Virginia Western Community College
IND 250
Introduction to Basic Computer Integrated Manufacturing

Prerequisite
none

Course Description
Presents basic principles used in the design and implementation in a computer integrated manufacturing system. Emphasizes team concept and all aspects of a computer integrated manufacturing system to include the following: Robotics, Conveyor Control, Machining Center Integration Quality Control, Statistical Quality Control, and Computer Integrated Manufacturing (CIM) software.

Semester Credits: 3 **Lecture Hours:** 1 **Lab Hours:** 4

Required Materials

Programmable Logic Controllers, Author: Rabiee, 4th ed., ISBN: 97881631269325
Programmable Logic Controllers Lab Manual, Author: Rabiee, 4th ed., ISBN: 9781631269349

Other Required Materials

Internet access

The following supplementary materials are available

Simulation software for PLC programming

Level 2, Course 2
Introduction to Totally Integrated Automation

Course Description

This course focuses on working with analogue modules in PLC systems. The course begins with connecting different analogue sensors (for example voltage, current, and resistance sensors) to analogue modules. In order to write a PLC program with analogue values, course participants need to know how to use real numbers. In order to work with these and other kinds of numbers, the participants also need to get to know additional STEP 7 functions like comparison, memory, arithmetic, conversion, and jump functions.
Later in the course, participants will learn the basics of MPI-Bus and PROFIBUS systems. PLCs will be connected to each other with a bus cable in order to create an MPI network with the corresponding data configuration in STEP 7. PROFIBUS modules are going to be wired with bus cables to a PLC.
Additionally, maintenance and troubleshooting of these bus systems are essential components of the course.

Course Philosophy

This course is the second in a series of six courses which prepare students for certification as a Siemens Certified Mechatronic Systems Associate. The job profile for which the Level 2 certification prepares students is that of a technician who has a well-rounded understanding of the complex inter-relationships and inter-workings of a mechatronic system.

This course, as all courses within the Certification Program, is based upon a systems-oriented approach. Students learn about individual components and system characteristics within the context of an actual mechatronic system. At

the beginning of this course, students should first be presented with a complex system. Ideally, this system is physically available at the educational institution and within the first class meetings should be visited by the students. By focusing on an actual system, students understand clearly why they are learning the subject material. This increases significantly the learning effect and promotes a fuller understanding of the material being learned. By viewing the system as a whole, learning retention is also increased, as the student experiences the components as part of a whole, rather than in isolation.

Of great importance is that the student is able to transfer the knowledge learned to a new system and is able to quickly familiarize himself with the new system.

This understanding leads to a better informed employee who has sufficient knowledge to make well-informed decisions about the running of the system upon which he or she is working.

For this course in particular, students will build on their previous knowledge of PLCs , either as part of the Level 1 course entitled “Digital Fundamentals and PLCs ”, or through equivalent education or experience. The knowledge of digital basics will be built upon to not only include more functions and advanced topics but to focus on communications between PLCs as well.

Course Goals

At the end of this course, participants should be prepared to:

1. Understand the role of analogue sensors and analogue modules in PLC technology.
2. Understand the components PROFIBUS and MPI Bus.
3. Apply the knowledge to ensure proper performance of networks.
4. Use STEP 7 correctly.
5. Carry out troubleshooting and preventive maintenance of PLC technology

Course Objectives

1. Basics of the handling of analogue values and modules:
   - Connection of different sensor types to different analogue modules of the SIMATIC S7 product family.
   - Handling of different analogue modules in the Step 7 program.
   - Scaling and unscaling analogue values using corresponding programming functions in Step 7.
   - Understanding and be able to work with real numbers in PLC technology

2. Learning of further Step 7 programming function with help of SIMIT:
   - Completion of comparison functions from level 1.
   - Programming functions of a specific PLC memory area.
   - Arithmetic functions which are needed for analogue value or closed loop control with PLC.
   - Conversion functions for specific kind of displays in the industry.
   - Specific jump functions as further PLC programming functions

3. Basics of the 2-wire bus cable which can be used for many kind of PLCs .

4. Basics of MPI-Bus system and the handling of a MPI-network in a Step 7 project.

5. The Basics of PROFIBUS DP:
   - The implementation of a PROFIBUS in a Step 7 project and connect specific PROFIBUS modules to the bus system.
   - Troubleshooting when a PROFIBUS is not working.

Course Prerequisites

Basic knowledge of algebra; previous education or experience with PLCs(installation and/or programming).

Topical Description

Course Content
Level 2, Course 2
Introduction to Totally Integrated Automation

1. Analogue Modules & Values

1.1. Wiring of Analogue Modules
(different types ⇒ Voltage, Current, Resistance)
1.2. Scaling and Unscaling (FC 105 & FC 106)

2. PLC-Programming

2.1. Real Numbers
2.2. Co mparison Functions (REAL)
2.3. Accumulator Functions (PUSH, POP, TAK)
2.4. Arithmetic Functions (+, -, *, / ⇒ INT, DINT, REAL)
2.5. Conversion Functions (ITB, BTI)
2.6. Jump Functions (JU, JC, JCN)

3. MPI-Bus & PROFIBUS

3.1. Bus cable & PROFIBUS plugs (MPI & PROFIBUS)
3.2. MPI-Bus connection in S7 project
(MPI-Network in STEP7 HardwareConfig)
3.3. Define Global Data in STEP 7
3.4. Implementation into the S7 project (Slaves)
3.5. Maintenance & Troubleshooting
3.6. Data traffic
3.7. I mplementation of Non-Siemens-PROFIBUS modules
(GSD, GSE – file)

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Notes to Instructors

1. Use Rockwell Industrial Automation Software suite
2. STEP 7 in W110
3. The final project is worth 15-20% of the final grade.