College of San Mateo
Official Course Outline

1. **COURSE ID:** ELEC 422 **TITLE:** Introduction to Programmable Logic Controllers
   Units: 4.0 units **Hours/Semester:** 48.0-54.0 Lecture hours; 48.0-54.0 Lab hours; and 96.0-108.0 Homework hours
   Method of Grading: Letter Grade Only
   Prerequisite: ELEC 421 or equivalent experience.

2. **COURSE DESIGNATION:**
   Degree Credit
   Transfer credit: CSU

3. **COURSE DESCRIPTIONS:**
   Catalog Description:
   Review of the component parts of a programmable logic controller and their function and their interrelationship. Examines PLC input/output systems and requirements. Covers ladder logic programming using basic I/O instructions, logic instructions, timers, counters, comparison, and math functions in-depth. Also introduces sequence of PLC operation, hardware installation, troubleshooting, and industrial applications of PLCs.

4. **STUDENT LEARNING OUTCOME(S) (SLO'S):**
   Upon successful completion of this course, a student will meet the following outcomes:
   1. Identify the parts of a programmable logic controller and describe their function.
   2. Use the binary, decimal, and hexadecimal number systems to code information needed in a PLC program.
   3. Explain the operation of basic input/output elements, timers, counters, sequencers, math elements, and logic elements used in a PLC.
   4. List the eight steps needed to develop a program for a PLC.
   5. Translate the description of a control process intro a ladder diagram.
   6. Translate a ladder diagram into instructions which particular PLC can execute.
   7. Correctly enter and debug a program using a CRT or a programming panel.
   8. Identify the important installation requirements for PLC hardware.
   9. Describe and perform typical PLC troubleshooting.
   10. Write, enter, and run PLC diagnostic programs.
   11. Describe the steps needed to properly maintain a functioning PLC system.

5. **SPECIFIC INSTRUCTIONAL OBJECTIVES:**
   Upon successful completion of this course, a student will be able to:
   1. Identify the parts of a programmable logic controller and describe their function.
   2. Use the binary, decimal, and hexadecimal number systems to code information needed in a PLC program.
   3. Explain the operation of basic input/output elements, timers, counters, sequencers, math elements, and logic elements used in a PLC.
   4. List the eight steps needed to develop a program for a PLC.
   5. Translate the description of a control process intro a ladder diagram.
   6. Translate a ladder diagram into instructions which particular PLC can execute.
   7. Correctly enter and debug a program using a CRT or a programming panel.
   8. Identify the important installation requirements for PLC hardware.
   9. Describe and perform typical PLC troubleshooting.
   10. Write, enter, and run PLC diagnostic programs.
   11. Describe the steps needed to properly maintain a functioning PLC system.

6. **COURSE CONTENT:**
   Lecture Content:
   1. Overview and history of programmable logic controllers (objective 1)
      A. Definition of a programmable logic controller
      B. History of industry
      C. Major manufacturers of programmable logic controllers
   2. Parts of a programmable logic controller (objective 1)
      A. Power Supply

B. Central Processor Unit (CPU)
C. Memory
D. Input/Output
E. Programming Panels

3. Number Systems used with Programmable Logic Controllers (objective 2)
   A. Decimal number system review
   B. Binary number system
   C. Octal number system
   D. Hexadecimal number system
   E. Integers, floating point numbers, high-order numbers, and fixed point numbers
4. Basic Input and output elements (objective 3)
   A. Sources of basic input signals
5. Timers (objective 3)
   A. Time base
   B. Off delay or on delay contacts
   C. No and NC contacts
   D. Reset, retentive and nonretentive functions
   E. Adjustable present time and accumulative time
   F. Count done bits
   G. Symbology used for PLC timers
6. Counters (objective 3)
   A. Symbology used for PC counters
   B. Parts of the counters
   C. Counter values
   D. Counter cascading techniques
   E. Overflow and underflow
7. Sequencers (objective 3)
   A. Sequence instruction allows the programmable to insure that the PLC will properly step through a set of machine operations
   B. A sequencer will activate a single output with each enable or advance of the sequencer via a set of input switch contacts
   C. Sequencer symbology
8. Math functions (objective 3)
   A. Most PLCS can perform addition, subtraction, multiplication, and division
9. Gate Logic (objective 3)
   A. The AND logic function
   B. The OR logic Function
   C. The NOT logic function
   D. The NOT AND (NAND) logic function
   E. The NOT OR (NOR) logic function
10. Programmable logic controller programming (objective 4)
    A. Eight steps used to program a PLC
11. Programming examples (objectives 5, 6)
    A. Automatic control of warehouse door
    B. Automatic lubricating oil supplier
    C. Conveyor belt motor control
    D. Automatic car washing machine
    E. Bottle label detection
12. Programmable logic controller installation (objective 7, 8)
    A. Installing the PLC
13. Programmable logic controller maintenance (objective 11)
    A. Inspection of system
    B. Tools and supplies needed for maintenance
    C. Battery considerations
14. Programmable logic controller troubleshooting (objectives 9, 10)
    A. troubleshooting philosophy
    B. Troubleshooting tools
    C. Recommended troubleshooting tools

Lab Content:

The lab content reinforces the lecture content and materials in a practical, applied manner.

7. **REPRESENTATIVE METHODS OF INSTRUCTION:**
   Typical methods of instruction may include:
   A. Other (Specify): Lectures; Analytical problem sets; Essay question sheets; Topic reading assignments; Assigned individual and group case studies; Assigned computer simulation activities.

8. **REPRESENTATIVE ASSIGNMENTS**
   Representative assignments in this course may include, but are not limited to the following:
   Writing Assignments:
   Written Exam - Prepare a ladder diagram which could implement a system based on a case analysis given. Clearly label all of the switches and the outputs. Use internal relays if needed. Draw the diagram in program edit mode and then in monitor mode.
   Reading Assignments:
   Review the material on number systems and number conversion in the textbook, the handout on "Number Systems, Number Bases, and Number Base Conversions" and the introduction to each of the first five Challenges in the tutor program "Digital Circuit Challenge."
   Other Outside Assignments:
   Lab assignments to insure the student can: use For/Next loop instructions effectively; use the unconditional Jump instructions; and demonstrate proper use of the Call/Return instruction - both unconditional and conditional.

9. **REPRESENTATIVE METHODS OF EVALUATION**
   Representative methods of evaluation may include:
   A. Graded problem sets; Graded homework word problems; Graded case study solutions; Graded program examples; Graded program interpretation; Quizzes; Midterm; Final exam.

10. **REPRESENTATIVE TEXT(S):**
    Possible textbooks include:
    A. unknown . *A Practical Guide To Programmable Logic Controllers*, ed. automationdirect.com, 2016
    B. unknown . *Your Personal PLC Tutor—A Guide to Understanding PLCs*, ed. plus.net, 2016
    Possible manuals include:
    A. unknown . DirectLogic 06 User's Manual , Automation Direct, 03-01-2016
    B. unknown. DirectSOFT6 User's Manual , Automation Direct, 06-01-2016

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