

SAULT COLLEGE OF APPLIED ARTS & TECHNOLOGY

SAULT STE. MARIE, ONTARIO

COURSE OUTLINE

COURSE OUTLINE: AUTOMATIC CONTROL SYSTEMS

CODE NO.: ELN 219-5

PROGRAM: INSTRUMENTATION TECHNICIAN

SEMESTER: FOUR

DATE: JANUARY 1994

**PREVIOUS
OUTLINE DATED:** NONE

AUTHOR: ENO LUDAVICIUS

NEW: **REV.:** X

APPROVED:

W. Filipawich Aug 30/94
COORDINATOR **DATE**

L.P. Choguth 94-08-31
DEAN **DATE**



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TOTAL CREDIT HOURS: 90

PREREQUISITE(S): ELN208

PHILOSOPHY/GOALS:

IN THIS COURSE THE STUDENT WILL DEVELOP THE UNDERSTANDING OF AUTOMATED CONTROL SYSTEMS WITH RATIO , CASCADE, ADAPTIVE AND FEEDBACK CONTROLS. THE STUDENT WILL OVERVIEW THE BASIC HARDWARE COMPONENTS OF CONTROL SYSTEMS.

(ie. I/O, CONTROLLERS, ACTUATORS, SENSORS)

THE LABWORK WILL INCLUDE INTERFACING WITH ANALOG DEVICES TO PLC'S PROGRAMMED BY IPC'S, UTILIZING SERVO, HYDRAULIC AND PNEUMATIC ACTUATORS, INTERFACING ROBOTS TO THEIR WORKCELLS.



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STUDENT PERFORMANCE OBJECTIVES (OUTCOMES):

UPON SUCCESSFUL COMPLETION OF THIS COURSE, THE STUDENT WILL BE ABLE TO:

1. PROGRAM AND TROUBLESHOOT THE AB 5 PLC FAMILY.
2. CONNECT SIMPLE PNEUMATIC ACTUATION.
3. PROGRAM HYDRAULIC ROBOTIC ACTUATION
4. PROGRAM SERVO ELECTRICAL ROBOTIC ACTUATION.
5. CONTROL A PROCESS WITH A PID LOOP CONTROLLER.

TOPICS TO BE COVERED:

1. OVERVIEW OF FEEDBACK CONTROL SYSTEMS.
2. COMPUTER-CONTROLLED INDUSTRIAL MACHINES, PROCESSES AND ROBOTS.
3. INTRODUCTION TO MODERN HYDRAULICS AND PNEUMATICS.
4. INTERFACING WITH ANALOG DEVICES.

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LEARNING ACTIVITIES

RESOURCE MATERIAL

CLASSICAL CONTROL THEORY

RESOURCE MATERIAL

- DESCRIBE WHAT CONTROL SYSTEMS ARE AND THE WAY WE USE THEM.
- DEFINE THE TERMINOLOGY NECESSARY TO DESCRIBE CONTROL SYSTEMS.
(ie. plant, process, system, feedback, ...)
- DEFINE THE DIFFERENCE BETWEEN OPEN AND CLOSED LOOP CONTROL SYSTEMS.
- DISCUSS THE CONTROL SYSTEM CHARACTERISTICS.
(ie. accuracy, stability, sensitivity, noise, cost)
- DISCUSS THE CONTROL STRATEGY STAGES OF MANUFACTURING PROCESSING.
- ILLUSTRATE EXAMPLES OF CONTROL SYSTEMS.
(ie. pressure, speed, numerical, computer, ...)

- REQUIRED TEXTBOOK
- HANDOUTS
- MANUALS FROM THE AUTOMATION LIBRARY

RESOURCE MATERIAL

OVERVIEW OF AUTOMATED CONTROL SYSTEMS

- DEFINE THE PURPOSE OF AUTOMATIC CONTROL SYSTEMS
- DESCRIBE THE IMPLEMENTATION OF INDUSTRIAL CONTROL SYSTEMS
- DESCRIBE THE TYPES OF MANUFACTURING PROCESSES THAT USE CONTROLLERS
- DESCRIBE THE TWO TYPES OF CONTROLLERS USED IN INDUSTRY
- DESCRIBE THE METHODOLOGY OF CHOOSING THE CORRECT CONTROLLER FOR THE INTENDED APPLICATION

INDUSTRIAL SERVO CONTROL SYSTEMS

- DISCUSS THE MEANING OF A FEEDBACK CONTROL SYSTEM.
- DISCUSS THE EVALUATION OF PERFORMANCE OF FEEDBACK SYSTEMS
(ie. error, setpoint, dynamic response, ...)
- DRAW A BLOCK DIAGRAM OF A CLOSED-LOOP FEEDBACK SYSTEM WITH A ROBOT IN THE SYSTEM.

LEARNING ACTIVITIES

- DESCRIBE SIMPLE SPEED CONTROL PROPORTIONAL - P + INTEGRAL - P + I + DERIVATIVE
- DISCUSS A SERVOMOTOR CONTROL SYSTEM.

THE ACTUATORS OF A INDUSTRIAL CONTROLS

- DESCRIBE THE ADVANTAGES & DISADVANTAGES OF THE THREE TYPES OF ACTUATORS USED IN INDUSTRY.
- DESCRIBE THE FACTORS WHICH INFLUENCE THE CHOICE OF A AN ACTUATOR FOR GIVEN APPLICATION.
- DISCUSS ELECTRICAL ACTUATION
 - SOLENOIDS
 - RELAYS
 - AC SERVOMOTOR
 - STEPPER MOTORS
- DISCUSS HYDRAULIC ACTUATION
 - LINEAR
 - ROTARY
- DISCUSS PNEUMATIC ACTUATION
 - LINEAR
 - ROTARY

INDUSTRIAL SENSORS & TRANSDUCERS

- DEFINE THE MAJOR DIFFERENCE BETWEEN THE TERMS SENSOR AND TRANSDUCER.
- DESCRIBE THE CATEGORIZATION OF SENSORS:
 - MECHANICAL
 - FLUID
 - THERMAL
 - OPTICAL
- DISCUSS THE DIFFERENT TYPES OF MECHANICAL TRANSDUCERS:
 - DISPLACEMENT
 - STRAIN
 - MOTION
- DISCUSS THE DIFFERENT TYPES OF FLUID TRANSDUCERS:
 - PRESSURE
 - FLOW
- DISCUSS THE DIFFERENT TYPES OF TEMPERATURE TRANSDUCERS:
 - RTD
 - THERMOCOUPLES

- REQUIRED TEXTBOOK
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RESOURCE MATERIAL

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LEARNING ACTIVITIES

- THERMISTORS
- IC SENSORS
- DISCUSS THE DIFFERENT TYPES OF OPTICAL TRANSDUCERS:
 - OPTICAL ENCODERS
 - VISION SYSTEMS - CAMERAS
 - LASER SCANNERS
 - X-RAYS
 - INFRARED CAMERAS
 - 3D CAMERAS

OVERVIEW OF PID CONTROL

- DISCUSS PROPORTIONAL PLUS INTEGRAL PLUS DERIVATIVE CONTROL
- DESCRIBE THE RELATIONSHIP BETWEEN PROCESS CHARACTERISTICS AND PROPER MODE OF CONTROL
- UTILIZE PID WITH PLC FUNCTION BLOCKS

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METHOD(S) OF EVALUATION

TESTS - THREE WRITTEN TESTS TOTALLING 50%.
(MINIMUM AVERAGE OF 55% MUST BE MAINTAINED
FOR A PASSING GRADE IN ALL THREE TESTS.)

PROJECTS - FOUR PROJECTS TOTALLING 50%.
(MINIMUM AVERAGE OF 55% MUST BE MAINTAINED
FOR A PASSING GRADE IN ALL FIVE PROJECTS.)

TOTAL 100%

THE GRADING SYSTEM USED WILL BE AS FOLLOWS:

A+ = 90 - 100% A = 80 - 89% B = 70 - 79% C = 55 - 69%

R REPEAT

REQUIRED STUDENT RESOURCES:

TEXT BOOKS: AUTOMATED PROCESS CONTROL SYSTEMS
 CONCEPTS AND HARDWARE
 RONALD P. HUNTER
 PRENTICE HALL

**ADDITIONAL RESOURCE MATERIALS AVAILABLE IN THE COLLEGE
LIBRARY BOOK SECTION:**

- 1) MODERN INDUSTRIAL ELECTRONICS
 SCHULER - McNAMEE
 GLENCOE
- 2) FEEDBACK CONTROL SYSTEMS FOR ATECHNICIANS
 ROBERT T. PICKETT
 PRINTICE HALL
- 3) AUTOMATED CONTROL SYSTEMS AND COMPONENTS
 JAMES R. CASRTENS
 PRINTICE HALL

SPECIAL NOTES:

