Programmable Logic Controller I

PEIMS Code: N1303689
Abbreviation: PROLGCNT1
Grade Level(s): 10–12
Award of Credit: 1.0

Approved Innovative Course

- Districts must have local board approval to implement innovative courses.
- In accordance with Texas Administrative Code (TAC) §74.27, school districts must provide instruction in all essential knowledge and skills identified in this innovative course.
- Innovative courses may only satisfy elective credit toward graduation requirements.
- Please refer to TAC §74.13 for guidance on endorsements.

Course Description:

Programmable Logic Controller I is a course designed to introduce students to the function and operation of Programmable Logic Controllers (PLC) through academic and applied instruction. Students will be introduced to relevant terminology, the components that make up a PLC, how PLC communicates with external components and other concepts relating to the use of PLC's in the manufacturing industry. Students will participate in structured, applied learning exercises taken from existing PLC applications. Students will also learn how to read ladder logic diagrams and ultimately write their first program. This course is recommended for students in grade 10 through 12. The central focus of this course is for students to gain an understanding of how programmable logic controllers work and how they are used in automated industries.

Essential Knowledge and Skills:

(a) General Requirements. This course is recommended for students in Grades 10-12. Recommended prerequisite: Principles of Applied Engineering or Principles of Manufacturing. Students shall be awarded one credit for successful completion of this course.

(b) Introduction.

(1) Career and technical education instruction provides content aligned with challenging academic standards and relevant technical knowledge and skills for students to further their education and succeed in current or emerging professions.

(2) The Manufacturing Career Cluster focuses on planning, managing, and performing the processing of materials into intermediate or final products. The Programmable Logic Controller I (PLC) course introduces students to the professional and technical support activities involved in process control used in the manufacturing industry.

(3) Programmable Logic Controller I is a course designed to introduce students to the function and operation of programmable logic controllers (PLC) through

academic and applied instruction. Students will be introduced to relevant terminology, the components that make up a PLC, how PLC communicates with external components and other concepts relating to the use of PLC's in the manufacturing industry.

(4) Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.

(5) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(c) Knowledge and Skills.

(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:

(A) identify career development and entrepreneurship opportunities by understanding of the use of programmable logic controllers (PLC)s in manufacturing;

(B) identify careers in industries which use PLCs in manufacturing;

(C) apply competencies related to resources, information, interpersonal skills, problem solving, critical thinking, and systems of operation in PLC systems;

(D) discuss certification opportunities;

(E) identify employers' expectations, appropriate work habits, ethical conduct, legal responsibilities, and good citizenship skills; and

(F) explore career goals, objectives, and strategies as part of a plan for future career opportunities.

(2) The student demonstrates knowledge of the workplace safety environment required for PLC operations in manufacturing. The student is expected to:

(A) describe component specifications developed by various PLC manufacturers within industrial and commercial applications;

(B) apply electrical safety protocols outlined by the PLC manufacturer;

(C) explain preventative measures to avoid electrical shock and static electrical discharges; and

(D) describe the personal protective equipment used within manufacturing industries as applied to PLC systems.

(3) The student describes the functionality of generic PLC hardware components and the interfacing between them. The student is expected to:

(A) describe the operation of a relay and how it is used for control;

(B) develop a diagram that includes the input and output module, power supply, CPU, and programming device for a generic PLC;

(C) compare the different variations of PLC setups by generating diagrams reflecting several different PLC configurations;

(D) Compare the functionality and suitability of fixed PLCs versus modular PLCs;

(E) classify and quantify input/output (I/O's) based on PLC design specifications;

(F) identify normally open (NO) and normally closed (NC) states for common field input devices;

(G) explain memory size in relation to the PLCs operating cycle;

(H) design a chassis/rack to house a generic PLC; and

(I) identify sinking and sourcing for input devices based on connectivity to voltage source.

(4) The student performs functions and solves problems associated with the electrical components in a PLC. The student is expected to:

(A) explain the influence of polarity when selecting input and output devices;

(B) describe current sinking and current sourcing for various input and output devices;

(C) describe the difference between analog and digital signals applied to input/output modules;

(D) describe how various components of different voltages and currents communicate with the PLC; and

(E) determine the voltage measurements that can be expected on both the input and output side, based on the external devices connected.

(5) The student understands that electrical signals and electrical circuits are represented by numerical systems and logic functions, respectively. The student is expected to:

(A) convert between binary and decimal number systems to process numbers in electrical circuits;

(B) explain how atomic data types such as Boolean, integer, double-integer, real, and long integer are used to create data objects;

(C) explain how relay logic can be represented as bits of information in the PLC memory;

(D) generate logic functions by analyzing relay states from field wiring schematics; and

(E) create and use representations to organize bit instructions for several input and output terminals.

(6) The student understands the connection between input devices and output devices by generating basic ladder logic programs with relay logic instructions. The student is expected to:

(A) describe the ladder logic program structure including rungs, branches, and instructions;

(B) display, explain, and justify the use of relay logic instructions, including Examine if Closed (XIC), Examine if Open (XIO), Output Energized (OTE), Output Latched (OTL), and Unlatched (OUT) within a ladder logic program;

(C) apply input information using logical conditions such as Logic OR and Logic AND functions to control actuators;

(D) generate ladder logic instructions for a given basic task;

(E) model the communication between memory and controller using graphical representations; and

(F) explain the role of data file addressing within the memory structure of a processor.

Recommended Resources and Materials:

Rabiee, M. (2017). Programmable Logic Controllers (4th ed.). Tinley Park, IL: Goodheart Wilcox.

Hardware: PLC module and software, inputs such as sensors or switches, outputs such as lights or fans

Recommended Course Activities:

- Use a multimeter to determine the contacts of a relay. Identify the coil contacts, NO contacts and NC contacts.
- Observe a PLC module and identify the input terminals, output terminals and power connections. Determine the number of I/O's for the module and locate the indicator lights.
- Using a multimeter, measure and verify the PLC DC output voltage. Identify sinking inputs and sourcing inputs.
- Look at a ladder logic diagram and determine how the system will operate.
- Write a ladder logic program, download and test its operation.
- Write a ladder logic diagram that used AND, OR and NOT logic.

Suggested methods for evaluating student outcomes:

- Written exams
- Projects, presentations, and group participation
- Evaluation of oral and written communication skills
- Completion of class assignments

Teacher qualifications:

An assignment for Programmable Logic Controller I is allowed with one of the following certificates.

- Secondary Industrial Arts: Grades 6-12.
- Secondary Industrial Technology: Grades 6-12.
- Technology Education: Grades 6-12.
- Trade and Industrial Education: Grades 6-12 with appropriate work approval as identified on the certificate.
- Trade and Industrial Education: Grades 8-12 with appropriate work approval as identified on the certificate.
- Vocational Trades and Industry. This assignment requires appropriate work approval.

Additional information: