

Virginia Western Community College

MEC 162

Applied Hydraulics and Pneumatics

Prerequisites

none

Course Description

Introduces hydraulic and pneumatic systems found in construction equipment, road vehicles, and farm equipment. Includes the basic theory, construction, maintenance, and repair of hydraulic and pneumatic power systems.

This course covers the basics of pneumatic, electropneumatic and hydraulic control circuits in a complex mechatronic system. Students will learn the functions and properties of control elements based upon physical principles, and the roles they play within the system. Technical documentation such as data sheets, circuit diagrams, displacement step diagrams and function charts will also be covered. By understanding and performing measurements on the pneumatic and hydraulic control circuits, students will learn and apply troubleshooting strategies to identify, localize and (where possible) correct malfunctions. Preventive maintenance of (electro) pneumatic and hydraulic components as well as safety issues within the system will be discussed.

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

Required Materials

Textbook:

Tooling University, online subscription, purchased through Tooling U bookstore(online) to receive student discount.

Other Required Materials:

none



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 be 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.

The following supplementary materials are available: [Simulation software for PLC programming.](#)

Level 1, Course 3 (Electro) Pneumatic and Hydraulic Control Circuits

Course Description:

This course covers the basics of pneumatic, electro pneumatic and hydraulic control circuits in a complex mechatronic system. Students will learn the functions and properties of control elements based upon physical principles, and the roles they play within the system. Technical documentation such as data sheets, circuit diagrams, displacement step diagrams and function charts will also be covered. By understanding and performing measurements on the pneumatic and hydraulic control circuits, students will learn and apply troubleshooting strategies to identify, localize and (where possible) to correct malfunctions. Preventive maintenance of (electro) pneumatic and hydraulic components as well as safety issues within the system will be discussed.

Course Philosophy:

This course is the third 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 what a mechatronic system is, and the inter-relationships of components and modules within a complex mechatronic system with a focus on (electro) pneumatic and hydraulic control systems.
2. Understand the role of (electro) pneumatic and hydraulic control systems in complex mechatronic system and subsystems.
3. Understand troubleshooting, maintenance and safety issues revolving around (electro) pneumatic and hydraulic circuits within a mechatronic system.

Course Objectives:

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

1. Explain the role of various (electro) pneumatic and hydraulic 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 pneumatic and hydraulic components.
4. Carry out measurements and adjustments on pneumatic and hydraulic components in a mechatronic system.
5. Read, analyze and utilize the technical documents such as data sheets, circuit diagrams, displacement step diagrams, timing diagrams and function charts for the pneumatic and hydraulic components within a mechatronic system.
6. Correctly localize, identify and document causes of malfunctions in pneumatic and hydraulic circuits, based upon the technical documentation.
7. Correct malfunctions in pneumatic and hydraulic circuits, 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

Content to be covered within this course includes the following topics:

1. Pneumatics and Electropneumatics
 - 1.1. Introduction
 - 1.2. Electropneumatic Control System
 - 1.3. Signal Processing Structure
 - 1.4. Function Diagram and Pneumatic Circuit Diagram
 - 1.5. Actuation of Pneumatic Cylinders
 - 1.6. Sequence Control Systems
 - 1.7. Electrically Actuated Directional Control Valves (DCVs)
 - 1.8. Displacement-Step Diagram
 - 1.9. Pneumatic Actuators
 - 1.10. Stroke Speed Regulation of Pneumatic Actuators
 - 1.11. Basic Electropneumatic Control Circuits
 - 1.12. Air Generation and Distribution
 - 1.13. Terminal Connections
 - 1.14. Electrical Control Devices
 - 1.15. Safety Regulations
2. Hydraulics
 - 2.1. Overview
 - 2.2. Circuit Symbols
 - 2.3. Design of Circuit Symbols
 - 2.4. Physical Principle
 - 2.5. Transmissions
 - 2.6. Pressure Transfer and Flow Rate
 - 2.7. Solenoid Activated Directional Control Valves

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.

Notes to Instructors

1. Fluid CIM, a software package for simulation, is required
2. The final exam is worth 15-20% of the final grade.

