Virginia Western Community College
ETR 238
Industrial Electronics II

Prerequisites
ETR 237

Course Description
Studies linear integrated circuits for industrial applications, motors, industrial control devices, power control circuits, transducers, industrial process control, and sequential process control. Teaches techniques for conducting site surveys, installing system components, installing inverters and performing system sizing and system maintenance. Introduces different battery configurations, and charge controllers. Introduces safety, system design and layout, National Electric Code, Component Selection, wiring and installation techniques. Lecture 3 hours. Laboratory 3 hours. Total 6 hours per week.

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

Required Materials

Textbook:

Motors

- 2nd Edition
- © 2010
- **ISBN:** 978-0-8269-1982-3
- Author(s): In Partnership with the electrical training ALLIANCE

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School of Science, Technology, Engineering and Mathematics
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Roanoke, VA 24015

Other Required Materials:

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

Course Description

This course covers principles of motor control in part as a continuation of the SMSCP Level 1 course on Mechanical Components and Electric Drives. Even though this course builds on the concepts of the related Level 1 course, the Level 1 course is not a prerequisite; equivalent knowledge gained elsewhere will also suffice.

In the first part of the course, General Machine Operation, different types of braking and loads on a motor are addressed, as well as questions of improving motor efficiency and power. Different control techniques are then discussed, including different methods of starting a motor, controlling voltage and frequency, and the role of different sensors in relation to motor operation.

Troubleshooting techniques and an examination of the various causes of motor failure are discussed; preventive measures that can be taken in order to protect motors are also taught.

Course Philosophy

This course is the fourth 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 be challenged to build on previous knowledge of electric drives (either acquired from the SMSCP Level 1 Course 2: Mechanical Components and Electric Drives or from equivalent electric drives course(s)) by not only looking at details of the various control and protection methods used in motors but also to see motors as parts of systems and as systems themselves.

Course Goals

Upon completion of the course, students should:

1. Understand the general principles of motors and machine operation.
2. Understand the importance of motor efficiency as well as various techniques to improve efficiency.
3. Understand motor notation symbology and control strategies, including voltage and frequency control.
4. Understand the role of motor control circuits in power electronics.
5. Understand how to protect motors and prevent motor failure.

Course Objectives

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

1. Start a motor in the correct way, using the correct method.
2. Set up a motor control circuit
3. Use control logic programs in motor control contexts.
4. Set up sensors in order to give feedback to a control circuit.
5. Choose and install the correct safety devices for specific control circuits.
6. Detect and prevent possible malfunctions.

Course Prerequisites

Education and/or experience equivalent to SMSCP Level 1 Course 2: Mechanical Components and Electric Drives and SMSCP Level 1 Course 1: Electrical Components.

Topical Description

Course Content

Motor Control

General Machine Operation

- Motor
- Generator
  - Electrical Braking
  - Regenerative Braking
- Motor Loads
  - Constant Torque
  - Constant Power
  - Constant Speed
- Efficieny
  - High Efficieny Motors
  - Power Electronics Effects (Harmonics)
  - Power Factor (incl. how to improve)

Motor Control Techniques

- Symbology (Motors. Power Circuit, Control Circuits)
- Starting Methods
  - Full Voltage
  - Reduced Voltage
  - Soft Starting
- Control Strategies
  - Voltage
  - Frequency
- Sensors / Encoders

Motor Failures and Protection

- Fuse / Circuit Breaker
- Thermal Protection
- Insulation
- Mechanical Failures
  - Bearings
  - Brushes, Armature
  - Belt and Shaft Allignment
- Overload - Application Abuse
- Stopping Methods - Mechanical Brakes

Learning Methodologies

Notes to Instructors

1. The final exam is worth 20% of the final grade.