

SOUTHEAST COMMUNITY COLLEGE
CONSTRUCTION MANUFACTURING AND TECHNOLOGY DIVISION
Energy Generation Operations Technology Program
Revision Date: August 21, 2023

I.

II. CATALOG DESCRIPTION

Course Number: ENER2010
Course Title: Instrumentation and Process Control
Prerequisite(s): PHYS1017 or higher
Catalog Description: Building on the Mechanical and Fluid Fundamentals course, this course will cover the essential elements of a process control system. It will cover common types of electrical and pneumatic signals used for data collection while exploring devices used to measure flow rates, pressures, temperatures, levels and analytic control. The course will compare fundamental control strategies such as on/off and PID. It will explain the basic components of Supervisory Control and Data Acquisition (SCADA), Distributed Control Systems (DCS) and their use in process control. Includes operation of coal and combined cycle plant control systems. Lab must be taken concurrently.

Credit Hours: 5.0
Class Hours: 60
Lab Hours: 45
Total Contact Hours: 105

III. COURSE OBJECTIVES: *Course will:*

- A.** Introduce students to industrial instruments and sensors.
- B.** Introduce students to the operating principles of different types of instruments and sensors (i.e. temperature, pressure, level, etc.)
- C.** Introduce students to transmission and communication systems used in industrial process control.
- D.** Introduce students to instrument and process control systems.

IV. STUDENT LEARNING OUTCOMES AND GENERAL EDUCATION LEARNING OUTCOMES:

- A.** Student Learning Outcomes: *Student will be able to:*
 - 1.** Understand the principles of industrial instruments, instrumentation diagrams and controls.
 - 2.** Explain the methods used to measure temperature, pressure, level, flow, analytic, and position.
 - 3.** Describe the different ways that information is communicated to the operator of a facility.
 - 4.** Identify the different types of portable and fixed measurement devices.
 - 5.** Describe the methods of automatic control systems and the process dynamics they cause.
 - 6.** Explain the operation of final control devices including regulators, valves and solenoids.
 - 7.** Automatic/Manual Control
 - a.** Explain the operation of modern automatic control systems.
 - b.** Explain the operation of modern manual control systems.
 - 8.** Final Elements
 - a.** Discuss the operation of final control elements.
 - 9.** Instrumentation and Control Applications

- a. Demonstrate how instruments and control systems are operated using automation.
 - 10. SCADA and DCS
 - a. Identify the major components of Supervisory Control and Data Acquisition (SCADA) and distributed control systems (DCS).
 - 11. Explain the role of operators in managing processes with the use of SCADA and DCS.
- B. General Education Learning Outcomes (GELOs)
 - 1. GELO 5: Analytical, Quantitative, and Scientific Reasoning
Outcome 4: Manipulate formulas, data sets, graphs, tables, etc. in a way to produce a meaningful outcome.

V. CONTENT/TOPICAL OUTLINE

- A. Introduction to Instrumentation
 - 1. Overview of Instrumentation
 - 2. Fundamentals of process control
 - 3. Piping and Instrumentation diagrams
- B. Temperature Measurement
 - 1. Scales
 - 2. Types of Thermometers
 - 3. Measurement and Calibration
- C. Pressure Measurement
 - 1. Pressure and Force
 - 2. Pressure Instruments
 - 3. Measurement and Calibration
- D. Level Measurement
 - 1. Level Instruments
 - 2. Measurement and Calibration
- E. Flow Measurement
 - 1. Fluid Flow
 - 2. Types of Flow Meters
- F. Analyzers
 - 1. Emissions
 - 2. Liquid & Chemical
 - 3. Composition
- G. Position Measurement
 - 1. Proximity Switches
 - 2. LVDT's
 - 3. Practical Position Measurement
- H. Transmission and Communication
 - 1. Types of Transmission Signals
 - 2. Principles of Transmission Signals
 - 3. Applications
- I. Final Control Elements
 - 1. Control Valves
 - 2. Regulators and Dampers
 - 3. Actuators and Positioners
 - 4. Variable Speed Drives and Electric Power Controllers
- J. Automatic Control
 - 1. Automatic Control and Process Dynamics
 - 2. Control Strategies

- 3. Controller Tuning
 - 4. Digital and Electric Controllers
- K. Instrumentation and Control Applications
 - 1. General Control Techniques
 - 2. Temperature Control
 - 3. Pressure and Level Control
 - 4. Flow Control
 - 5. Analysis and Multivariable Control
- L. SCADA and DCS Application
 - 1. Components of process management systems (SCADA and DCS)
 - 2. Implementation of control systems, their benefits and limitations
 - 3. Operator responsibilities

VI. INSTRUCTIONAL MATERIALS

- A. Required Text(s):
 - 1. Kirk, Franklyn W., Weedon, Thomas A., and Kirk Phillip; *Instrumentation and Process Control*, (Refer to CID and/or instructor for current edition)
 - 2. Weedon, Thomas a., *Instrumentation and Process Control Workbook*, (Refer to CID and/or instructor for current edition)
 - 3. Howlett, H.C., *The Industrial Operator's Handbook*, (Refer to CID and/or instructor for current edition)
- B. Other Resources: Instructor provided.
- C. Supplies: 3 ring binder with blank paper for notes and Calculator

VII. METHODS OF PRESENTATION/INSTRUCTION

- A. Methods of presentation typically include a combination of the following:
 - 1. Face to Face Class

VIII. METHODS OF EVALUATION

- A. Methods of evaluations, although determined by the individual instructor, traditionally includes a combination of the following:
 - 1. Class participation
 - 2. Regular assignments
 - 3. Written exams and/or quizzes
 - 4. Performance and observational assessments

IX. SPECIFIC COURSE REQUIREMENTS

- A. A minimum grade of "C" (70%) is required to receive credit for this course.
- B. A minimum grade of "B" or 80% is required to achieve the NUCP certificate, in accordance with ACAD 08-006, Revision 1, dated October 2016.
- C. Cheating within the Manufacturing Division: Any violation of academic integrity on assignments, quizzes or tests will result in a grade of 0 on that assignment, quiz or test. A second violation in any course after the initial infraction will result in a grade of F for that course. Any additional violations while in the program will result in a suspension from the program. For additional information, refer to the *Academic Integrity* pamphlet available from Student Services.
- D. Credit by Examination: Credit for the course CANNOT be earned through Credit by Examination.