Virginia Western Community College
ETR 237
Industrial Electronics I

Prerequisites

ETR 113

Course Description

Studies linear integrated circuits for industrial applications, motors, industrial control devices, power control circuits, transducers, industrial process control, and sequential process control.

Semester Credits: 4 **Lecture Hours: 3 Lab/Recitation Hours: 2**

Required Materials

Textbook:

Industrial Electronics, Year: 2006, Author: Rehg, Publisher: Pearson Prentice Hall, ISBN# 9780132064187

Other Required Materials:

Scientific Calculator: TI, Casio, or HP, a must to be brought to class each session. Know your calculator!

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Course Content

Plant Model

- Bottling Plant
  - Introduction
  - Videos
  - Tasks
- Module Level Control
  - Introduction
  - Simulation
  - Tasks
  - Alternative Solutions
- Module Temperature Control
  - Introduction
  - Simulation
  - Tasks
  - Alternative Solutions
- Module Heater-Cooler
  - Introduction

- **Simulation**
- **Tasks**
- **Alternative Solutions**

Control Technology

- **Process Automation**
- **Process Control Technique**
- **Closed Loop Control**
- **ON/OFF Control**
- **PID Control**
- **Step Response**
- **Tuning the Controller**
- **Three Position Control**
- **Trouble Shooting**
- **PWM**

Training Elements

- **Starting LabView**
- **LabView Results in Excel**
- **DAQ interface**

- **Oven Simulation**
- **Motor-Pump Simulation**
- **RCR Simulations**
- **Heater Experiment**
- **Motor Experiment**
- **DR21 Tuning**

Technical Components

- **Reading Diagrams**
- **Bottling Plant**
- **Filling Module**
- **Heating Module**
- **Heater Coller Module**
- **Controller Types**
    - **Compact Controller**
    - **PLC Controller**
- **Amplifier and Electronics**
- **Operating Tools**

Process Control Technologies

Course Description

This course covers topics in Closed Loop Control and technologies used in Process Control in the context of a complex mechatronic system. Based on a real system, students will learn the basic functions related to obtaining knowledge of plant documentation and manuals, making suggestions for use in future analysis, creating sets of suggestions for future analysis, and creating diagrams that show the interaction between controllers, sensors and actuators.

The course focuses in helping students to be able to characterize a system by its step response function, and creating and interpreting charts with diagrams for time-based changes of measured values. Students will learn how to establish controller operating parameters and learn the difference between the types of controllers that are typically used in mechatronic systems. PID controllers will be introduced and discussed, along with strategies for optimizing them. Based on the step response functions mentioned above, students will learn how to determine which controller is the best one to use. The advantages and disadvantages of ON/OFF and PID controllers are covered with regard to certain systems. Finally, optimization and troubleshooting of industry controllers is covered.

Course Philosophy

For this course particularly, the entire system will be analyzed, the individual processes examined, and the use of automated processes control techniques and their types will be discussed. Next, modules with process control will be individually examined in the context of the whole mechatronic system, and its constituent control systems will be studied. For each of these parts, students will be given sets of tasks. By completing them, they will work with an actual mechatronic system and come to understand the control technologies contained inside.

Course Goals

Upon completion of the course, students should:

- Understand the role of control devices within mechatronic system, and the inter relationships with components and modules within that system.
- Understand the different control strategies and their use for different applications.
- Understand why control technology is important for process control in mechatronic systems.
- Know how to identify malfunctions of control systems because of knowing their influence on the system itself.
- Be able to troubleshoot and optimize control systems.

Course Objectives

At the conclusion of this course, students will be able to:

- Monitor the operation of permanently installed plants
- Perform regular maintenance
- Perform fault troubleshooting, diagnosis and elimination
- Exchange and replacement of components, including plant controllers
- Apply process control technology knowledge, including fluency with all regulator types

Course Prerequisites

Basic knowledge of algebra. Basic knowledge of sensors and actuators, from exposure to courses in the Siemens Mechatronic Systems Certification Program Level 1 or equivalent.

Course Materials

Recommended basic course materials are in digital form:

Course materials provided by SMSCP Partner Schools to their students are at the partner school's discretion, and may include special software such as LabView or other visualization/simulation software. If desired, a supporting textbook on closed loop control and/or process control technology may required by the school or instructor.

Students must also have access to a mechatronic training system containing all or most of the basic component types covered in the course. Please see the SMSCP "Hardware Requirements" document for more information on system requirements for Level 2 instruction.

Course Objectives

At the end of the semester, the student will be able to:

1. To understand the basics of a process control loop
2. To discern the difference between the various types of process variables
3. To have an expanded understanding of basic electrical components and the basic terms used in electricity as required for instrumentation
4. To identify basic passive components in AC circuits and understand their application in instrumentation.
5. To identify active devices and how they are used in instrument applications and the difference between analog and digital circuits
6. To differentiate the roles of pressure, flow, temperature, heat, humidity, density, viscosity and pH in process control
7. To understand a variety of sensors and the very important part they play in process control

Topical Description

Week #	Topic	Ch.
1	Industrial Electronics Introduction, AC/DC Review	1
2	Switches and Actuators	2
3	Solid State Devices - Diodes, Power Supplies	3
4	Solid State Devices - Transistors and Amplifiers	3
5	Operational Amplifiers - Introduction	4
6	Test 1. Ch. 1 -3	Test 1
7	Operational Amplifiers Circuits	4
8	SCRs, Thyristors	5
9	Sensor Basics	6
10	Test 2. Ch. 4 - 6	Test 2
11	Process Control Devices and Sensors Part 1	7
12	Process Control Devices and Sensors Part 2	7
13	Continous Process Control (PID) Part 1	14
14	Continous Process Control (PID) Part 2	14
15	Review	
16	Final, Comprehensive	

Notes to Instructors

1. The course should have a comprehensive final exam worth 15% of the course grade.