**SAULT COLLEGE OF APPLIED ARTS AND TECHNOLOGY**

**SAULT STE. MARIE, ONTARIO**

# COURSE OUTLINE

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| **COURSE TITLE:** | PROCESS CONTROL | | |
| **CODE NO. :** | ELR212 | **SEMESTER:** | FOUR |
| **PROGRAM:** | Electrical Technician – Power Generation and Instrumentation | | |
| **AUTHOR:** | Frank Musso | | |
| **DATE:** | JAN 2010 | **PREVIOUS OUTLINE DATED:** | JAN 2009 |
| **APPROVED:** | *"Corey Meunier"* **CHAIR** | | _____ **DATE** |
| **TOTAL CREDITS:** | 6 | | |
| **PREREQUISITE(S):** | ELN229 | | |
| **HOURS/WEEK:** | 5 | | |

## I. COURSE DESCRIPTION:

This course is a study of process control systems including; single loop, multi-loop, cascade, ratio, feedforward and DCS control. The student will calibrate, adjust, tune, test and maintain these type of control systems.

## II. LEARNING OUTCOMES AND ELEMENTS OF THE PERFORMANCE:

Upon successful completion of this course the student will demonstrate the ability to:

***1. Understand process control terminology and define common Instrumentation terms.***

Potential Elements of the Performance:

- List the classifications of industrial control systems.
- Identify open and closed loop systems.
- Recognize and describe controller modes.
- Recognize and describe single loop control dynamics.
- Explain SAMA and ISA symbols.
- Describe the use and list requirements for instrument air supply
- Identify pneumatic control systems
- Identify Hydraulic control systems
- Understand the workings of SLC (Single Loop Controller)

***2. Develop an insight into the concepts of tuning feedback controllers.***

Potential Elements of the Performance:

- Define the basis for tuning automatic controllers.
- Review ¼ wave amplitude decay.
- Describe the Trial and Error Method of controller tuning.
- Calculate and apply the tuning parameters for a feedback controller using the Ziegler-Nichols ultimate method.
- Calculate and apply the tuning parameters for a feedback controller using the Ziegler-Nichols process reaction method.
- Understand adaptive controller tuning.

***3. Understand the basic principles of cascade control.***

Potential Elements of the Performance:

- Understand the basic concept of feedback control
- Understand the basic concept of feedforward control
- Explain the general guidelines for cascade controller mode selection.
- Draw the block diagram of a cascade system

- Identify primary and secondary systems.
- Describe function of remote/local transfer.
- Configure and tune a cascade system.

***4. Understand the basic concepts of ratio control.***

Potential Elements of the Performance:

- Identify a ratio control system.
- Draw the block diagram of a ratio control system.
- Describe wild and controlled variables.
- Calculate loop values for a common flow ratio system.
- Configure and tune a ratio control system.

***5. Understand the basic concepts of feedforward control.***

Potential Elements of the Performance:

- Analyse feed-forward control systems.
- Draw the general block diagram of a feedforward control system.
- Identify limitations and problems of feedforward control systems.
- Describe the reasons for feedback trim on a feedforward system.
- Sketch a feedforward control loop with feedback trim.

***6. Understand DCS control systems***

Potential Elements of the Performance:

- Develop advance PLC 5 programs to control various processes
- Analyze and troubleshoot PLC circuits that contain discrete logic, sequential logic and A to D and D to A conversion
- Apply logic family characteristics in PLC programming design
- Design and implement solutions to control problems using PLCs
- Configure PLC Analog input and output interfacing modules
- Configure PLC, PID software advance instructions
- Program a PLC to control a single loop process

## III. TOPICS:

1. Basic Process Control Review
2. Controller tuning
3. Cascade Control
4. Ratio Control
5. Feedforward Control
6. Dcs Control

## IV. REQUIRED RESOURCES/TEXTS/MATERIALS:

- Lab Volt Process Control Training Manual
- Assorted handouts supplemented by the Instructor

## V. EVALUATION PROCESS/GRADING SYSTEM:

The final grade will be derived as follows :

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| Tests and quizzes | 60% |
| Practical test and lab reports | 30% |
| Attendance and work ethics | 10% |
| TOTAL | 100% |

The following semester grades will be assigned to students:

| **Grade** | **Definition** | *Grade Point Equivalent* |
|---|---|---|
| A+ | 90 – 100% | 4.00 |
| A | 80 – 89% | |
| B | 70 - 79% | 3.00 |
| C | 60 - 69% | 2.00 |
| D | 50 – 59% | 1.00 |
| F (Fail) | 49% and below | 0.00 |

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| CR (Credit) | Credit for diploma requirements has been awarded. |
| S | Satisfactory achievement in field /clinical placement or non-graded subject area. |
| U | Unsatisfactory achievement in field/clinical placement or non-graded subject area. |
| X | A temporary grade limited to situations with extenuating circumstances giving a student additional time to complete the requirements for a course. |
| NR | Grade not reported to Registrar's office. |
| W | Student has withdrawn from the course without academic penalty. |

## VI. SPECIAL NOTES:

Disability Services:

If you are a student with a disability (e.g. physical limitations, visual impairments, hearing impairments, or learning disabilities), you are encouraged to discuss required accommodations with your professor and/or the Disability Services office. Visit Room E1101 or call Extension 2703 so that support services can be arranged for you.

Retention of Course Outlines:
It is the responsibility of the student to retain all course outlines for possible future use in acquiring advanced standing at other postsecondary institutions.

Communication:
The College considers ***WebCT/LMS*** as the primary channel of communication for each course. Regularly checking this software platform is critical as it will keep you directly connected with faculty and current course information. Success in this course may be directly related to your willingness to take advantage of the ***Learning Management System*** communication tool.

Plagiarism:
Students should refer to the definition of "academic dishonesty" in *Student Code of Conduct*. Students who engage in academic dishonesty will receive an automatic failure for that submission and/or such other penalty, up to and including expulsion from the course/program, as may be decided by the professor/dean. In order to protect students from inadvertent plagiarism, to protect the copyright of the material referenced, and to credit the author of the material, it is the policy of the department to employ a documentation format for referencing source material.

Course Outline Amendments:
The professor reserves the right to change the information contained in this course outline depending on the needs of the learner and the availability of resources.

Substitute course information is available in the Registrar's office.

## VII. PRIOR LEARNING ASSESSMENT:

Students who wish to apply for advance credit transfer (advanced standing) should obtain an Application for Advance Credit from the program coordinator (or the course coordinator regarding a general education transfer request) or academic assistant. Students will be required to provide an unofficial transcript and course outline related to the course in question.

Credit for prior learning will also be given upon successful completion of a challenge exam or portfolio.

**ADVANCE CREDIT TRANSFER**:
Students who wish to apply for advance credit transfer (advanced standing) should obtain an Application for Advance Credit from the program coordinator (or the course coordinator regarding a general education transfer request) or academic assistant. Students will be required to provide an unofficial transcript and course outline related to the course in question.

**Student Portal:**
The Sault College portal allows you to view all your student information in one place. **mysaultcollege** gives you personalized access to online resources seven days a week from your home or school computer. Single log-in access allows you to see your personal and financial information, timetable, grades, records of achievement, unofficial transcript, and outstanding obligations, in addition to announcements, news, academic calendar of events, class cancellations, your learning management system (LMS), and much more. Go to https://my.saultcollege.ca

**Electronic Devices in the Classroom**:
Students who wish to use electronic devices in the classroom will seek permission of the faculty member before proceeding to record instruction. With the exception of issues related to accommodations of disability, the decision to approve or refuse the request is the responsibility of the faculty member. Recorded classroom instruction will be used only for personal use and will not be used for any other purpose. Recorded classroom instruction will be destroyed at the end of the course. To ensure this, the student is required to return all copies of recorded material to the faculty member by the last day of class in the semester. Where the use of an electronic device has been approved, the student agrees that materials recorded are for his/her use only, are not for distribution, and are the sole property of the College.

**Use of cell phones/PDAs for any form of communication (voice, text…) during class or lab time is strictly prohibited. Cell phones/PDAs must be silenced during regular class and lab times and *must be turned off and kept out of sight during test sittings. Failure to follow the latter requirement during a test sitting will result in a grade of 0 being assigned.***

**Attendance:**

Sault College is committed to student success. There is a direct correlation between academic performance and class attendance; therefore, for the benefit of all its constituents, all students are encouraged to attend all of their scheduled learning and evaluation sessions. This implies arriving on time and remaining for the duration of the scheduled session.

**Labs**

Attendance to scheduled lab activities is compulsory, unless permission has been granted by the instructor. Lab attendance and final grade are directly related. If a student arrives late for, or is not continuously present and actively participating at (scheduled breaks excepted), a scheduled lab class he/she will be considered absent for the entire class and will not be permitted to submit the associated lab report.

**Students must continuously wear all Sault College required personal protective equipment (PPE) during lab activities. Failure to do this will result in expulsion from the lab activity and a grade of zero being assigned. Students are expected to be wearing their required PPE prior to entering the lab.. Successful completion of this orientation will be demonstrated by the student completing a quiz with a minimum grade of 100%.**

**The instructor will advise what specific PPE is required. If a student repeatedly neglects to wear PPE as required he/she will be considered to be in violation of the Sault College Academic Code of Conduct and may be sanctioned accordingly (see Student Code of Conduct & Appeal Guidelines). For instance, first violation – verbal warning, second violation written warning, third violation suspension from lab activities. Students must complete a lab safety orientation prior to participating in lab activities**

All lab reports are to be computer generated. Hand written reports will not be accepted.
All lab reports are to include a title page with the following information in the following sequence:

- Name
- Lab title and number
- Due date
- Date submitted
- Course number
- Names of group members
- Instructor’s name

Lab reports are to include all procedures, observations and questions listed in the order they appear in the lab handout and numbered to match the lab handout
Maximum 2 members per group unless approved by the instructor. Each member must submit a lab report.
Lab reports are due at the beginning of class 1 week after the scheduled period in which it was done. A ***penalty of 10% per day*** will be assessed for late submissions. It is recommended students submit lab reports prior to the deadline to avoid late submissions due to unforeseen circumstances (i.e. bad weather, transportation problems…).
Students are not permitted to work on live equipment outside of regular class time and may not work in the lab without faculty permission. This permission will not be considered outside of the regular 8:30am to 4:30pm, Monday – Friday time period.
Students must supply their own personal protective equipment (PPE). Students will not be permitted in the lab if not wearing required PPE. Students must never work alone in the lab. Unsafe work habits will not be tolerated.
Students are expected to maintain a clean and organized work area. Failure to put away equipment (in assigned location) and to clean up after a lab activity will result in a ***penalty of 10%***.

<u>Final Marks</u>
The student must maintain a minimum 50% average in **both** the **theory** portion **and lab** portion of the class in order to receive a passing grade.
If a student misses a test/lab he/she must have a valid reason (i.e. medical or family emergency – documentation may be required). In addition, the instructor **must** be notified **prior** to the test or lab sitting. If this procedure is not followed the student will receive a mark of zero on the test/lab with no make-up option.
Students may not submit lab reports for labs in which they were not in continuous attendance.