Virginia Western Community College
MEC 140
Introduction to Mechatronics

Prerequisites
divisional approval

Course Description:
Presents foundational concepts in mechatronics including analog and digital electronics, sensors, actuators, microprocessors, and microprocessor interfacing to electromechanical systems. Surveys components and measurement equipment used in the design, installation, and repair of mechatronic equipment and circuits.

Semester Credits: 3 Lecture Hours: 2 Lab Hours: 2

Required Materials

Textbook:
Tooling University (online subscription)

Other Required Materials:
Internet access

The following supplementary materials are available:
Simulation software for PLC programming.

Level 1, Course 2
Mechanical Components and Electrical Drives

Course Description:
This course covers the basics of mechanical components and electrical drives in a complex mechatronic system. Based upon a physical system, students will learn the basic functions and physical properties of mechanical components as well as electrical drives (AC and DC), and the roles they play within the system. They will also learn

about mechanical components which lead and support the energy through a mechanical system to increase efficiency and to reduce wear and tear. Materials, lubrication requirements and surface properties will be examined. Technical documentation such as data sheets and specifications of mechanical elements and electrical drives will also be covered. By understanding the interworkings of the complete system, students will learn and apply troubleshooting strategies to identify, localize and (where possible) to correct malfunctions. Preventive maintenance of mechanical elements and electrical drives as well as safety issues within the system will be discussed.

Course Philosophy:

This course is the second in a series of four courses which prepare students for certification as a Siemens Certified Mechatronic Systems Assistant. The job profile for which the Level 1 certification prepares students is that of a machine operator, 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 in a new context.

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.

Course Goals:

Upon completion of the course, students should:

1. Understand the role of mechanical components and electrical drives in complex mechatronic systems, modules and subsystems.
2. Understand the flow of energy in the system.
3. Understand troubleshooting, preventive maintenance and safety issues revolving around mechanical components and electrical drives within a mechatronic system.

Course Objectives:

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

1. Explain the role of various mechanical components within a given system or module.
2. Trace and describe the flow of energy in a given mechatronic system or subsystem.

3. Describe the basic physical properties of mechanical components including materials, lubrication requirements and surface properties.
4. Carry out adjustments on mechanical components in a mechatronic system.
5. Read, analyze and utilize the technical data sheets for the mechanical components and electrical drives within a mechatronic system.
6. Correctly localize, identify and document causes of malfunctions in mechanical components or electrical drives, based upon the technical documentation.
7. Correct malfunctions where possible, or correctly identify the expertise required to correct a malfunction.
8. Apply safety rules while working on the system.
9. Transfer the knowledge learned from one system to another system.

Topical Description

Mechanical Components and Electrical Drives

1. Electrical Concepts
   - 1.1. Wires and Cables
   - 1.2. Basic Electrical Quantities
   - 1.3. Basic Electrical Components
   - 1.4. Electrical Safety
2. Electric Motors
   - 2.1. DC Motors
     - 2.1.1. Basics
     - 2.1.2. Characteristics
   - 2.2. AC Motors (Three Phase)
     - 2.2.1. Basics
     - 2.2.2. Motor Types and Characteristics
   - 2.3. AC Motors (Single Phase)
3. Mechanical Components
   - 3.1. Pins and Keys
     - 3.1.1. Fundamentals
   - 3.2. Chain Drives
     - 3.2.1. Fundamentals
     - 3.2.2. Types and Applications
     - 3.2.3. Using and Maintaining
   - 3.3. Gears
     - 3.3.1. Fundamentals
     - 3.3.2. Gear Types
     - 3.3.3. Using and Maintaining
   - 3.4. Rolling Contact Bearing
     - 3.4.1. Fundamentals

- 3.4.2. Bearing Types
- 3.4.3. Using and Maintaining

3.5. Power Transmission Shafts
- 3.5.1. Fundamentals
- 3.5.2. Radial Locating Devices
- 3.5.3. Axial Locating Devices
- 3.5.4. Flywheels
- 3.5.5. Using and Maintaining

3.6. Shaft Couplings
- 3.6.1. Fundamentals
- 3.6.2. Shaft Coupling Types
- 3.6.3. Using and Maintaining

3.7. Clutches
- 3.7.1. Fundamentals
- 3.7.2. Clutch Types
- 3.7.3. Using and Maintaining

3.8. Belt Drives
- 3.8.1. Fundamentals
- 3.8.2. Belt Drive Types
- 3.8.3. Using and Maintaining

3.9. Journal Bearings
- 3.9.1. Fundamentals
- 3.9.2. Types and Lubrication

3.10. Mechanical Springs
- 3.10.1. Types
- 3.10.2. Compression Springs

3.11. Threads and Screws
- 3.11.1. Fundamentals
- 3.11.2. Types

NOTE: The order in which the content will be discussed is dependent upon the mechatronic system which is being used. In each case, the component and/or class of components will be discussed within the context of the system and the module in which the component is located. This means that the exact order of presentation will vary according to the system available for instruction. It is also important that all classes of electrical components be discussed, whether available in the training system or not. Focus in all cases is on the role of the components within a module and system, identification of problems, routine maintenance, troubleshooting, and safety issues with the goal of preventing system downtime or reducing them to a minimum.

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 SIMIT, Diagnostic Kit software, etc. If desired, a supporting textbook on basic PLC topics 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 1 instruction.

Notes to Instructors

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