

**7700012**

## **VARIABLE FREQUENCY DRIVES**

### **COURSE INFORMATION**

Credits: 2

### **PREREQUISITES AND/OR COREQUISITES**

A minimum grade of C in ADVANCED ELECTRICAL SYSTEMS

### **COURSE DESCRIPTION**

This class emphasizes the many facets of installation and troubleshooting of Variable Frequency Drives (VFD's) seen in today's manufacturing and processing facilities. Specific topics will include electrical safety, electric motor load and power requirements, electronic drive components, operational fundamentals, installation procedures, drive programming and configurations, startup procedures, troubleshooting, VFD selection and retrofitting considerations. Laboratory exercises using industrial components will enhance classroom studies.

### **COURSE GOALS**

This course will:

1. Identify safety and electrical safety considerations
2. Develop an understanding of the different motor loads and power requirements
3. Explain the VFD applications and advantages
4. Develop an understanding of electronic components found in many drives
5. Strengthen your understanding in VFD operation fundamentals
6. Develop installation considerations for both the VFD and the motor
7. Offer hands on programming and configurations
8. Sharpen your VFD troubleshooting skills
9. Provide greater understanding of VFD selection guidelines
10. Explain retrofitting considerations and procedures

### **STUDENT LEARNING OUTCOMES**

1. Overview of electric motor energies and motor control history
  - a. Electrical energy
  - b. Motor control methods
  - c. Why electric motor drives
  - d. Drive features
2. Electric motor drive safety points
  - a. PPE

- b. Grounding and why
  - c. Lockout/Tag-out
  - d. Machine safety
3. Electric motor loads and power requirements
  - a. Define work, power, hp, torque,
  - b. Understand relationships between speed, torque, and horsepower
  - c. Identify constant torque loads
  - d. Identify constant horsepower loads
4. Motor installation essentials
  - a. Nameplate data
  - b. Insulation class
  - c. Motor enclosure ratings
  - d. Environmental Conditions
5. Motor Drive components
  - a. Rectifiers
  - b. Capacitors
  - c. Transistors
6. Drive operation Fundamentals
  - a. Converter section
  - b. DC Buss
  - c. Inverter section
  - d. Pulse Width Modulation
7. Drive installation Procedures
  - a. Installation Considerations
  - b. Motor wiring Considerations
  - c. NEC rules and restrictions
  - d. Startup procedures
8. Drive Programming variables
  - a. Start modes
  - b. Stop modes
  - c. Ramp times
  - d. Brake or not to brake
  - e. Current limit vs Overload
9. Drive Selection
  - a. List drive benefits for application
  - b. Energy savings and ROI
  - c. Load considerations and Drive sizing
10. Retrofit procedures
  - a. Replacing a starter with a drive
  - b. Replacing a dc motor with a VFD and motor

## **COURSE MATERIALS**

Electric Motor Drive Installation and Troubleshooting 3<sup>rd</sup> edition, Glen A. Mazur, American Technical Publishers, ISBN#978-0-8269-1254-1

## **GRADING CRITERIA**

Students can expect to be graded on Written Assignments, Quizzes, Tests, Lab Activities, and Attendance. There is currently no scheduled time available to makeup classes or labs that are missed.

## **PARTICIPATION/ATTENDANCE POLICY**

Students can expect that attendance/participation will be a part of their final grade, and determined by the instructor at his/her discretion. Students are encouraged to attend every class as regular attendance as it contributes to successful course completion and will impact the final grade.

## **COURSE EXPECTATIONS**

For successful completion of this course, students are expected to Read Course Material, Complete all Assignments, Take Notes, Study and Participate in classroom discussions.

## **ACADEMIC INTEGRITY AND CONDUCT POLICY**

The integrity of a class and program rests on the principle that the grades awarded to students must reflect only their own individual efforts and achievement. Students are required to perform the work specified by the instructor and are responsible for the content of work submitted, such as papers, reports, examinations, and other work. Violations of academic integrity include various types of plagiarism and cheating.

### **Plagiarism**

Plagiarism includes, but is not limited to:

- Using exact words from a source without appropriate crediting
- Cutting and pasting electronically from any source without appropriate crediting
- Using wording and/or sentence structure too close to the original in paraphrasing
- Using visual images in whole or in part created by someone else without appropriate crediting
- Buying a paper and presenting any part of it as your own
- Borrowing any part of a paper and presenting it as your own without appropriate crediting
- Falsifying or inventing any information or citation in an academic exercise

### **Cheating**

Cheating includes, but is not limited to:

- Obtaining or giving assistance in any academic work such as on quizzes, tests, homework, etc., without instructor's consent
- Taking a test or course or turning in work for someone else
- Allowing someone to take a test or course or turn in work in your name
- Using crib notes or electronic devices to get unauthorized assistance on tests or other in-class work
- Using work from another class or previous semester without instructor consent

## **CLASS CANCELLATION POLICY**

Class meetings can occasionally be called off due to bad weather, check the local news and radio for information or call 319-296-4444 for the current status of college closings, class cancelations, delay start, or early dismissal information.

## **STUDENTS' SPECIAL NEEDS STATEMENT**

Hawkeye Community College (HCC) strives for student-centered, quality education with flexibility to allow for students' special needs. Students with physical, mental, or learning disabilities should contact the Special Needs Coordinator in Student Services at 319-296-4014 or [specialneeds@hawkeyecollege.edu](mailto:specialneeds@hawkeyecollege.edu) to learn how to apply for accommodations at HCC. Or, visit our website for more information and forms: <http://www.hawkeyecollege.edu/students/services/student-disability-services/default.aspx>

## **NONDISCRIMINATION STATEMENT**

Hawkeye Community College does not discriminate on the basis of sex; race; age; color; creed; national origin; religion; disability; sexual orientation; gender identity; genetic information; political affiliation; or actual or potential parental, family, or marital status in its programs, activities, or employment practices as required by Iowa Code §§ 216.6 and 216.9, Titles VI and VII of the Civil Rights Act of 1964 (42 U.S.C. §§ 2000d and 2000e), the Equal Pay Act of 1973 (29 U.S.C. § 206, et seq.), Title IX (Educational Amendments, 20 U.S.C. §§ 1681-1688), Section 504 (Rehabilitation Act of 1973, 29 U.S.C. § 794), and Title II of the Americans with Disabilities Act (42 U.S.C. § 12101, et seq.). Veteran status is also included to the extent covered by law. Any person alleging a violation of equity regulations shall have the right to file a formal complaint. Inquiries concerning application of this statement should be addressed to: John Clopton (Equity Coordinator and Title IX Coordinator for Employees) or Nancy Henderson (Title IX Coordinator for Students), Hawkeye Community College, 1501 East Orange Road, P.O. Box 8015, Waterloo, Iowa 50704-8015, telephone 319-296-4405, email: [equity-titleIX@hawkeyecollege.edu](mailto:equity-titleIX@hawkeyecollege.edu), or the Director of the Office for Civil Rights, U.S. Department of Education, Citigroup Center, 500 W. Madison, Suite 1475, Chicago, IL 60661, phone number 312/730-1560, fax 312/730-1576.

## **DISCLAIMER**

This syllabus is believed to be accurate at the time it was written. However, the instructor reserves the right to make changes as deemed necessary, provided notification is given to the students.

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