MECH 0004 - FUNDAMENTALS OF MECHATRONICS

Catalog Description

Formerly known as CIE 4
Hours: 108 (54 lecture, 54 laboratory)
Description: Introduction to mechatronics, which combines electronics, mechanics, pneumatics, and hydraulics, under computer control; as applied to robotics and automation. Presented through hands-on, project-based experiments that demonstrate industrial applications. (CSU)

Course Student Learning Outcomes

- CSLO #1: Apply industrial electrical wiring standards.
- CSLO #2: Construct functional electric motor control circuits.
- CSLO #3: Design PLC programs to control actuators and indicators.

Effective Term

Fall 2021

Course Type

Credit - Degree-applicable

Contact Hours

108

Outside of Class Hours

108

Total Student Learning Hours

216

Course Objectives

Lecture Objectives:
1. Explain the proper safety procedures and precautions required in the mechatronics field.
2. Describe the function and application of common electrical devices and circuits used in mechatronic systems.
3. Analyze technical documentation for electrical motor power and control circuits.
4. Analyze the function of various electrical transducers.
5. Analyze technical documentation on industrial-quality sensors and assess their applicability to solving challenges in lab assignments.
6. Examine rudimentary Programmable Logic Controller (PLC) programs and conjecture the resultant logical equipment behavior.
7. Design original PLC code to implement assigned tasks.
8. Describe the function and application of common pneumatic devices and circuits used in mechatronic systems.
9. Investigate sensor and pneumatic-actuator operation.
10. Diagnose errors in the operation of a mechatronics system and formulate hypotheses for root causes.
Laboratory Objectives:
1. Demonstrate the proper safety procedures and precautions required in the mechatronics field.

2. Design, construct, and document common electrical motion control circuitry.
3. Construct electrical motor power and control circuits.
4. Demonstrate the function of various electrical transducers.
5. Construct and appraise systems using industrial-quality sensors.
6. Develop rudimentary Programmable Logic Controller (PLC) programs and interpret the resultant logical equipment behavior.
7. Test original PLC code to implement assigned tasks. Appraise and modify the program as needed to fix unintended behaviors.
8. Test the function and application of common pneumatic devices and circuits used in mechatronic systems.
9. Test sensor and pneumatic-actuator operation and experiment with methods of adjustment/calibration.
10. Implement solutions to errors in the operation of a mechatronics system and critique the resultant behavior.

General Education Information

- Approved College Associate Degree GE Applicability
- CSU GE Applicability (Recommended-requires CSU approval)
- Cal-GETC Applicability (Recommended - Requires External Approval)
- IGETC Applicability (Recommended-requires CSU/UC approval)

Articulation Information

- CSU Transferable

Methods of Evaluation

- Essay Examinations
  - Example: Students must write an essay explaining the three different voltage domains in a motor control circuit.
- Objective Examinations
  - Example: Students must complete a quiz on transducer and sensor characteristics. Standard Grading. Example: Is a coil of wire considered a sensor or a transducer?
- Problem Solving Examinations
  - Example: Students must utilize operational indicator lights to find root-cause of non-functional equipment.
- Projects
  - Example: Students must create a flowchart for a puck-sorting PLC program and successfully implement it on a classroom mechatronics trainer. Grading based on industry standard.
- Skill Demonstrations
  - Example: Students must properly wire up a 240VAC three-phase motor and demonstrate safe operation. Grading based on industry standards.

Repeatable

No

Methods of Instruction

- Laboratory
- Lecture/Discussion
- Distance Learning

Lab:

1. Following a lecture on three phase motors construction, ratings, connections points and hazards the student will be required to properly wire a 208 volt three phase induction motor, then document

and analyze the behavior and features to decide if the behavior is as expected.

Lecture:

1. Instruction is given on the topic of stepper motors and their control techniques. Students are expected to actively engage in the lecture by answering questions related to the primary types of stepper motors and how to distinguish. They will evaluate stepper motor control modes and discuss features and characteristics of each mode.

Distance Learning

1. Instructor will present through video the programming language format, syntax, and mnemonics for basic PLC code. Students will download & install PLC simulation software to write their own automation routine per student created flowchart.

2. Instructor will review code in both ladder and list formats and evaluate process on simulator and discuss improvements and upgrade potentials. Student will take feedback and write additional code to modify and improve automation.

Typical Out of Class Assignments
Reading Assignments

1. Read assigned material that covers electrical safety procedures. Be prepared to discuss how current levels affect the human body. 2. Research on the internet electric motor specifications. Be prepared to discuss the suitability of a motor to its anticipated application.

Writing, Problem Solving or Performance

1. Write an analysis of an electrical control circuit, clearly delineating the functions of the low-voltage and high-voltage regions of the circuit. 2. Analyze the behavior of a mechatronic system in which an intentional error has been inserted. Hypothesize potential root causes and test these hypotheses.

Other (Term projects, research papers, portfolios, etc.)

Organize and maintain a portfolio incorporating all pertinent documentation related to basic mechatronic principles and materials covered in the course.

Required Materials

- Automating Manufacturing Systems with PLCs, Version 6.0
  - Author: Hugh Jack
  - Publisher: Hugh Jack
  - Publication Date: 2010
  - Text Edition: Online
  - Classic Textbook?:
  - OER Link:
  - OER:
- Industrial Electricity and Motor Controls
  - Author: Rex Miller / Mark Miller
  - Publisher: McGraw-Hill Education
  - Publication Date: 2013
  - Text Edition: 2nd
  - Classic Textbook?:
  - OER Link:
  - OER:
- Lessons in Electric Circuits
  - Author: Kuphaldt, Tony R.
  - Publisher: www.allaboutcircuits.com - Design Science License
  - Publication Date:
  - Text Edition:
  - Classic Textbook?:
  - OER Link:
  - OER:

Other materials and-or supplies required of students that contribute to the cost of the course.

1. Scientific calculator 2. Safety Glasses (meeting national Z-87 standard).