GROSSMONT COLLEGE

Official Course Outline

# COMPUTER SCIENCE AND INFORMATION SYSTEMS 255 – INTRODUCTION TO PROGRAMMABLE LOGIC CONTROLLERS (PLCs)

1. Course Number Course Title Semester Units Semester Hours

CSIS 255 Introduction to 4 3 hours lecture: 48-54 hours

Programmable Logic 3 hours lab: 48-54 hours

Controllers 96-108 outside-of-class hours

for lecture

192-216 total hours

2. Course Prerequisites

None.

Corequisite

None.

Recommended Preparation

"C" grade or higher or "Pass" in CSIS 250 or equivalent.

3. Catalog Description

An introductory course in Programmable Logic Controller with an emphasis on industrial automation and related applications. Concepts include automation processing systems, input/output decision support systems; basic electronic circuits, ladder logic, basic analog circuit, Boolean logic, and digital circuits. There will also be an introduction to Raspberry Pi as the automation computer and Arduino as open source Programmable Automation Controller PAC. Typical examples of automation using Python to build Human Machine Interface HMI. The laboratory hands-on component consists of hands-on familiarization, diagnostics and solving automation setup and operational problems.

4. Course Objectives

The student will:

1. Classify the components and functions of PLC systems, including both hardware and software.
2. Compare and contrast various architectures of PLC related to automation management.
3. Explain the PCS evolution and its impact on the way industrial automation is performed.
4. Identify which automation technology tools are used to solve various industrial problems.
5. Examine how cybersecurity will impact industrial automation.
6. Design and code simple but non-trivial automation scenarios using open source hardware and software.

5. Instructional Facilities

Standard computer lab with one internet-connected workstation per student with appropriate software installed.

6. Special Materials Required of Student

Removable storage media compatible with lab computers.

7. Course Content

a. Automation information systems concepts:

1. Components of an automation system used for input, process, output, control.
2. Different sizes/types of PLC, RTU, DCS and how they are used as part of automation systems.
3. Basic Electronic Circuits, Ladder logic and Relays and Coil representation within a PLC.

b. Industrial Automation System:

1. Surveying of available proprietary software/hardware tools for developing automation solutions.
2. Open Source automation using Raspberry PI and Arduino as Programmable Automation Controller or PANDA PAC
3. Functions of Human Machine Interface HMI.
4. Hands-on Input/Output:
   1. Common Sensors
      * + 1. Analog sensors using current and voltage
          2. Digital sensors such shut off valves and low/high limiting switches
          3. Vibration and magnetic sensors
   2. Automation design
5. PLC, DCS design principles.
6. Common design patterns for industrial applications.
   1. Automation design using PANDA PAC
7. Raspberry and Arduino controller with replays and coils
8. Python and GUI toolkit to implement HMI

8. Method of Instruction

a. Lecture and demonstration.

b. Hands-on lab assignments.

9. Methods of Evaluating Student Performance

1. Examinations and quizzes, including a final examination.
2. Skills demonstration**.** An example could be: given a set of industrial automation requirements students will design a minimum PLC, or DCS that can control basic sensors mentioned in 7.a.1)

c. Hands-on lab assignments. An example could be:

Practical exams or labassignments that measure students’ ability to use open source hardware/software to design PLC circuits from a ladder schematic.

1. Outside class assignments. An example could be: In class presentation of the current trends in industrial automation.

10. Outside Class Assignments

a. Reading assignments.

b. Industry case studies and current events.

c. Visiting local manufacturing plants and preparing presentations of observations to class.

11. Texts

Required Text(s):

1. Adrover, Perez, *Introduction to PLCs: A beginner's guide to Programmable Logic Controllers*, Adrover, UK, July 2012.
2. Supplementary materials:
   1. <https://raspberry-pi-industrial.info/>
   2. <https://www.rs-online.com/designspark/raspberry-pi-and-arduino-in-industrial-environments>
   3. <https://nevonprojects.com/iot-industry-automation-using-raspberry-pi/>

Addendum: Student Learning Outcomes

Upon completion of this course, our students will be able to do the following:

* 1. Demonstrate proficiency by selecting and using the appropriate categories of PLC, DCS solutions to solve specific automation problems.
  2. Understand the importance of the automation technology infrastructure in modern day factory.
  3. Design a simple but non-trivial automation solution for common industrial automation scenarios.

Date approved by the Governing Board: May 19, 2020