DOC. **NO. 679**

SAULT COLLEGE OF APPLIED ARTS & TECHNOLOGY

SAULT STE. MARIE, ONTARIO

COURSE OUTLINE

COURSE TITLE: PROCESS CONTROL

CODE NO.: PPE **344-5** **SEMESTER:**

PROGRAM: ENVIRONMENTAL ENG./PULP & PAPER/WATER RESOURCES

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DATE: DECEMBER 1996 **PREVIOUS OUTLINE DATED:** DECEMBER 1994

APPROVED: _____ ^yiy/rr

DEAN

PROCESS CONTROL PPE **344-5**

COURSE NAME **CODE NO.**

TOTAL CREDIT HOURS: 80

PREREQUISITE(S): HYD220 HYDRAULICS

I. PHILOSOPHY/GOALS:

The course is designed to provide theoretical and practical knowledge of the fundamentals of process control systems. Particular emphasis is placed upon the functioning of the various components, including measuring devices and transducers, transmitters, controllers, and final control elements.

II. STUDENT PERFORMANCE OBJECTIVES:

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

1. Describe applications of process control and recognize the basic control types.
2. Identify the functions of the components of a control loop.
3. Define and apply the principles of hydrostatics and fluid mechanics, and use these concepts in appropriate applications.
4. Identify the characteristics and applications of various pressure measuring elements.
5. Describe the function of a transmitter.
6. Draw and interpret process and instrumentation diagrams.
7. Explain the operation of an on-off control loop.
8. Describe the general characteristics and operation of the proportional control mode.
9. Describe applications of on-off and proportional control loops to the control of pH.

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III. TOPICS TO BE COVERED:

TOPICS

1. Process Control Applications
2. Control Loop Components
3. Principles and Applications of Hydrostatics and Fluid Mechanics
   - Hydrostatics
   - Pressure Measuring Scales
   - Fluid Mechanics
4. Process and Instrumentation Diagrams
5. On/Off Control
   - The On/Off Control Mode
   - Error and Switching Cycle Time
6. Proportional Control
   - The Proportional Control Mode
   - Controller Output Calculations
7. pH Control

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IV. LEARNING ACTIVITIES

A. LECTURES

1.0 OVERVIEW OF AUTOMATIC CONTROL

Upon successful completion of this unit the student will be able to:

1.1 Explain the purpose of automatic control.

1.2 Describe some applications of control projects.

1.3 Recognize the basic control types.

2.0 **HYDROSTATICS**

Upon successful completion of this unit the student will be able to:

2.1 Define weight, mass, weight-density and specific gravity and to use these concepts in appropriate applications.

2.2 Calculate liquid pressure at any given depth.

2.3 Demonstrate the use of Pascal's Law.

3.0 PRESSURE MEASURING **SCALES**

Upon successful completion of this unit the student will be able to:

3.1 Define and differentiate between differential, atmospheric, absolute and gauge pressures.

3.2 Use instrumentation to measure pressures.

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IV. LEARNING ACTIVITIES

4.0 FLUID MECHANICS

Upon successful completion of this unit the student will be able to:

4.1 Determine the flow pattern in a closed conduit.

4.2 Calculate velocities at any point of the pipe.

4.3 Solve problems to find pressures, velocities and elevations in a fluid using Bernoulli's Law.

4.4 Calculate Reynold's No. for a given flow situation.

5.0 PROCESS & INSTRUMENTATION DIAGRAMS

Upon successful completion of this unit, the student will be able to:

5.1 Draw a P & ID for a simple control loop.

5.2 Interpret a P & ID for a simple control loop.

6.0 ON-OFF CONTROL

Upon successful completion of this unit the student will be able to:

6.1 Explain the operation of a simple on-off control loop.

6.2 Calculate the speed of response from the capacitance of and the net input into a process loop.

6.3 Calculate "error" and "switching cycle time" for loops having differential gap and delayed response.

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IV. LEARNING ACTIVITIES

7.0 PROPORTIONAL CONTROL

Upon successful completion of this unit the student will be able to:

7.1 Describe the general characteristics of the proportional control mode.

7.2 Express, in mathematical form, the operation of the proportional control mode.

7.3 Calculate the output of a proportional controller depending on "gain" and "error".

7.4 Make a graphical representation of the controller-output calculation.

B. LABORATORY EXERCISES

Upon successful completion of these laboratory exercises, the student will be able to:

No. 1; Calibrate a Differential Pressure Transmitter (DPT) that may be used for the measurement of flow, level or pressure.	LABORATORY EXERCISE NO. 1 Calibration of a Differential Pressure Transmitter
No. 2; Perform flow measurements using an orifice plate and flange taps.	LABORATORY EXERCISE NO. 2 Flow Versus differential Pressure for an Orifice Plate
No. 3; Perform a calibration check on a DPT and measure the level of fluid in a tank using a DPT.	LABORATORY EXERCISE NO. 3 Level Measurement of an Open Tank
No. 4; Determine the response characteristics of an electronic and/or a pneumatic DPT.	LABORATORY EXERCISE NO. 4 Pressure Transmitter Response Check

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V. METHOD OF ASSESSMENT: **GRADING:**

Assignments/Laboratory Exercises	25%	A+	90-100%
Interim Test	25%	A	80- 89%
Assignments	25%	B	70-79%
Final Examination	25%	C	60-69%

A passing grade will be based on a minimum composite grading of 60%. Students obtaining a composite grading of 55% to 59% may be allowed to complete a supplementary examination.

VI. REQUIRED STUDENT RESOURCES:

PPE34**4** - Process Control - Campus Shop

VII. ADDITIONAL RESOURCE MATERIALS AVAILABLE IN THE COLLEGE LIBRARY BOOK SECTION:

Introduction to Process Control, Publication 105B by The Foxboro Company.

Process Measurement Fundamentals, Vol. 1; by T.E. Collis, E.M. Eacho,
J.P. Jerald, and M.K. Reardon; General Physics Corporation.

Process Control Fundamentals; by Quintech Division of Lab-Volt.

Instrumentation, Third Edition; by F.W. Kirk and N.R. Rimboi. American Technical Publishers, Inc.

Automation and Instrumentation, AWWA Manual M2, Second Edition, American Water Works Society.

Process Instrumentation and Control Systems - Manual of Practice No. OM-6
Water Pollution Control Federation.

VIII. SPECIAL NOTES

Students with special needs (e.g. physical limitations, visual impairments, hearing impairments, learning disabilities) are encouraged to discuss required accommodations confidentially with the instructor.

Your instructor reserves the right to modify the course as he/she deems necessary to meet the needs of students.

LATE POLICY

ADDENDUM TO COURSE OUTLINES

SEMESTER - WINTER 1997

COURSE: PPE 344

Students will be assessed the following academic penalties for late submission of assignments/laboratory assignments.

Assignments are due at the start of each scheduled class.

ASSIGNMENTS (Where Applicable)::

Late Assessment

- 20% if not submitted when due
- *10% additional for each successive day
- 100% if submitted post marking

LABORATORY ASSIGNMENTS (Where Applicable)::

Late Assessment

Attendance:
- 20% first late infraction
- 50% second late infraction
- 100% third and successive infraction(s)

Write-ups:
- Due by 12 noon one week from date of experiment. Students have the option to submit write-ups at the beginning of any scheduled lecture or lab on the due date.

Late Assessment

- 20% if not submitted when due
- *10% additional for each successive day
- 100% if submitted post marking

* Students are aware that they risk **a** mark of "zero" if lateness goes beyond two (2) days.

Assignments should be submitted directly to the Professor to ensure that they are not misplaced. The Professor is not responsible for assignments deposited through his office door/mailbox.