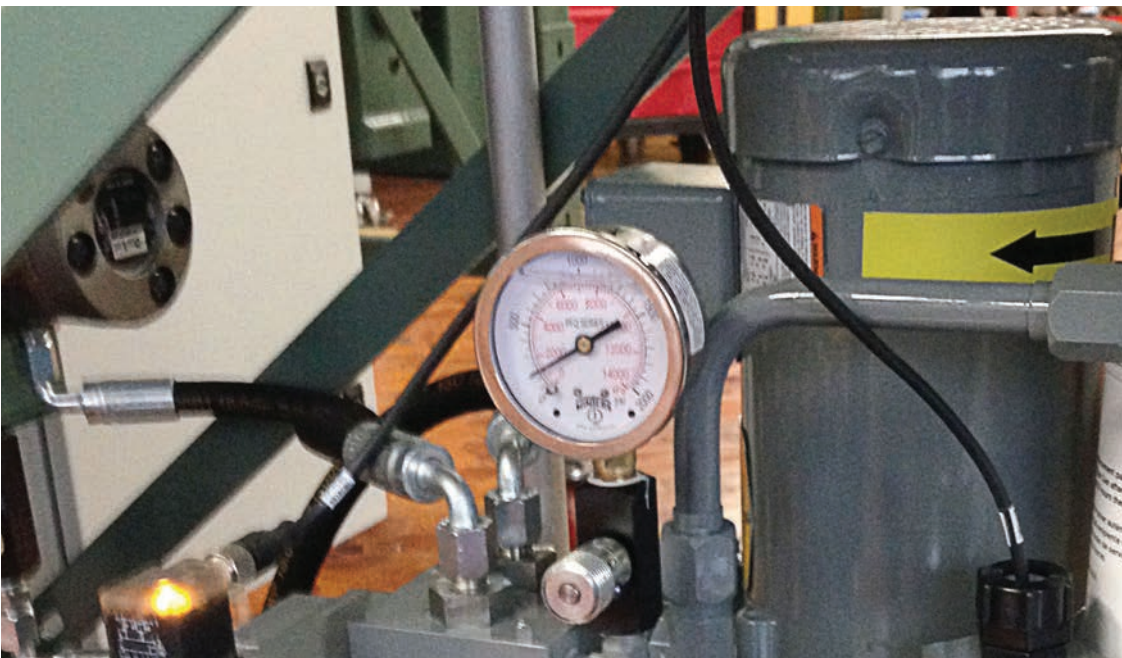
40 hours

# Pneumatics Fundamentals

*A strong command of pneumatic components is vital to a successful industrial career. This is a modularized entry level course in the principles of pneumatic energy and its controlled application that consists of an introductory and an advanced training module. Learn to build basic Electro-pneumatic Circuits and apply fault finding techniques. (Prerequisite: Technical Math and Blueprint Reading; DC Fundamentals; AC Fundamentals; DC/AC Motor Controls)*

## Topics covered will include:

Pneumatics Trainer, Pneumatics Power, Conditioning Unit and its components

Basic pneumatics physical concept; Pressure vs. Force; Pressure vs. Volume; Pressure Drop vs. Flow; and Vacuum Generation

Directional Control Valves
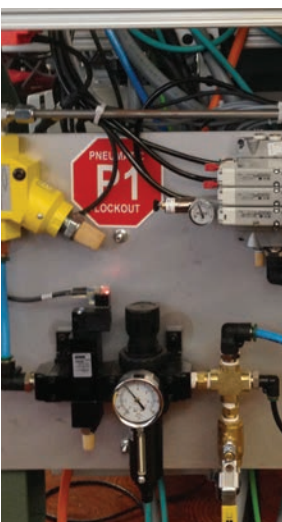
Directional and Speed Control of Cylinders

Cylinders in Series

Cylinders in Parallel

Pneumatic Motor Circuit

Basic Electro-pneumatic circuit

## By the completion of the training participants will be able to:

Identify pneumatic symbols

Identify pneumatic components and schematics drawings

Understand the basic physical concepts

Understand and build basic lab applications

Demonstrate knowledge of the advantages/disadvantages of pneumatic components

Identify pumps

Understand basic motor circuits

Understand the fundamentals of electricity

Understand the construction and function of the components in electro-pneumatic control systems

Identify and use control schematics

**40 hours**

# Introduction to PLC

*Programmable Logic Controllers are used throughout industry in today's world. Learn the maintenance, programming and troubleshooting of Allen Bradley PLC systems. It includes power supplies, discrete Input/Output (I/O) modules, programming devices, processors, basic logic elements, PLC programming, timers, counters, program control instructions, data manipulation instructions and math instructions. (Prerequisite: Technical Math and Blueprint Reading; DC Fundamentals; AC Fundamentals; DC/AC Motor Controls; Electromechanical Devices)*

## Topics covered will include:

PLC Safety

PLC's vs. Relay Logic

Advantages and Disadvantages of PLC

Basic Instructions

Number Systems

Normally open/closed contacts inputs

Coils Outputs

Basic PLC Operations

And/Or/Combination Circuits

I/O Wiring

Allen Bradley Control Logix 1200 Hardware and Software

Basics of PLC Programming

Fundamentals of Logic

Timers/Counters

Basic Program Control Instructions

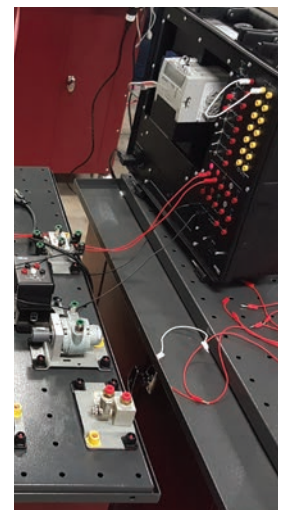*" The hands-on and the knowlegeable instructor helped me learn a lot in this class."*

*— Ray*
*H-E-B*

## By the completion of the training participants will be able to:

Understand the fundamental principles of PLC hardware structure and programming

Understand and design programming

Understand the fundamental principles and PLC operations

Demonstrate an understanding of programming software

Understand the fundamentals of timers, counters and other different instructions

Demonstrate an understanding of PLC programming using different functions

Demonstrate basic troubleshooting skills for Allen Bradley PLCs

80 hours

# Robotics Fundamentals

*Robotics is increasingly used by companies as a means for increased production. Learn the fundamentals of robotics used in manufacturing with an emphasis on safety, robot operations, programming, applications in manufacturing, and general industry.*
*(Prerequisite: DC Fundamentals; AC Fundamentals; DC/AC Motor Controls; Electro-mechanical Devices; Pneumatics Fundamentals and Introduction to PLC )*

## Topics covered will include:

Safety with Robotics in Industry

Work Envelopes/Work Areas

Robotic Systems and Operation

Teach Pendants

Start Up Procedures

Programming using Teach Pendant

Virtual Programming
- Robo CIM – Festo/Lab Volt
- Robo Guide - Fanuc

Fanuc Specific Topics
- Error & Fault Recovery
- Frames
- Motion Programs
- Motion Instructions
- Copying and Editing Programs
- Branching Programs
- Instructions
- Position Registers
- Input / Output

40 hours
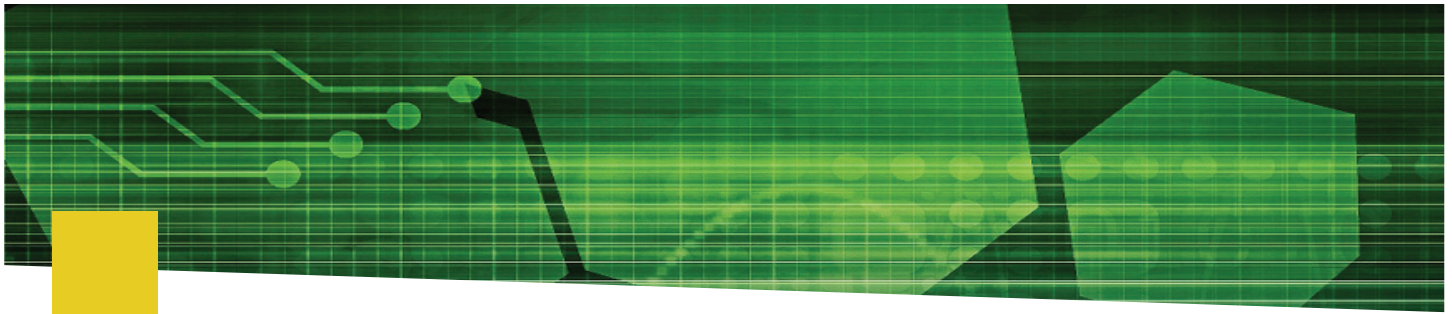
## By the completion of the training participants will be able to:

Complete a written pre-assessment to assist in establishing a baseline

Identify and discuss the difference between the maximum envelope and work envelope of a robotic system

Identify at least three safety features/devices used to ensure employee safety where robotic systems are in use, and the two types of control systems used in robotic systems

List the five major systems that comprise an industrial robotic system, and the six degrees of freedom and associated movements

Define and explain the difference between linear and rotary actuation

Explain how a non-servo control system operates, and how a servo control system operates

Identify at least two of the three types of actuator drives and explain their operations

Given a Festo/Lab Volt Robotic Training System with teach pendant participants will be able to:
   - Demonstrate the ability to calibrate the system using tools provided, to execute a soft and a hard home
   - Develop programs to execute set criteria within given tolerances
   - Demonstrate the ability to effectively recover the system from minor faults

Given a Fanuc LR Mate 200ic robot and teach pendant participants will be able to demonstrate how to:
   - Identify and explain the operation of various switches and buttons on the Teach Pendant; the purpose of, and demonstrate the correct operation of the Deadman Switch
   - Demonstrate the ability to navigate and describe the purpose of various menus on the teach pendant
   - Correctly power up and power down the robot system
   - Demonstrate how to reset a general fault, reset a Cartesian/Joint DCS error, recover from various Alarms/Errors, jog the robot in the Joint frame mode, and how to change the speed of axis movement
   - Explain and demonstrate the use of the Abort All command
   - Select a prescribed frame
   - Define Singularity and demonstrate recovery from a singularity fault

Given RoboGuide virtual programming software participants will be able to demonstrate the ability to:
   - Navigate the software and create a robot work cell
   - Demonstrate Jogging the virtual robot
   - Add parts and fixtures to the work cell
   - Create and execute multiple programs in various configurations

Demonstrate successful transfer of knowledge and skills through attaining a score of 70% or higher through a written, a virtual, and a hands-on-final review exercise

40 hours

# National Electrical Code

*Get a basic overview and introduction to the 2017 National Electrical Code® (NEC®). Learn the structure of the various articles of the NEC®, how to navigate these complex articles, understand major changes, and basic application of the major articles. Cover the major articles found in the current 2017 edition of the NFPA 70 National Electrical Code®.*

*" The classes were put together very well and the teacher was very knowledgeable and helpful."*

*– Shawn*
*Pressure Systems International*

## By the completion of the training participants will be able to:

Identify key terms associated with the NEC®

Identify the nine chapters associated with the NEC®

Identify basic requirements covered by the four general chapters of the NEC®

Demonstrate understanding of the organization of the NEC® through classroom exercises

Demonstrate an understanding of how to identify 2017 NEC® updates

Demonstrate ability to apply NEC® applications through written exercises to 70% accuracy

Demonstrate ability to apply NEC® by completing a written assessment with 65% accuracy

**16 hours**

# Integrated Systems Troubleshooting

*Is there an indispensable skill needed in the manufacturing environment? Basic troubleshooting is it. Experience this capstone class that utilizes the AMTEC Manufacturing Simulator to provide an introduction and troubleshooting skills using the integrated systems approach for advanced integrated automation systems used in today's industrial manufacturing.  You focus on the overview/familiarization of the sophisticated manufacturing systems, various factors and skills to troubleshoot systems and the subsystems.*
*(Prerequisite: Technical Math and Blueprint Reading; DC Fundamentals; AC Fundamentals; DC/AC Motor Controls; Hydraulics Fundamentals; Pneumatics Fundamentals; Electro-mechanical Devices and Introduction to PLC)*

## By the completion of the training participants will be able to:

Identify troubleshooting safety hazards

Demonstrate the various factors of the troubleshooting process

Demonstrate a standard process for reducing machines from the systems to their subsystems

Demonstrate the philosophies of troubleshooting in an industrial environment
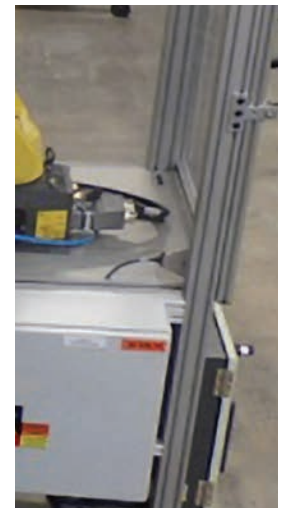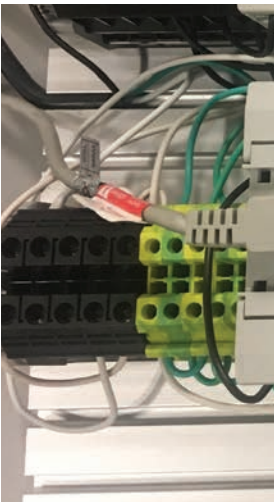
**80 hours**

# Intermediate PLC

*Continue learning the fundamentals of PLC and covers the maintenance, programming and troubleshooting of Allen Bradley PLC systems. It includes PLC programming, program control instructions, data manipulation instructions, math instructions, and shift register instructions.*

## Topics covered will include:

Continuous to work on Timers and Counters

Master Control Reset (MCR) instruction

Jump Instruction (JMP)

Subroutine (JSR) Function

Immediate Input/Output Instructions

Data Transfer Operations

Data Compare Instructions

Data Manipulation Instructions

Bit/Words Shift Instructions
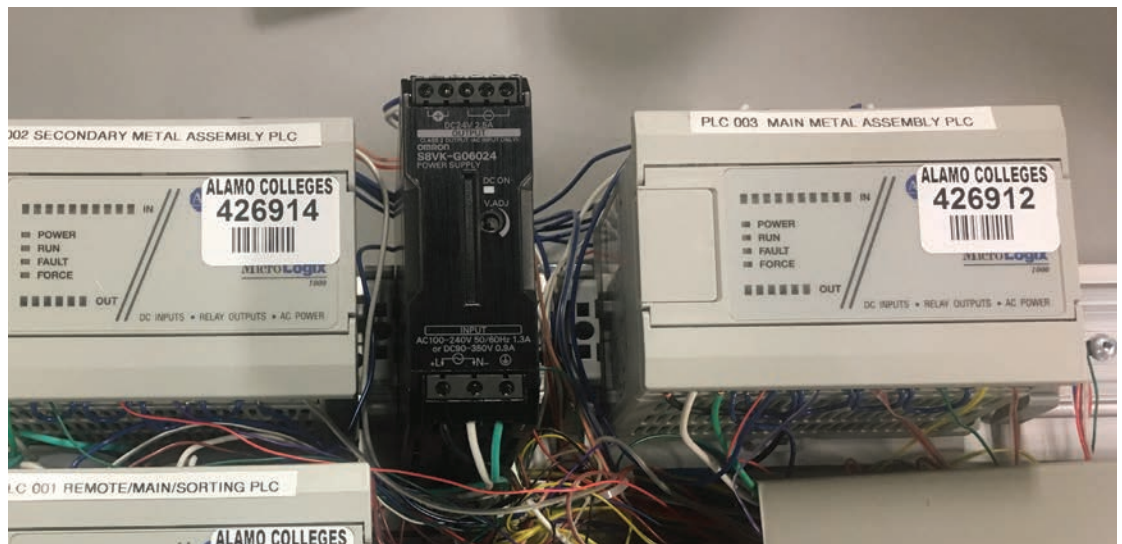
## By the completion of the training participants will be able to:

Be more familiar with PLC programming

Understand more clearly about timers and counters in PLC applications

Describe the operation of the master control reset instruction

Describe the operation for the jump instruction and the label instruction

Explain the function of subroutines

Describe the immediate input and output instruction function

Execute data transfer of word and file level instructions from one memory location to another

Interpret data compare instructions

Describe the operation of bit and word shift instructions

## 40 hours

# Sequence Control

*Focus on how various components, machines, systems, and larger entities rely on each other through interaction and integration between various systems. Although operated on a smaller scale than most industrial plants, it will provide participants with a good understanding of how the larger systems are sequenced to ensure fluid and efficient control.*

## Topics covered will include:

Safety in Industry

Review of Electrical Symbols & Schematics

Variable Frequency Drives (VFD)

Review of Basic Control Circuits

Review of Jogging (Inching) Control Circuits

Methods of Braking

Reduced AC Voltage Starters

Synchronous Machine Controls

## By the completion of the training participants will be able to:

Identify power hazards and describe the proper safety precautions related to safety practices used in industry

Demonstrate the use of the following items to navigate, identify, and describe the function of electrical circuits: Symbols>Electrical Diagrams>Schematics>Line Diagrams>Applications

Understand variable frequency drives and how a variable frequency drive controls the speed, acceleration and deceleration of an induction motor

Be familiar with different control circuits, e.g., two-wire controls, thee-wire controls, hand-off-automatic controls, multi-pushbuttons, mechanical interlock for reversing control, sequence control etc.

Be familiar with different jogging control circuits, e.g. Jogging using a control relay and a reversing starter, jogging using a reversing starter and a selector switch
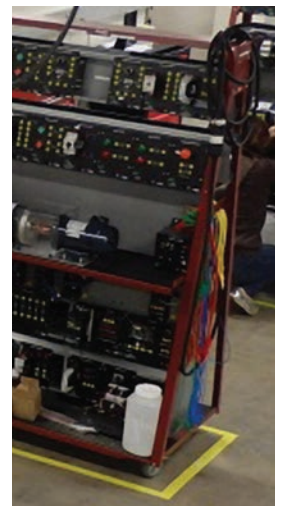
Connect and troubleshoot reduced voltage starters using resistors, and an autotransformer starter

Understand synchronous motors

Connect and troubleshoot a pushbutton synchronous motor control circuit, and a timed semi-automatic synchronous motor controller

Synchronize a synchronous alternator to a power system

40 hours

# Electric Pneumatics

*Review basic concepts of electricity, ladder diagrams, basic electrically controlled pneumatic circuits, logic function valves, and cover functional systems, industrial pneumatic applications including drilling  system and garbage compactor circuit and PLC controlled pneumatic  systems.*

## Topics covered will include:

Basic Electricity

Ladder Diagrams

Basic Electrically controlled Pneumatic Circuits

Basic and/or Logic Function Circuit

Sequencing Pneumatic Circuits

Time-Delay Electro-pneumatic Applications

PLC-Controlled Clamp and Work Circuit

PLC-Controlled Conveyor system
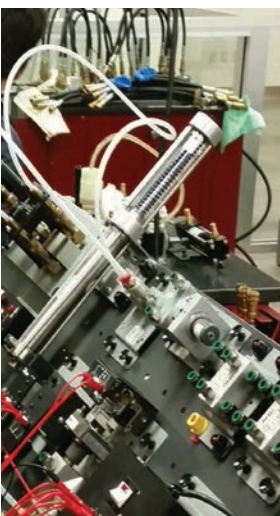
## By the completion of the training participants will be able to:

Describe electrically controlled pneumatic systems

Understand indirect control e.g., how a directional valve is actuated by a pressure signal delivered by another directional valve or by an electrical signal provided by an input device

Understand the basic memory and priority electro-pneumatic circuit

Be familiar with multi-pressure systems, sequencing pneumatic circuits, time-delay electropneumatic applications, and pneumatic actuator deceleration circuits

Understand how PLC controls electro-pneumatic circuits, and how to use simple and logical methods to perform troubleshooting application to both electric and pneumatic circuits

Understand industrial type circuits and sensors used in different applications

**40 hours**

# Advanced PLC

*Take your PLC knowledge and skills to the next level.  Get a basic overview of the Allen Bradley Control Logix5000 family of industrial automation.*

## Topics covered will include:

Logix5000 system with different modules configu ation
RSLinx including RS232 serial driver and Ethernet
RSWho
Control Logix Controller
I/O Configurations
Alias Tag and Base Tag
Data Types
Subroutine
Tasks, Programs, and Routines
Get System Values (GSV)
Cross Reference
Forcing in RSLogix5000
Trends
Produced and Consumed Tags
Messaging
DeviceNet

## By the completion of the training participants will be able to:

Understand the controller properties and tag memory with
I/O configurations
Understand control logix addressing scheme
Demonstrate basic programming concepts and online editing in
RSLogix5000
Understand the difference between base tags and alias tags and how
to create and apply alias tags
Recognize the different data types and memory usage
Understand the properties of tasks, programs and routines
Cross references tags and I/O cards
Be familiar with the troubleshooting skills and understanding of the
tools available in the software
Describe the messaging and produced/consumed tags configured
over Ethernet Peer to Peer Communications
Be familiar with DeviceNet
Understand configuration in Networks

## 40 hours

# Alamo Colleges District

# Campus Locations

Northeast Lakeview

Northwest Vista
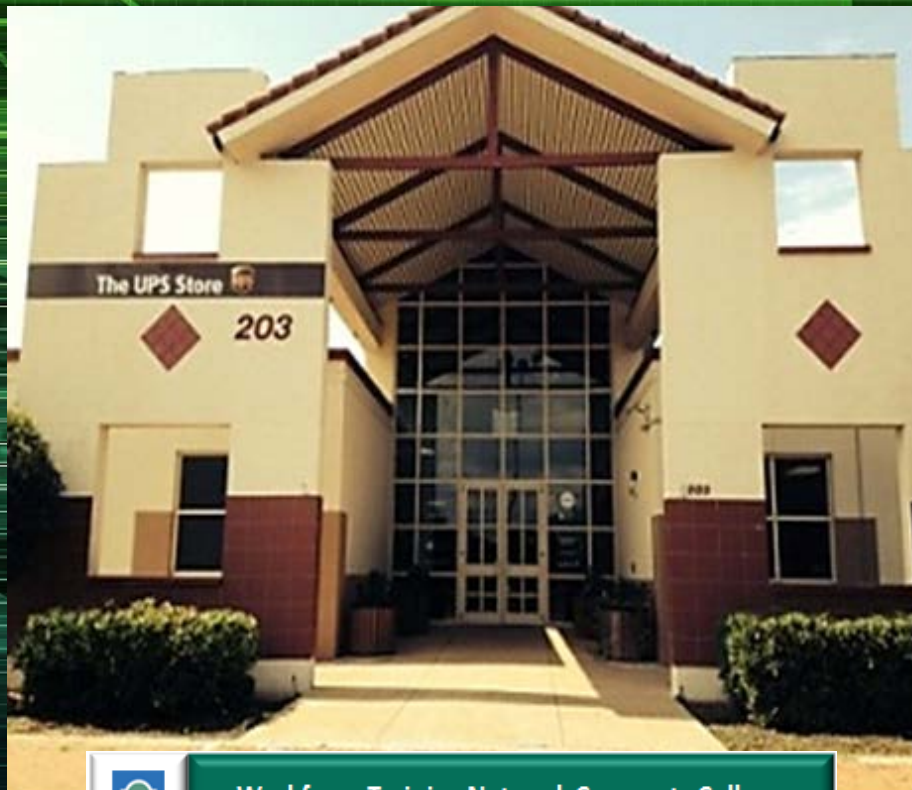
Palo Alto

St. Philip's

San Antonio

# Serving San Antonio & Surrounding Counties

# *Strengthening skills to develop your workforce!*

**Workforce Training Network Corporate College**

**800 Quintana Rd., Bldg. 8, San Antonio, TX 78211**

**For more information call (210) 485-0880**

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