The purpose of this guide is to provide a range of knowledge at which students can demonstrate proficiency for each objective. Subsequent college course success depends strongly on courses taught primarily at the "some applied skills present" and "applied skills strongly demonstrated" levels.

Objective	Applied skills strongly demonstrated	Some applied skills present	Little applied skills present	Minimal applied skills
1. Recall the history of control systems and PLCs.*	Create a bill of material and price list for a pushbutton, solenoid, relay, contactor, and motor starter using a vendor's website or catalog. Create a bill of material and price list for the PLC on your trainer using a vendor's website or catalog.	Explain N.O. and N.C. contacts on a pushbutton and limit switch and disassemble and explain how a relay, contactor, motor starter, and solenoid work. Explain what each of the five parts of a modular PLC do.	List and identify examples of common electrical control devices (pushbutton, limit switches, etc.) and common electrical loads (relays, contactors, pilot lights, etc.). Describe the difference between a PC and a PLC. Describe the difference between a fixed and modular PLC. List and identify the five basic parts of a modular PLC (rack, power supply, processor, I/O, programming device)	Describe what electrical control is. Describe the evolution of electrical control systems from Oersted's discovery of electro-magnetism in the early 1800's to the invention of the first Programmable Logic Controller in 1969. Describe what a PLC is and what it does. List the advantages of using a PLC. List common manufacturers of PLC's.

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2. **Explain and describe the use of number systes.***		Convert a binary number into a decimal number and a decimal number into a binary number. Convert a BCD to a decimal number and a decimal number to a BCD	List the base for binary, hexadecimal, and octal numbers. Explain the advantages of the different numbering systems	Explain the manner in which information and data is stored in the CPU of a PLC. List the different numbering systems (decimal, binary, 2's complement, octal, hexadecimal, and BCD) that can be employed by the CPU of a PLC.
3. **Demonstrate use of ladder logic programming devices.***	Troubleshoot basic fault codes associated with PLC downloading and running. Perform limited online editing and forcing.	Enter PLC programs into PLC's CPU . Call up PLC programs from storage (and / or upload them from the PLC's memory) and edit & print out both.	Generate simple (paper) ladder diagrams and then convert those diagrams into PLC programs (with addresses, rung comments, instruction comments, and symbol comments). Configure PLC's CPU for the hardware being used.	List the three main types of PLC programming devices (handheld, PC w/ vendor's software, and HMI panel) used to write and enter a ladder diagram into a PLC.

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4. **Employ ladder logic in control circuit design.***	Design ladder diagrams to meet a given set of criteria.	Clearly identify a design project's requirements based on a given set of criteria. Explain common PLC instructions (XIO, XIC, OTE, MCR, LATCH, UNLATCH, etc.) Convert back and forth between ladder diagrams and wiring diagrams.	Explain current flow in common control circuit ladder diagrams (start/stop /seal-in contacts, jog-run, multiple start / multiple stop, etc.) Identify and explain intermediate control devices (photoeyes, prox. switches, pressure switches, etc.) and common industrial loads (motor starters, solenoid operated valves, etc.)	List the rules of ladder diagrams. List common ladder diagram symbols for inputs and outputs. Describe the difference between ladder diagrams and wiring diagrams List common wiring diagram symbols. Explain the difference between analog and digital inputs and outputs.

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				Explain the difference between online and offline programming.
5. Use addressing to control I/O modules.*	Download programs, go online, and test. Go offline, make edits, save, re-download edited version, go back online, and test. Troubleshoot using I/O status lights and data tables.	Hardwire discrete inputs and outputs to PLC I/O cards. Launch PLC software and configure for hardware being controlled.	Convert (paper) ladder diagrams into PLC programs with appropriate addresses and comments. Print out hardcopies of PLC programs (with all addresses and comments displayed).	List the general storage particians of PLC memory (data memory, and user memory). List the specific storage areas and addressing formats for Inputs, Outputs, internal bits, Timers, Counters, and Integers.
6. **Demonstrate the use of relays, contacts, coils, and timers.***	Download program, go online, and test. Go offline, make edits, save, re-download edited version, go back online, and test.	Hardwire discrete inputs and outputs to PLC I/O cards. Launch PLC software and configure for hardware being controlled.	Convert (paper) ladder diagrams into PLC programs with appropriate addresses and comments Print out a hardcopy of edited program.	Design (paper) ladder diagrams (with standard start-stop logic and holding contacts) that include real world inputs and outputs, internal (B3) coils, and internal (On Delay and Off Delay) timers.
7. **Demonstrate counters and sequencers.***	Download program, go online, and test.	Hardwire discrete inputs and outputs to PLC I/O	Convert (paper) ladder diagrams into PLC	Design (paper) ladder diagrams (with standard

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	Go offline, make edits, save, re-download edited version, go back online, and test.	cards. Launch PLC software and configure for hardware being controlled.	programs with appropriate addresses and comments Print out a hardcopy of program.	start-stop logic and holding contacts) that include real world inputs and outputs, internal coils, internal timers, internal (Count Up and Count Down) counters and sequence instructions.
8. Demonstrate fundamental PLC programming (e.g., comparators, block transfers, I/O forcing).*	Download program, go online, and test. Use PLC software's search, help, copy & replace, and histogram functions.	Hardwire discrete inputs and outputs to PLC I/O cards. Launch PLC software and configure for hardware being controlled.	Design ladder diagrams that include common PLC commands with appropriate addresses and comments.	List and explain common PLC commands (MOVE, Data Comparison (<,>, =), Math, Word & File moves, Jump-to-label, and Jump-to-subroutine)
9. **Demonstrate data transfer in PLC networks.***		Perform a data transfer transaction between a PLC and an HMI or between two PLC's.	Explain the protocols used to facilitate data transfer between PLCs.	Explain what data transfer between PLCs and between PLC's and various devices is, and why it would be used.