CAMOSUN COLLEGE

Trades and Technology

ELECTRONICS & COMPUTER ENGINEERING DEPARTMENT

ECET 280
Data Acquisition & Programmable Logic Controllers

Fall 2020

COURSE OUTLINE

CREDIT:	3
IN-CLASS WORKLOAD:	3 hours lecture, 2.5 hours lab
OUT-OF-CLASS WORKLOAD:	6 hours
PREREQUISITES:	ECET 165

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	**Alternative:**	
(e) E-mail	BaconM@camosun.bc.ca		
(f) Website	http://camosun.ca/learn/school/trades-technology/bios/bacon.html		

2. INTENDED LEARNING OUTCOMES

This course offers a comprehensive study of data acquisition (DAQ) systems including: sampling theory, aliasing, time and frequency domains representation, anti-aliasing and recovery filter design, sample-and-hold (S/H) techniques, quantization theory, analog-to-digital (A/D) and digital-to-analog (D/A) converters, and the virtual instrumentation software LabVIEW. This course also covers major topics of programmable logic controllers (PLCs) including: PLC addressing and basic instructions, PLC Ladder logic, PLC timer and counter functions, PLC comparison and math operations, data handling and program flow control.

OBJECTIVE

- Be able to critique Data Acquisition (DAQ) systems in following aspects: signal acquiring, signal conditioning, and signal digitizing.
- Be able to program the virtual instrumentation software LabVIEW
- Be able to use programmable logic controllers (PLCs)

3. REQUIRED MATERIALS

- Access to D2L (Course Notes, Labs, Assignments, Quizzes, Tests)
- Max Rabiee, **Programmable Logic Controllers**: Hardware and Programming, 3rd Edition, G-W Publisher, ISBN: 978-1-60525-945-1
- James A. Rehg, Glenn J. Sartori: **Programmable Logic Controllers**, 2nd Edition, Pearson Education Limited, ISBN: 978-0-13-504881-8

4. COURSE CONTENT

Part I Laboratory Virtual Instrument Engineering Workbench (LabVIEW)

(to be done in the lab)

0. Introduction to LabVIEW

0.1. What is LabVIEW
0.2. LabVIEW control panels, block diagrams, and tools
0.3. LabVIEW functions and subroutines (sub-vi)
0.4. LabVIEW Serial communication and network communication

Part II Data Acquisition Systems (DAQ)

1. Introduction to Data Acquisition (DAQ) systems

1.1. DAQ, DDS and "pure" computer systems
1.2. Five stages of a DAQ system
1.3. Relationships between stages
1.4. DSP applications in DAQ systems

2. Signal Conditioning and sample-hold circuits

2.1. Introduction to Signal Conditioning
2.2. Anti-aliasing and reconstruction filters
2.3. Switched capacitor filters
2.4. Sampling theory
2.5. Sample-hold circuit design

3. Analog-to-Digital (A/D) converters and Digital-to-Analog (D/A) converters

3.1. Quantization theory
3.2. Digital-to-analog (D/A) converters
3.3. Analog-to-digital (A/D) converters
3.4. The frequency relationship between A/D converters and S/H circuits
3.5. A/D and D/A circuits design
3.6. Voltage-to-frequency (V/F) and frequency-to-voltage (F/V) converters

4. Instrumentation *(selective)*

4.1. Review of transducers and signal conditioning
4.2. Voltage references
4.3. Analog multiplexers and demultiplexers
4.4. Field wiring: shielding, grounding and noise considerations
4.5. Errors in data acquisition systems
4.6. DAQ systems specification
4.7. Examples of DAQ systems design
4.8. Over-sampling versus under-sampling

Part III Programmable Logic Controllers (PLCs)

5. Introduction to PLCs
- 5.1. What are PLCs
- 5.2. Input/output devices
- 5.3. PLC hardware – Allen-Bradley controllers
- 5.4. PLC software – LogixPro 500 and RSLogix 500

6. PLC addressing and basic instructions
- 6.1. Allen-Bradley PLC addressing
- 6.2. Basic input/output instructions
- 6.3. Branches

7. Ladder logic programming
- 7.1. Boolean statements and Ladder logic equivalents
- 7.2. Commonly used ladder logic sequences
- 7.3. Properly formatted outputs
- 7.4. Boolean logic and truth table review

8. PLC functions and operations
- 8.1. Timers
- 8.2. Counters
- 8.3. Math instructions
- 8.4. Comparison
- 8.5. Data handling
- 8.6. Program flow control
- 8.7. Bit shifts and Sequencer

LAB EXERCISES: (Subject to change)

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

1. Week 1-LabVIEW (I) – LabVIEW (Teaching to be done in the lab)
2. Week 2-LabVIEW (II) – Introduction to LabVIEW
3. Week 3-LabVIEW (III) – LabVIEW Functions and Sub-VI
4. Week 4-DAQ (I) – Sample-and-hold circuit or Butterworth/Chebyshev Or Sallen-key Filter
5. Week 5-DAQ (II) – Digital-to-analog converter
6. Week 6-DAQ (III) – Analog-to-digital converter
7. Week 7-DAQ (IV) – **EXAM (I)-DAQ (21/22-Oct-2020)**
8. Week 8-PLCs (I) – Introduction to LogixPro 500 PLC Simulator
9. Week 9-PLCs (II) – Garage Door Control
10. Week 10-**Holiday** – **No Lab**
11. Week 11-PLCs (III) – Silo system
12. Week 12-PLCs (IV) – Traffic control (1)
13. Week 13-PLCs (V) – Traffic control (2)
14. Week 14-PLCs (VI) – Bottle Line or Batch Mixing

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%
Exam 1-DAQ	25%
Final Exam (Exam2-PLC)	25%
Total theory	**75%**
Laboratory Evaluation	25%
Total	**100%**

*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

[X] 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	*Incomplete*: 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	*In progress*: 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	*Compulsory Withdrawal*: 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.