EET-2500: INSTRUMENTATION AND CONTROL

Cuyahoga Community College

Viewing: EET-2500 : Instrumentation and Control

Board of Trustees:
May 2023

Academic Term:
Fall 2023

Subject Code
EET - Electrical/Electronic Engineer

Course Number:
2500

Title:
Instrumentation and Control

Catalog Description:
Concepts and practice in measurement and control of mechanical process variables in industry. Introduction to methods of instrumentation, characteristics of instruments, sensors, data acquisition and presentation, measurement and analysis of basic dimensions, force, motion, pressure, temperature, fluid flow and fluid viscosity.

Credit Hour(s):
3

Lecture Hour(s):
2

Lab Hour(s):
3

Other Hour(s):
0

Requisites

Prerequisite and Corequisite
EET-1220 Circuits and Electronics; or EET-2120 Electronics I; or departmental approval.

Outcomes

Course Outcome(s):
Use National Instrument Compact Data Acquisition (CDAQ) input hardware to measure pressure, height, and flow from separate transmitters; and use CDAQ output hardware to provide an output signal to a pressure valve; and E-Trac Inverter in order to control pressure, height, and flow.

Essential Learning Outcome Mapping:
Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

Objective(s):
1. Using Labview, demonstrate how to output a 4-20mA signal to a pressure valve and then measure and record the resulting input voltage signal from a pressure transmitter and a corresponding pressure gauge reading.
2. Using Labview, demonstrate how to output a 4-20mA signal to an E-Trac controller and then measure and record the resulting input voltage signal from a height transmitter and a corresponding tank height reading.
3. Using Labview, demonstrate how to output a 4-20mA signal to an E-Trac controller and then measure and record the resulting input voltage signal from a flow transmitter and a corresponding flow reading.

Course Outcome(s):

Use software to take measurements (pressure, height, and flow), store data, and control these parameters real time.

Essential Learning Outcome Mapping:

Not Applicable: No Essential Learning Outcomes mapped. This course does not require application-level assignments that demonstrate mastery in any of the Essential Learning Outcomes.

Objective(s):

1. Perform percent error calculations on measured height versus calculated height.
2. Create control loops in LabView software to control height.
3. Perform curve fit calculations in class to model the input voltage to the flow reading.
4. Implement the curve fit calculations into LabView software to control the flow.
5. Perform percent error calculations on measured flow versus calculated flow.
6. Create control loops in LabView software to control flow.
7. Perform curve fit calculations in class to model the input voltage to the pressure reading.
8. Implement the curve fit calculations into LabView software to control the pressure.
9. Perform percent error calculations on measured pressure versus calculated pressure.
10. Create control loops in LabView software to control pressure.
11. Perform curve fit calculations in class to model the input voltage to the height reading.
12. Implement the curve fit calculations into LabView software to control the height.

Methods of Evaluation:

a. Homework
b. Examinations
c. Final examination
d. Lab reports
e. Required by ABET
    i. Portfolio
    ii. Spreadsheet Assignment

Course Content Outline:

a. Process of measurement
    i. Methods of measurement instrumentation
    ii. Measuring system
    iii. Characteristics of instruments
    iv. Errors
    v. Calibration
b. Data collection and utilization
    i. Analog and digital signals
    ii. Signal conditioning
    iii. A/D and D/A converter
    iv. Digital circuit
    v. Microprocessor
c. Sensors
    i. Mechanical sensors
        1. Contact
        2. Elastic
        3. Mass
        4. Thermal
        5. Hydro-pneumatic
        6. Dynamic
    ii. Electrical
        1. Resistive
        2. Inductive
        3. Capacitive
        4. Piezoelectric

5. Semiconductor
6. Photoelectric

d. Measurement of process variables
   i. Displacement/position
   ii. Acceleration and vibration
   iii. Pressure
   iv. Force and torque
   v. Temperature
   vi. Fluid flow
   vii. Level
   viii. Viscosity
   ix. Humidity
e. Introduction to control system
   i. Control principles
   ii. Control modes
      1. On-off control
      2. Proportional control
      3. Proportional-integral control
      4. Proportional-integral-derivative control
   iii. Techniques of process control
      1. Digital control
      2. Open loop control
      3. Feedback control
      4. Feed forward control
      5. Multiple loop control
      6. Adaptive control
      7. Statistical process control
   iv. Safety in instrumentation and control system

Resources

T. Beckwith, R. Mavangoniand, and J. Lienhard. *Mechanical Measurements*. 6th ed. Addison-Wesley, 2006. 8/7/2006.

Bishop. *Learning with Labview 7, Express*. 1st ed. Delmar, 2004. 1/1/2004.

Robert Boylestad, and Louis Nashelsky. *Electronic Devices and Circuit Theory*. 11th ed. Boston, MA: Pearson, 2015. 10/8/2015.

Curtis Johnson. *Process Control Instrumentation Technology*. 8th ed. 2005. 6/21/2005.

Franklin Kirk, Thomas Weedon, and Phillip Kirk. (2019) (5/20/2019) *Instrumentation and Process Control*, American Technical Publishers.

William Bolton. (2021) (2021) *Instrumentation & Control Systems*, Newnes.

NAPTA. (2020) (2020) *Process Instrumentation*, Pearson.

Resources Other

a. Laboratory handout workbook.

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