

SAULT COLLEGE OF APPLIED ARTS AND TECHNOLOGY

SAULT STE. MARIE, ONTARIO



Sault College

COURSE OUTLINE

COURSE TITLE: Advanced Process Control
CODE NO. : ELR 212 **SEMESTER:** F/W
PROGRAM: ELECTRICAL/ELECTRONICS/INSTRUMENTATION
TECHNICIAN/TECHNOLOGY
AUTHOR: Bill Armstrong
DATE: Jan **PREVIOUS OUTLINE DATED:** Oct
2007 2005
APPROVED:

	<hr/>	DEAN	<hr/>	DATE
TOTAL CREDITS:	6			
PREREQUISITE(S):	ELN 229			
HOURS/WEEK:	5			

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For additional information, please contact C. Kirkwood, Dean
School of Technology, Skilled Trades & Natural Resources
(705) 759-2554, Ext.688

I. COURSE DESCRIPTION:

This course is a study of process control systems including; single loop, multi-loop, cascade, ratio feedforward and boiler 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.
 - Understand the basic concept of feedback control.
 - Understand the basic concept of feedforward control.
 - Recognize and describe controller modes.
 - Recognize and describe single loop control dynamics.
 - Explain SAMA and ISA symbols.
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.
- Understand how to verify controller settings.

3. Understand the basic principles of cascade control.

Potential Elements of the Performance:

- 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. Analyse and understand boiler controls.

Potential Elements of the Performance:

- Explain the main control systems required to control a boiler.
- Identify applications of one, two and three element feedwater controls.
- Analyse air-fuel relationships and determine mixtures for optimum combustion, minimum losses and safety.
- Apply principles of series, parallel and series/parallel combustion controls.
- Select and apply steam temperature control.
- Assess application of oxygen and carbon dioxide analysers in controlling stack emissions and excess air.
- Analyse basic boiler types and their construction methods.
- Select and apply furnace pressure controls.

III. TOPICS:

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

IV. REQUIRED RESOURCES/TEXTS/MATERIALS:

Industrial Control Electronics Devices, Systems and applications
 Terry Bartlett 2nd Edition 2002 Delmar Publishing.
 Assorted handouts supplemented by the Instructor.

V. EVALUATION PROCESS/GRADING SYSTEM:

The final grade will be derived as follows :

Theory tests and Quizzes	= 50%
Practical tests and report	= <u>50%</u>
Total	= 100%

The following semester grades will be assigned to students:

Grade	<u>Definition</u>	<i>Grade Point Equivalent</i>
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
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:

Special Needs:

If you are a student with special needs (e.g. physical limitations, visual impairments, hearing impairments, or learning disabilities), you are encouraged to discuss required accommodations with your professor and/or the Special Needs office. Visit Room E1101 or call Extension 703 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.

Plagiarism:

Students should refer to the definition of “academic dishonesty” in *Student Rights and Responsibilities*. 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.

<include any other special notes appropriate to your course>

VII. PRIOR LEARNING ASSESSMENT:

Students who wish to apply for advanced credit in the course should consult the professor. Credit for prior learning will be given upon successful completion of a challenge exam or portfolio.

VIII. DIRECT CREDIT TRANSFERS:

Students who wish to apply for direct credit transfer (advanced standing) should obtain a direct credit transfer form from the Dean's secretary. Students will be required to provide a transcript and course outline related to the course in question.