COURSE SYLLABUS

COURSE TITLE: ECET 234- PLC Control 1

CLASS SECTION:

TERM: 2023 Fall

COURSE CREDITS:3

DELIVERY METHOD(S): Lecture

Camosun College campuses are located on the traditional territories of the Lək̓ʷəŋən and W̱SÁNEĆ peoples. We acknowledge their welcome and graciousness to the students who seek knowledge here.
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Camosun College requires mandatory attendance for the first class meeting of each course. If you do not attend, and do not provide your instructor with a reasonable explanation in advance, you will be removed from the course and the space offered to the next waitlisted student.

INSTRUCTOR DETAILS

NAME: **Dr. Mozhgan Moazzen zadeh-Bacon**

EMAIL: **Baconm@camosun.ca**

OFFICE: TEC 216

LECTURE HOURS: 3hrs /week

LAB HOURS: 2.5hrs /week

OFFICE HOURS: 1hrs /week

As your course instructor, I endeavour to provide an inclusive learning environment. However, if you experience barriers to learning in this course, do not hesitate to discuss them with me. Camosun College is committed to identifying and removing institutional and social barriers that prevent access and impede success.

CALENDAR DESCRIPTION

Public holidays:

(Week 1)	Sep 4th Monday	labour day
(Week 5)	Oct 2nd Monday	National Day for Truth and Reconciliation
(Week 6)	Oct 9th Monday	Thanksgiving Day
(Week 11)	Nov 13th Monday	Remembrance Day

Exam dates:

Exam Type	Exam Date and Time	Syllabus
Quiz-1	27th September 2023, (Week 4)	Lecture 01 to 06 + Boolean
Quiz-2	11th October 2023, (Week 6)	Lecture 07, 08
Midterm	31st October 2023, (Week 9)	Lecture 01 up to 11
Quiz-3	21st November 2023, (Week 12)	Lecture 11up to 18
Final Exam	As per college date	Week1 to Week14

PREREQUISITE(S): ECET 165
CO-REQUISITE(S): None
EXCLUSION(S): None

COURSE LEARNING OUTCOMES / OBJECTIVES

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 purpose.
- 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.

REQUIRED MATERIALS & RECOMMENDED PREPARATION / INFORMATION

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

COURSE SCHEDULE, TOPICS, AND ASSOCIATED PREPARATION / ACTIVITY / EVALUATION

Course outline:

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
5.3 Logic AND, Logic OR, Logic NOT
5.3 Realization of logics

6. **Advanced PLC Instruction**

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
62.1 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
  - 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

Labs (Subject to change):

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

1. Week 1 –Information Session
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 (31-Oct-2023)**
10. Week 10 – Bit Shift Instructions-Bottle Line
11. Week 11 – Batch Mixing Utilizing Counters
12. Week 12 – Dual Compressor
13. Week 13 – Multi Floor Elevator
14. Week 14 – Allen-Bradley PLCs and RSLogix 500

Lesson Plan:

The following schedule and course components are ***subject to change***, as deemed appropriate by the instructor.

WEEK	DAY	DATE / TIME	LECTURE	PROBLEM SETS	DUE DATE	QUIZ & TESTS
WEEK 1	Monday	04-09-2023 11:30	(1) ----------			
	Wednesday	06-09-2023 11:30	(2) Lecture 1: Introduction to PLC	**Problem set 1** (Lecture 01-03)		
	Wednesday	06-09-2023 12:30	(3) Lecture 2: PLC Application- Boolean Refresher			
	Tuesday Lab	05-09-2023 08:30	**Lab0**: Information Session	06-09-2023 11:30	18-09-2023 11:30	
WEEK 2	Monday	11-09-2023 11:30	(1) Lecture 3a: Karnaugh Map			
	Wednesday	13-09-2023 11:30	(2) Lecture 3: PLC Programming	**Problem set 1** (Lecture 01-03)		
	Wednesday	13-09-2023 12:30	(3) Tutorial			
	Tuesday Lab	12-09-2023 08:30	**Lab1**: Review of Ladder Logic, the LogixPro PLC Simulator, and RSLogix	06-09-2023 11:30	18-09-2023 11:30	
WEEK 3	Monday	18-09-2023 11:30	(1) Lecture 4: BIT Instruction			
	Wednesday	20-09-2023 11:30	(2) Lecture 5: Software Usage			
	Wednesday	20-09-2023 12:30	(3) Lecture 6: Logical Operation			
	Tuesday Lab	19-09-2023 08:30	**Lab2**: Garage Door Simulation-Exercise 1			
WEEK 4	Monday	25-09-2023 11:30	(1) Lecture 7: Timer Instruction			
	Wednesday	27-09-2023 11:30	(2) Lecture 7: Timer Instruction	**Problem set 2** (Lecture 04-08)		**Quiz 1** (Lecture 01 to 06 + Boolean)
	Wednesday	27-09-2023 12:30	(3) Lecture 7: Timer Instruction			
	Tuesday Lab	26-09-202 08:30	**Lab3**: Garage Door Simulation-Exercise 2&3	25-09-2023 11:30	11-10-2023 11:30	**27-09-2023 11:30**
WEEK 5	Monday	02-10-2023 11:30	(1) Holiday			
	Wednesday	04-10-2023 11:30	(2) Lecture 8: Counter Instruction	**Problem set 2** (Lecture 04-08)		
	Wednesday	04-10-2023 12:30	(3) Lecture 8: Counter Instruction			
	Tuesday Lab	03-10-2023 08:30	**Lab4**: Silo System Simulation	25-09-2023 11:30	11-10-2023 11:30	
WEEK 6	Monday	09-10-2023 11:30	(1) Holiday			
	Wednesday	11-10-2023 11:30	(2) Lecture 9: Compare Instruction	**Problem set 3** (Lecture 09-10)		**Quiz 2** (Lecture 07-08)
	Wednesday	11-10-2023 12:30	(3) Lecture 9: Compare Instruction			
	Tuesday Lab	10-10-2023 08:30	**Lab5:** Traffic Control Exercises utilizing TON (1)	11-10-2023 11:30	23-10-2023 11:30	**11-10-2023 11:30**
WEEK 7	Monday	16-10-2023 11:30	(1) Lecture 10: Subroutine Instruction			
	Wednesday	18-10-2023 11:30	(2) Lecture 10: Subroutine Instruction	**Problem set 3** (Lecture 09-10)		
	Wednesday	18-10-2023 12:30	(3) Lecture 10: Subroutine Instruction			
	Tuesday Lab	17-10-2023 08:30	**Lab6**: Traffic Control Exercises utilizing TON (2)	11-10-2023 11:30	23-10-2023 11:30	

WEEK 8	Monday	23-10-2023 11:30	(1) Lecture 11- 12: MOV Instruction- Math Instruction			
	Wednesday	25-10-2023 11:30	(2) Lecture 11- 12: MOV Instruction- Math Instruction	**Problem set 4** (Lecture 11-12-13)		
	Wednesday	25-10-2023 12:30	(3) Lecture 11- 12: MOV Instruction- Math Instruction			
	Tuesday Lab	24-10-2023 08:30	**Lab7:** Traffic Control utilizing Word Comparison	23-10-2023 11:30	06-11-2023 11:30	
WEEK 9	Monday	30-10-2023 11:30	(1) Lecture 13: Sequencer Instruction			
	Wednesday	01-11-2023 11:30	(2) Lecture 13: Sequencer Instruction	**Problem set 4** (Lecture 11-12-13)		**Midterm** (Lecture 01 up to 11)
	Wednesday	01-11-2023 12:30	(3) Lecture 13: Sequencer Instruction			
	Tuesday Lab	31-10-2023 08:30	**Lab**: **Midterm (31-Oct-2023)**	23-10-2023 11:30	06-11-2023 11:30	**31-10-2023 08:30**
WEEK 10	Monday	06-11-2023 11:30	(1) Lecture 14: Shift Instruction			
	Wednesday	08-11-2023 11:30	(2) Lecture 14: Shift Instruction	**Problem set 5** (Lecture 14-15-16-17)		
	Wednesday	08-11-2023 12:30	(3) Lecture 14: Shift Instruction			
	Tuesday Lab	07-11-2023 08:30	**Lab8:** Bit Shift Instructions-Bottle Line	06-11-2023 11:30	20-11-2023 11:30	
WEEK 11	Monday	13-11-2023 11:30	(1) Holiday			
	Wednesday	15-11-2023 11:30	(2) Lecture 15: Logic Instruction	**Problem set 5** (Lecture 14-15-16-17)		
	Wednesday	15-11-2023 12:30	(3) Lecture 16-17: Data Conversion Instruction-Analog Control Module			
	Tuesday Lab	14-11-2023 08:30	**Lab9**: Batch Mixing Utilizing Counters	06-11-2023 11:30	20-11-2023 11:30	
WEEK 12	Monday	20-11-2023 11:30	(1) Lecture 18: Interrupts			
	Wednesday	22-11-2023 11:30	(2) Lecture 18: Interrupts			**Quiz 3** (Lecture 11-up to 18)
	Wednesday	22-11-2023 12:30	(3) Lecture 18: Interrupts			
	Tuesday Lab	21-11-2023 08:30	**Lab10**: Dual compressor			**22-11-2023 11:30**
WEEK 13	Monday	27-11-2023 11:30	(1) Practice exercises			
	Wednesday	29-11-2023 11:30	(2) Practice exercises			
	Wednesday	29-11-2023 12:30	(3) Practice exercises			
	Tuesday Lab	28-11-2023 08:30	**Lab11:** Allen-Bradley PLCs and RSLogix 500			
WEEK 14 (REVIEW)	Monday	04-12-2023 11:30	(1) Course review			
	Wednesday	06-12-2023 11:30	(2) Course review			
	Wednesday	06-12-2023 12:30	(3) Course review			
	Tuesday Lab	05-12-2023 08:30	**Lab:** Makeup Week			

Students registered with the Centre for Accessible Learning (CAL) who complete quizzes, tests, and exams with academic accommodations have booking procedures and deadlines with CAL where advanced noticed is required. Deadlines scan be reviewed on the CAL exams page. http://camosun.ca/services/accessible-learning/exams.html

EVALUATION OF LEARNING

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

If you have a concern about a grade you have received for an evaluation, please come and see me as soon as possible. Refer to the Grade Review and Appeals policy for more information. http://camosun.ca/about/policies/education-academic/e-1-programming-and-instruction/e-1.14.pdf

COURSE GUIDELINES & EXPECTATIONS

GRADING ACCORDING TO COLLEGE POLICY (GPA)

A minimum of 60% must be achieved in both the theory and lab portions to pass the course. Less than 60% in either portion will result in a failure of the entire course and **minimum of 50% must be achieved in Final exam to pass the course.**

-To earn credit for the course, it is essential to complete *all labs and lab reports* satisfactorily.
-Please ensure that you submit your lab reports by the specified due date on D2L.
(Typically, lab reports are expected to be turned in at the beginning of the next week's lab session.)
- For every day your labs are late, there will be a 10% deduction from your score.
-You are required to attend and be on time for ALL labs.
-Failure to attend a lab without a valid excuse may result in being assigned a failing grade for that lab.
-If you cannot attend a lab (for a valid reason) please inform your lab instructor (ahead of time if possible) and arrange to make it up.

Lecture Attendance

To get the most out of this course, students are expected to attend all classes and be on time. It is your responsibility to acquire all information given during a class missed, including notes, hand-outs, changed exam dates etc.

Exam Procedures

All exams must be written at the scheduled times with the exception of students requiring an accommodation by CAL. It is understood that emergency circumstances do occur (e.g. severe illness or family emergency); for such circumstances accommodation may be offered at the discretion of the instructor, provided the student:
a) notifies the instructor in advance of the exam (not after), and
b) provides documented evidence of the circumstance (e.g. medical certificate).

If an exam is missed with an excused absence, it is up to the instructor's discretion as to how the mark will be made up. In most cases, an oral exam will be scheduled for the student as soon as possible.
Be sure not to make travel plans for the end of semester until the final exam schedules are finalized and posted. Please ask any family members who might make travel plans on your behalf to consult you before booking tickets.
Please note: the use of cell phones during a test or quiz is not allowed and may result in a zero for that assessment.

Study Habits

Good and regular study habits are essential to do well in this course. You should plan on a weekly minimum of 5 hours outside of scheduled class time for the completion of readings, assignments and for general studying. Joining a study group can help make this more achievable.
Lecture presentations will be uploaded to the course website. These should be used as a study guide, not as your sole source of information. You will need to write down additional key words for examples and explanations given during lecture and review text and videos to support your understanding. It is also recommended practice to transform lecture notes into a study-friendly format after each lecture, incorporating additional information from your textbook. Study these notes before the next class to prepare yourself for new material, which will often build on previously covered material.

Please take advantage of office hours if you need extra clarification and help.

SCHOOL OR DEPARTMENTAL INFORMATION

Electronics and computer Engineering

STUDENT RESPONSIBILITY

Enrolment at Camosun assumes that the student will become a responsible member of the College community. As such, each student will display a positive work ethic, assist in the preservation of College property, and assume responsibility for their education by researching academic requirements and policies; demonstrating courtesy and respect toward others; and respecting expectations concerning attendance, assignments, deadlines, and appointments.

SUPPORTS AND SERVICES FOR STUDENTS

Camosun College offers a number of services to help you succeed in and out of the classroom. For a detailed overview of the supports and services visit http://camosun.ca/students/.

Academic Advising	http://camosun.ca/advising
Accessible Learning	http://camosun.ca/accessible-learning
Counselling	http://camosun.ca/counselling
Career Services	http://camosun.ca/coop
Financial Aid and Awards	http://camosun.ca/financialaid
Help Centres (Math/English/Science)	http://camosun.ca/help-centres
Indigenous Student Support	http://camosun.ca/indigenous
International Student Support	http://camosun.ca/international/
Learning Skills	http://camosun.ca/learningskills
Library	http://camosun.ca/services/library/
Office of Student Support	http://camosun.ca/oss
Ombudsperson	http://camosun.ca/ombuds
Registration	http://camosun.ca/registration
Technology Support	http://camosun.ca/its
Writing Centre	http://camosun.ca/writing-centre

If you have a mental health concern, please contact Counselling to arrange an appointment as soon as possible. Counselling sessions are available at both campuses during business hours. If you need urgent support after-hours, please contact the Vancouver Island Crisis Line at 1-888-494-3888 or call 911.

COLLEGE-WIDE POLICIES, PROCEDURES, REQUIREMENTS, AND STANDARDS

Academic Accommodations for Students with Disabilities

The College is committed to providing appropriate and reasonable academic accommodations to students with disabilities (i.e. physical, depression, learning, etc). If you have a disability, the Centre for Accessible Learning (CAL) can help you document your needs, and where disability-related barriers to access in your courses exist, create an accommodation plan. By making a plan through CAL, you can ensure you have the appropriate academic accommodations you need without disclosing your diagnosis or condition to course instructors. Please visit the CAL website for contacts and to learn how to get started: http://camosun.ca/services/accessible-learning/

Academic Integrity

Please visit http://camosun.ca/about/policies/education-academic/e-1-programming-and-instruction/e-1.13.pdf for policy regarding academic expectations and details for addressing and resolving matters of academic misconduct.

Academic Progress

Please visit http://camosun.ca/about/policies/education-academic/e-1-programming-and-instruction/e-1.1.pdf for further details on how Camosun College monitors students' academic progress and what steps can be taken if a student is at risk of not meeting the College's academic progress standards.

Course Withdrawals Policy

Please visit http://camosun.ca/about/policies/education-academic/e-2-student-services-and-support/e-2.2.pdf for further details about course withdrawals. For deadline for fees, course drop dates, and tuition refund, please visit http://camosun.ca/learn/fees/#deadlines.

Grading Policy

Please visit http://camosun.ca/about/policies/education-academic/e-1-programming-and-instruction/e-1.5.pdf for further details about grading.

Grade Review and Appeals

Please visit http://camosun.ca/about/policies/education-academic/e-1-programming-and-instruction/e-1.14.pdf for policy relating to requests for review and appeal of grades.

Mandatory Attendance for First Class Meeting of Each Course

Camosun College requires mandatory attendance for the first class meeting of each course. If you do not attend, and do not provide your instructor with a reasonable reason in advance, you will be removed from the course and the space offered to the next waitlisted student. For more information, please see the "Attendance" section under "Registration Policies and Procedures" (http://camosun.ca/learn/calendar/current/procedures.html) and the Grading Policy at http://camosun.ca/about/policies/education-academic/e-1-programming-and-instruction/e-1.5.pdf.

Medical / Compassionate Withdrawals

Students who are incapacitated and unable to complete or succeed in their studies by virtue of serious and demonstrated exceptional circumstances may be eligible for a medical/compassionate withdrawal. Please visit http://camosun.ca/about/policies/education-academic/e-2-student-services-and-support/e-2.8.pdf to learn more about the process involved in a medical/compassionate withdrawal.

Sexual Violence and Misconduct

Camosun is committed to creating a campus culture of safety, respect, and consent. Camosun's Office of Student Support is responsible for offering support to students impacted by sexual violence. Regardless of when or where the sexual violence or misconduct occurred, students can access support at Camosun. The Office of Student Support will make sure students have a safe and private place to talk and will help them understand what supports are available and their options for next steps. The Office of Student Support respects a student's right to choose what is right for them. For more information see Camosun's Sexualized Violence and Misconduct Policy: http://camosun.ca/about/policies/education-academic/e-2-student-services-and-support/e-2.9.pdf and camosun.ca/sexual-violence. To contact the Office of Student Support: oss@camosun.ca or by phone: 250-370-3046 or 250-3703841

Student Misconduct (Non-Academic)

Camosun College is committed to building the academic competency of all students, seeks to empower students to become agents of their own learning, and promotes academic belonging for everyone. Camosun also expects that all students to conduct themselves in a manner that contributes to a positive, supportive, and safe learning environment. Please review Camosun College's Student Misconduct Policy at http://camosun.ca/about/policies/education-academic/e-2-student-services-and-support/e-2.5.pdf to understand the College's expectations of academic integrity and student behavioural conduct.

Changes to this syllabus: Every effort has been made to ensure that information in this syllabus is accurate at the time of publication. The College reserves the right to change courses if it becomes necessary so that course content remains relevant. In such cases, the instructor will give the students clear and timely notice of the changes.