CNC Technical Solutions – Phase 4 Advanced AC Motor Controls

Phase 4 - Advanced AC Motor Controls

Classroom and lab hours - Combined 96 total hours.
Typical method of delivery - 1 day of class per week, 8 hours a day. Instructor led, combined classroom and lab delivery.

Phase 4 - Advanced Motor Controls is an instructor led class that will build on the concepts of Phase 1 Industrial Electronics, Phase 2 Industrial Controls and Phase 3 Advanced Control Systems. The Phase 1 and 2 are pre-requisites to this class. The primary learning objective of this class is the theory, implementation, and practical understanding of Variable Frequency Drives (VFD) and AC Motors and how they function and interact with each other in the mechanical systems that they drive. In addition, curricula will cover methods to debug and analyze these systems when they fail using proper test equipment and troubleshooting methods.

Course Highlights

- Allen Bradley Compact Logics PLC Controls &The Panel View Plus
- Allen Bradley 525 & 527 VFDs
- Motor Starters and Relays
- Wiring of Three phase AC Motors, VFD's & Motor Starters and Single-phase AC Motors and Motor Starters.
- Tuning VFDs & PID concepts
- Motor Controls concepts –Both open and closed loop with Encoder Feedback
- Laptop/cabling - PC to PLC communications using Studio 5000
- Electrical drawing set for the Motor Control Simulator
- Student will debug using all associated test equipment including, but not limited to, DVMs, Oscilloscopes, Amp Meters, Megger and High Potential Testing.

Advanced AC Motors and VFD

This class will focus on functions and applications that AC Motor Controls play in the overall manufacturing process. During the practical lab portion of the class students will wire and field commission both a three-phase dual voltage induction motor & AB 527 VFD application and then a single-phase AC motor and motor starter application. Students will review both a Networked VFD and Stand-alone VFD motor control application. Students will review both open and closed loop positioning systems concepts using a custom designed CNCTS Dual Motor & Drive system which utilizes the AB Compact Logix PLC and Panel View Plus for the operator interface and twin AB 527 power flex VFD and Marathon Inverter rated motors with a shaft mounted 12 bit 4095 count A Quad B encoder for positioning.

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The system is intended to give the student a comprehensive understanding of PID tuning concepts using our CNCTS designed state of the art industrial hardware simulation system. The simulation system will be using three inertia wheels of different mass which is intended to demonstrate the concept of the load inertia ratio and how this will affect the performance of a system.

Under direction from an instructor the student will plot and graft the systems response with these changing masses and the student will understand the relationship between position error, velocity command and current and the how the associated tuning parameters effect the performance of the entire system. This tuning will all be graphically displayed using custom developed trend applications which will allow the student to do real time comparative analysis of two VFD motor-controlled systems running side by side.

Motor controls application concepts covered will include VFD closed loop device with feedback (PID application) air compressor, water pressure pumping system, load sharing concept (EGB) conveyor and tension control. VFD open loop pumps & fan application concepts. Students will Troubleshoot failed motors and motor cables using the insulation tester ”megger” and high potential tester “HiPot”. Use of the proper instrumentation for AC motor diagnostics, i.e. digital voltmeters with low pass filtration, AC clamp on amp meter with low pass filtration, digital oscilloscopes, both contacting and non-contacting tachometers, the insulation tester (Megger) and the high potential tester (HiPot) will be covered in great detail.

Anticipated Learning Outcomes

Upon completion of Phase 4 - Advanced Ac Motor Controls the student will achieve the following Learning Outcomes.

- Comprehend AC Motor theory and practical applications, rules & formulas
- Comprehend Magnetism, Electromagnetism & Induction
- Comprehend Rotating Magnetic Field Theory in Poly Phase Motors
- Comprehend the theory and practical applications of Polyphase motors, Synchronous Motors, Single Phase Motors and DC Motors
- Comprehend the Principles of Electronic speed control and applications of VFD using pulse width modulation.
- Review the negative effect of PWM - harmonics, negative sequence voltage & power factor
- Be proficient in troubleshooting failures in Motor Control applications and systems using all applicable testing equipment