



CAMOSUN COLLEGE

Trades and Technology

ELECTRONICS & COMPUTER ENGINEERING DEPARTMENT

**ECET 234  
PLC Control 1**

**Fall 2020**

**COURSE OUTLINE**

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CREDIT:	3
IN-CLASS WORKLOAD:	3 hours lecture, 2.5 hours lab
OUT-OF-CLASS WORKLOAD:	8 hours
PREREQUISITES:	ECET 165

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**1. INSTRUCTOR INFORMATION**

(a) Instructor	Dr. Mozhgan Moazzen Zadeh-Bacon
(b) Office hours	Email for an appointment
(c) Location	TEC 206
(d) Phone	250 370 4623 <b>Alternative:</b> _____
(e) E-mail	BaconM@camosun.bc.ca
(f) Website	<a href="http://camosun.ca/learn/school/trades-technology/bios/bacon.html">http://camosun.ca/learn/school/trades-technology/bios/bacon.html</a>

**2. INTENDED LEARNING OUTCOMES**

*Upon successful completion of this course a student will be able to:*

- Use knowledge of PLC systems and functions to design and execute PLC programs
- Draft a PLC ladder diagram for programming purposes
- Use a variety of basic and more advanced PLC instructions in order to implement more complex programs
- Explain interrupts and how to use them in a PLC program
- Operate a PLC's analog I/O module to convert analog signals to digital form.

**OBJECTIVE**

Upon completion of this course the student will have a working knowledge of ladder diagrams, PLC programming and applications.

### 3. REQUIRED MATERIALS

- Access to D2L (Course Notes, Labs, Assignments/Problem sets, Quizzes, Tests)
- Max Rabicee, **Programmable Logic Controllers: Hardware and Programming**, 3<sup>rd</sup> Edition, G-W Publisher, ISBN: 978-1-60525-945-1

### 4. COURSE CONTENT

#### 1. Introduction to PLCs

- 1.1 Description of a PLC
- 1.2 History of the PLC
- 1.3 Function of the PLC
  - 1.3.1 Compared to traditional relay control systems
  - 1.3.2 Compared to microprocessor-based systems: PC, etc.
  - 1.3.3 Typical PLC Controller
- 1.4 PLC Applications
- 1.5 PLC Instruction
  - 1.5.1 Main part
  - 1.5.2 Extension parts
- 1.6 Typical PLC control unit and system
- 1.7 How PLCs function

#### 2. Introduction to PLC Programming

- 2.1 File Structure
  - 2.1.1 Program Files
  - 2.1.2 Data Files
  - 2.1.3 Function Files
- 2.2 Addressing
  - 2.2.1 I/O Address
  - 2.2.2 Data file Address
- 2.3 Construction of Logix500 programming window
- 2.4 Basic ladder diagram edition
- 2.5 Project verification

#### 3. Bit Instructions

- 3.1 What are bit instructions
- 3.2 Main applications of bit instructions
- 3.3 XIC bit instruction
- 3.4 XIO bit instruction
- 3.5 OTE bit instruction
- 3.6 OTL bit instruction
- 3.7 OUT bit instruction
- 3.8 OSR bit instruction

#### 4. Software Usage

- 4.1 Overview on debugging
- 4.2 Force On and Force Off

## 5. Logical Operations

- 5.1 Main types of logic
- 5.2 Logic AND, Logic OR, Logic NOT
- 5.3 Realization of logics

## 6. Advanced PLC Instructions

- 6.1 Timer Instructions
  - 6.1.1 What are timer instructions?
  - 6.1.2 Structure of timer instructions
  - 6.1.3 How timer instructions work
  - 6.1.4 Application of timer instructions
- 6.2 Counter Instructions
  - 6.2.1 How counter instructions work
  - 6.2.2 CTU and CTD
  - 6.2.3 Usages of counter instructions
- 6.3 Compare Instructions
  - 6.3.1 What is a compare instruction?
  - 6.3.2 How compare instructions work
  - 6.3.3 Common compare instructions: EQU, NEQ, GRT, GEQ, LES, LEQ, MEQ, and LIM
  - 6.3.4 Usage of compare instructions
- 6.4 Subroutine Instructions
  - 6.4.1 What is a subroutine?
  - 6.4.2 Why use a subroutine?
  - 6.4.3 How subroutines work
  - 6.4.4 Usage of subroutine instructions
- 6.5 Sequencer Instructions
  - 6.5.1 Why sequencer instructions are popular?
  - 6.5.2 Sequencer instructions SQC, SQO, and SQL
  - 6.5.3 Mask and its effects
  - 6.5.4 Steps and sequencer operation
- 6.6 Move Instructions
  - 6.6.1 Move instructions MOV and MVM
  - 6.6.2 Move instructions' role in resetting and initializing PLC systems

## 7. Advanced PLC Instructions II

- 7.1 Math Instructions
  - 7.1.1 Structure of math instructions
  - 7.1.2 ADD, SUB, MUL, DIV, SQR, CLR, NEG, SCL, and SCP
  - 7.1.3 How the PLC handles math instructions
  - 7.1.4 Math status bits
- 7.2 Shift Instructions
  - 7.2.1 Construction of shift instruction BSL
  - 7.2.2 How shift instructions work
  - 7.2.3 Other instructions: BSR, BSL FFL, FFU, LFL, LFU
- 7.3 Logic Instructions
  - 7.3.1 Logical functions
  - 7.3.2 Ways to use logical functions
  - 7.3.3 Logical instructions: AND, OR, XOR, and NOT

- 7.4 Data Conversion Instruction
  - 7.4.1 DCD, INC, TOD, FRD Instructions

## 8. Analog Control Modules

- 8.1 A typical Digital System
- 8.2 Introduction to ADC and DAC
- 8.3 Analog Input Module 1762-IF4
- 8.4 Analog Output Module 1762-OF4
- 8.5 Input/output Module Configuration

## 9. Interrupts

- 9.1 What is an interrupt?
- 9.2 How the Micrologix 1200 handles interrupts
- 9.3 When interrupts can be responded too
- 9.4 Interrupt priority
- 9.5 Interrupt instructions: INT, UIE, UID, and UIF
- 9.6 Interrupt configuration: EII

## **LAB EXERCISES: (Subject to change)**

Various lab exercises will be performed to practice and reinforce the lecture material.

- 1. Week 1 – Boolean Refresher (Teaching to be done in the lab)
- 2. Week 2 – Review of Ladder Logic, the LogixPro PLC Simulator, and RSLogix
- 3. Week 3 – Garage Door Simulation-Exercise 1
- 4. Week 4 – Garage Door Simulation-Exercise 2&3
- 5. Week 5 – Silo System Simulation
- 6. Week 6 – Traffic Control Exercises utilizing TON (1)
- 7. Week 7 – Traffic Control Exercises utilizing TON (2)
- 8. Week 8 –Traffic Control utilizing Word Comparison
- 9. Week 9 – **Midterm (04-Nov-2020)**
- 10. Week 10 – **No Lab/Holiday (11<sup>th</sup> Nov)**
- 11. Week 11 – Bit Shift Instructions-Bottle Line
- 12. Week 12 – Batch Mixing Utilizing Counters
- 13. Week 13 – Multi Floor Elevator
- 14. Week 14 –Allen-Bradley PLCs and RSLogix 500

## **Holidays:**

- Mon-Oct 12 - Thanksgiving - College closed (Week 6)
- Wed-Nov 11 – Remembrance Day - College Closed (Week 10)

## 5. STUDENT ASSESSMENT (WEIGHTING)

Problem Sets	10%
Quizzes/Tests	15%
Midterm	15%
Final Exam	40%
<b>Total theory</b>	<b>80%</b>
Laboratory Evaluation	20%
<b>Total</b>	<b>100%</b>

\*Students must achieve a passing grade in both the theory and lab portions of the course in order to pass the entire course. Lab attendance is compulsory and all labs must be completed satisfactorily to pass this course. 40% of the lab mark will be based on preparation, performance and successful completion of each lab.

\*Students must obtain a minimum of 50% in both the theory and practical portions of the course and a minimum of 50% on the final exam.

### Note:

- Lab and lecture portions **MUST** be passed individually.
- Late penalties of 30% per week will be applied at the instructor's discretion.
- Lab attendance is **MANDATORY**. Failure to attend sufficient labs will result in an F grade.
- Lab grades will not be awarded for missed labs without a valid reason for absence.

## 6. Grading System

Standard Grading System (GPA)

Competency Based Grading System

## 7. Recommended Materials or Services to Assist Students to Succeed Throughout the Course

### LEARNING SUPPORT AND SERVICES FOR STUDENTS

There are a variety of services available for students to assist them throughout their learning. This information is available in the College Calendar, Student Services or the College web site at <http://www.camosun.bc.ca>

### STUDENT CONDUCT POLICY

There is a Student Conduct Policy. It is the student's responsibility to become familiar with the content of this policy. The policy is available in each School Administration Office, Registration, and on the College web site in the Policy Section.  
<http://www.camosun.bc.ca/policies/policies.html>

## A. GRADING SYSTEMS <http://www.camosun.bc.ca/policies/policies.php>

The following two grading systems are used at Camosun College:

### 1. Standard Grading System (GPA)

Percentage	Grade	Description	Grade Point Equivalency
90-100	A+		9
85-89	A		8
80-84	A-		7
77-79	B+		6
73-76	B		5
70-72	B-		4
65-69	C+		3
60-64	C		2
50-59	D		1
0-49	F	Minimum level has not been achieved.	0

### 2. Competency Based Grading System (Non-GPA)

This grading system is based on satisfactory acquisition of defined skills or successful completion of the course learning outcomes

Grade	Description
COM	The student has met the goals, criteria, or competencies established for this course, practicum or field placement.
DST	The student has met and exceeded, above and beyond expectation, the goals, criteria, or competencies established for this course, practicum or field placement.
NC	The student has not met the goals, criteria or competencies established for this course, practicum or field placement.

## B. TEMPORARY GRADES

Temporary grades are assigned for specific circumstances and will convert to a final grade according to the grading scheme being used in the course. See Grading Policy at <http://www.camosun.bc.ca/policies/E-1.5.pdf> for information on conversion to final grades, and for additional information on student record and transcript notations.

Temporary Grade	Description
I	<i>Incomplete:</i> A temporary grade assigned when the requirements of a course have not yet been completed due to hardship or extenuating circumstances, such as illness or death in the family.
IP	<i>In progress:</i> A temporary grade assigned for courses that are designed to have an anticipated enrollment that extends beyond one term. No more than two IP grades will be assigned for the same course.
CW	<i>Compulsory Withdrawal:</i> A temporary grade assigned by a Dean when an instructor, after documenting the prescriptive strategies applied and consulting with peers, deems that a student is unsafe to self or others and must be removed from the lab, practicum, worksite, or field placement.