

COURSE OUTLINE
CET 221 Basic Controls
5 Credit Hours

Course Description

This course offers a foundation for working with control system devices that are commonly used to automate building systems and equipment. Topics include controllers, sensors, actuators, controlled devices, power supply devices, transducers, relays and contactors, motor controls, enclosures, and power monitoring devices.

Prerequisite(s)

CET 101 OSHA 30 – Safety Orientation OSHA 30

CET 111 AC/DC Circuits I or HVA 1104 Electrical Fundamentals

Purpose of Course

The purpose of this course is to prepare students to work with control devices and wiring used in building automation systems of modern buildings and critical environments.

Required Materials

- Petruzella, Frank D. 2017. *Programmable Logic Controls*, 5th ed. McGraw Hill. ISBN:978-0-0733-7384-3

Optional Resources

- Shultz, P. T. (2007). *AC/DC Principles Workbook*. Homewood, IL: American Technical Publishers. ISBN #: 978-0-8269-1351-7
- Mazur, G. A., & Proctor, T. E. (2010). *Troubleshooting Electrical / Electronic Systems*. Orland Park, IL: American Technical Publishers. ISBN #: 978-0-8269-1791-1
- Online Kele catalog

Learning Outcomes

The intention is for the student to be able to:

1. Demonstrate understanding of the roles of sensors, controllers, and devices in control loops.
 - a. Identify and describe the following types of sensors: temperature--thermistor, thermocouple, RTD, pressure, humidity, light, motion, flow, level, position.
 - b. Identify devices often found in control loops, including valves, pumps, lamps, locks, dimmers, switches.
 - c. Describe the functions of the following actuators often found in control loops: motors, pistons and relays.
 - d. Describe the difference between an input signal and an output signal in a control loop.
 - e. Describe the difference between digital and analog signals and state which signal type various sensors and devices send and receive.
 - f. Describe how setpoints and signals from sensors can be used to control devices.
 - g. Explain the characteristics of controllers: modulating, electrical, mechanical, electro-mechanical, electronic/digital, pneumatic.
 - h. Define the following terms: torque, reverse-acting, direct-acting, throttling, feedback, two-position, tri-state, modulating.

2. Compare and contrast the following types of controllers: PLCs, Direct Digital Controllers (DDC), application specific controller, supervisory controller, front-end controller, BAS/BMS vs SCADA.
 - a. Describe differences between Programmable Logic Controllers (PLCs) and Direct Digital Controllers.
 - b. List automation needs that are different for industrial and building automation applications.
3. Assemble the physical components of simple control loops.
 - a. List and identify controller hardware components.
 - b. Use Ohm's Law to calculate the size of resistors and voltage sources needed to ensure a circuit will not damage equipment.
 - c. Connect wires of input and output devices to a controller.
 - d. Describe functions of overload device.
 - e. Describe how a solenoid works.
 - f. Identify and describe purposes of function generators, oscilloscopes, and power supplies.
 - g. Interpret and draw control loop wiring diagrams.
 - h. Assemble control loops using sensors, resistors, and other electrical components.
 - i. Predict values of electrical properties in a circuit, and then test to ensure calculations are correct using a multimeter.
 - j. Explain the importance of separating different line types (power, communication, input, output, AC, DC) to avoid electromagnetic interference.
 - k. Troubleshoot mechanical/ electrical problems of a controller by checking connections, testing electrical properties and grounding, and ensuring that incoming voltage meets specifications.
4. Write simple programming instructions.
 - a. Describe the Number Systems and Codes used in ladder logic.
 - b. Discuss the fundamentals of programming logic.
 - c. Develop a simple control loop using ladder logic programming.
 - d. Describe relationship between normally open/normally closed and fail-safe modes.
 - e. Draw a ladder logic diagram for a control loop.
 - f. Write simple control instructions using ladder logic.
 - g. Write simple control instructions using Sedona-based graphical block programming.
 - h. Write simple control instructions using line logic.
 - i. Interpret control instructions.
5. Apply understanding of basic control loops to building automation systems.
 - a. Using control loop terminology, explain how lights in a hallway might be controlled in a way that conserves daylight.
 - b. Explain how a Building Automation System controller interacts with application controllers that operate various building equipment.
 - c. Describe the sequence of operations of simple mechanical systems.

Learning Units

- I. Sensors, Controllers and Devices
- II. Controllers – An Overview
- III. Controller Hardware Components
- IV. Basics of Programming

V. Building Automation Control Concepts

Method of Delivery/Instruction

☒ Face-to-Face ☒ Blended ☐ Online

Learning activities will be assigned within and outside the classroom or online to assist the student to achieve the intended learning outcomes through lecture, Instructor-led class discussion, hands-on experiences, and others at the discretion of the instructor.

Method of Grading and Evaluation

The student will be graded on learning activities and assessment tasks. Grade determinants may include the following: daily work, quizzes, chapter or unit tests, comprehensive examinations, student projects, student presentations, class participation or forum posts, and other methods of evaluation employed at the discretion of the instructor.