



**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  $\frac{1}{4}$  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:

- Describe the functions of a DSC system
- Analyze and troubleshoot PLC analog card
- 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	50%
Practical test and lab reports	40%
Attendance and work ethics	<u>10%</u>
TOTAL	100%

The following semester grades will be assigned to students:

<b>Grade</b>	<b><u>Definition</u></b>	<i>Grade Point Equivalent</i>
A+	90 – 100%	
A	80 – 89%	4.00
B	70 - 79%	3.00
C	60 - 69%	2.00
D	50 – 59%	1.00
F (Fail)	49% and below	0.00
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:**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.

It is the departmental policy that once the classroom door has been closed, the learning process has begun. Late arrivers will not be granted admission to the room.

**VII. COURSE OUTLINE ADDENDUM:**

The provisions contained in the addendum located on the portal form part of this course outline.

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%**.

### Final Marks

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.