

**CAMOSUN COLLEGE**  
**Mechanical Engineering Technology**  
***MENG 181 - Mechanical Control Programming***  
**Course Outline**

**Calendar Description:**

Using programming of microcontroller-based control systems, students will be introduced to the creation of automated control systems for electro-mechanical applications. Programmable logic controllers (PLCs) and stand-alone microcontrollers will be programmed and used. Program design and programming language syntax will be detailed. Devices such as switches, potentiometers, lights, a variety of sensors, and R/C servo motors will be used. Flowcharts and other programming related topics will be covered.

|                        |                                     |
|------------------------|-------------------------------------|
| Offered:               | Fall Semester                       |
| Credit:                | 3                                   |
| In-Class Workload:     | 3 Hours Lecture, 2 Hours Laboratory |
| Out-Of-Class Workload: | 4 Hours                             |
| Prerequisites:         | None.                               |

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**Objectives:**

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

1. Identify and describe the various components of a control system and their functions.
  2. Describe a variety of control modes and the systems in which they will be used..
  3. Set up and use a PLC control system (using ladder logic).
  4. Identify, select and use the most appropriate on/off (buttons, contacts, opto-interrupt) and position (optical encoder, acceleration, temperature, etc.) sensors for a control system.
  5. Describe and create a control sequence using flowchart and other descriptive techniques.
  6. Apply the features of a stand-alone microcontroller including: I/O (digital, analogue, etc.), communication protocols, memory, peripheral devices, etc.
  7. Use a high-level computer programming language for control systems.
  8. Assemble and program a working electronic circuit with a stand-alone microcontroller system at its core that can interact with the real world in real time.
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**Outline:**

| <b>Week</b> | <b>Content</b>  |
|-------------|---|
| 1 & 2       | <i>Introduction to the Arduino Uno Microcontroller Board</i><br>Microcontroller Architecture<br>I/O Pins and Registers<br>Clocks and Resonators<br>Packages and Ratings<br>Memory   |
| 3 & 4       | <i>Interfacing to Microcontrollers</i><br>Inputs & Outputs<br>Basic Electricity<br>Resistors and Potentiometers<br>Voltage Dividers<br>Switches<br>Pull-Up and Pull-Down Resistors<br>LEDs  |
| 5           | <i>Midterm #1 (2 Hours)</i>   |
| 5 & 6       | <i>Preparing to Programming</i><br>Flowchart Blocks and Signals<br>Flowchart Applications<br>Electronic Circuit Diagrams<br>I/O Pin Tables<br>Programming the Arduino Uno   |
| 7           | <i>Numbering Systems</i><br>Decimal, Binary, Octal and Hexadecimal<br>Conversion between Numbering Systems<br>Binary Numbers – Addition & Subtraction   |
| 8 & 9       | <i>Programming Languages</i><br>C-Language, Assembler, Machine Language<br><i>Arduino Uno Programming Language</i><br>Ports and Registers<br>Variables, Constants, Strings and Arrays<br>Comments<br><i>Program Flow</i><br>If-Else Statement<br>For Loops<br>While Statement<br>Goto and Line Labels<br>Select Case<br><i>Advanced Program Flow</i><br>Subroutines<br>Interrupts |
| 10          | <i>Midterm #2 (2 Hours)</i>   |

| <b>Week</b> | <b>Content</b>  |
|-------------|---|
| 10          | <i>Introduction to PLCs</i><br>The construction of PLCs<br>Inputs (contacts) and outputs (coils)<br>Opto-isolation and electromagnetic relays     |
| 11          | <i>Introduction to Ladder Logic</i><br>Event-oriented vs sequential programming<br>Ladder logic diagrams<br>Introduction to ladder logic commands |
| 12          | <i>Ladder Logic Continued</i><br>Additional ladder logic commands   |
| 13          | <i>Advanced Ladder Logic Commands</i><br>Examples of advanced PLC applications  |
| 14          | <i>Summary of PLCs – Preparation for Final Exam</i>   |

**Distribution of Marks:**

|                 |       |
|-----------------|-------|
| Midterm Exam #1 | 20%   |
| Midterm Exam #2 | 20%   |
| Laboratories    | 30%   |
| Final Exam      | 30%   |
|                 | ----- |
|                 | 100%  |

**Grading:**

|    |           |    |          |
|----|-----------|----|----------|
| A+ | 90 - 100% | B- | 70 - 72% |
| A  | 85 - 89%  | C+ | 65 - 69% |
| A- | 80 - 84%  | C  | 60 - 64% |
| B+ | 77 - 79%  | D  | 50 - 59% |
| B  | 73 - 76%  | F  | < 50%    |

**Reference Website:**

<http://online.camosun.ca>

This course is fully supported by Desire-2-Learn.

**Laboratory Supplies:**

Laboratory kits will be available from Amazon. Please use the following link:

[https://www.amazon.ca/gp/product/B06X3V84PV/ref=ppx\\_yo\\_dt\\_b\\_asin\\_title\\_o06\\_s00?e=UTF8&psc=1](https://www.amazon.ca/gp/product/B06X3V84PV/ref=ppx_yo_dt_b_asin_title_o06_s00?e=UTF8&psc=1)

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**Laboratory Reports:**

Formal laboratory reports are expected for each lab. The reports are due one week after the lab period. There will be one lab report for each student.

No late laboratory reports will be accepted.

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**Instructor:**

*R. Derek C. Wakefield, P.Eng.*

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**Midterms & Final Exam:**

All tests in this course will be online through D2L.

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