AC/DC Motors
Outlines of Instruction

Course Information

Organization	Monroe County Community College, Applied Science and Engineering Technology
Development Date	10/24/2007
Course Number	ELEC 127
Potential Hours of Instruction	60
Total Credits	3

Description
Course Description/Purpose

This course is designed to provide students with a knowledge of AC/DC motor operating characteristics and control circuits. It will provide hands-on experience with wiring control circuits, checking the operational characteristics of motors and the use/installation of circuit protection devices. Development and application of ladder logic theory, diagrams and circuits will be covered. This course acquaints the student with concepts and applications of three-phase power, including wye and delta configurations. Basic operation and circuit characteristics of three-phase alternators and transformers will be covered. The construction and operation of three-phase induction motors and their related starting, control and protection circuits along with variable-frequency drives will also be addressed.

Major Units:

1. Dc motor structure and winding identification
2. Dc motor starting considerations
3. Reversing motor-starters - wiring, interconnections, interlocks, overload protection
4. Motor-control circuits - ladder-logic format, wiring, testing
5. Three-phase ac
6. Three-phase induction motor starting and directional control
7. Three-phase induction motor torque characteristics
8. Three-phase reversing motor-starters - wiring, interconnections, interlocks, overload protection

Types of Instruction

Instruction Type	Contact Hours	Credits
Leacture/Lab	60	3

Textbooks

Rockis and Mazur. *Electrical Motor Controls for Integrated Systems*.

Learner Supplies

Safety Glasses.

Scientific Calculator.

Tools (Not Required).

Prerequisites

ELEC 125 (Fundamentals of Electricity)

Exit Learning Outcomes

Program Outcomes

A. Design, Construct, and Troubleshoot AC and DC Motor Control Circuits and an demonstrate an understanding of process control.

B. Develop and Demonstrate Problem Solving Skills.

C. Develop a willingness to learn independently.

D. Develop and demonstrate effective wiring and laboratory skills.

E. Demonstrate Equipment/Instrumentation Competence

F. Develop and demonstrate Technical Documentation/Lab Report writing skills and the ability to comprehend Technical Documentation including Schematic Diagrams

G. Value Safety Training, Safe Work Practices and acknowledge Safety Standards

H. Demonstrate a thorough understanding of DC and AC theory and operating concepts.

General Education Outcomes

A. Apply mathematical approaches to the interpretation of numerical information

B. Apply mathematical approaches to the analysis of numerical information

C. Demonstrate an understanding of the process of scientific inquiry

D. Use computer technology to retrieve information

Outcomes

1. **Identify/Recognize the advantages of 3-phase ac versus single-phase ac, versus dc and the significance of motor efficiency and motor power factor**
2. **Identify/Recognize a standard reversing 3-phase motor-starter, 3-phase induction motor-control circuits presented in ladder-logic format**
3. **Identify/Recognize the necessity for multi-station control of an induction motor, and the jog versus run distinction**
4. **Identify/Recognize the need for time delay to prevent simultaneous starting of two or more induction motors from the same 3-phase power feeder, and the essential difference between the synchronous motor's I/V phase relation and that of all other ac motors**
5. **Identify/Recognize the essential disadvantage of ac induction motor speed control by voltage variation and the essential advantage of ac induction motor speed control by electronic (SCR) frequency variation**
6. **Demonstrate wiring a 3-phase alternator and display its 3-phase ac output on an oscilloscope, wire a 3-phase transformer driving a 3-phase resistive load, and measure the line voltage and current, and the total system power using electronic wattmeters, Electronic/Rotary Phase Conversion**
7. **Demonstrate/Practice start a 3-phase induction motor with a manual disconnect switch, and show the relation between shaft rotational direction and phase winding connections to the 3-phase supply and attach a dynamometer to the shaft of an ac induction motor and take data to show the motor's torque relationships to current, speed, efficiency, and power factor**
8. **Demonstrate/Practice correct wiring access to the following standard-labeled terminals**

of a 3-pole reversing motor starter: L1, L2, L3, T1, T2, T3, 2, 3, 4, 5, OL, X1, X2, Design and draw, in ladder-logic format, wire and test a single-station reversing 3-phase motor control circuit with and without manual switch interlocks

9. **Demonstrate/Practice design, draw in ladder-logic format, wire and test a two-station, reversing 3-phase motor control circuit with directional indicator lights and with Jog/Run capabilities and design, draw in ladder-logic format, wire and test a two-motor, single-station time-delay induction motor control circuit**
10. **Demonstrate/Practice wire and run a synchronous motor with a dynamometer load to demonstrate the motor's leading current/voltage relationship, which makes the motor unique, and wire and test a 3-phase feeder driving both an induction motor and a synchronous motor to demonstrate power factor correction**
11. **Demonstrate/Practice demonstrate the possibility of ac induction motor speed control by a) voltage variation b) frequency variation**
12. **Identify/Recognize a standard reversing motor-starter and the natural difficulties accompanying the starting process for a dc motors**
13. **Identify/Recognize motor-control circuits presented in ladder-logic format and the necessity for multi-station control of a motor**
14. **Identify/Recognize the jog versus run distinction and the need for time delay to prevent simultaneous starting of two or more motors form the same power supply feeder**
15. **Identify/Recognize the need to temporarily insert current-limiting resistor(s) in the armature path during motor acceleration and the elegant electric/magnetic braking schemes for a dc motor, contrasted with the crude mechanical braking idea**
16. **Identify/Recognize the efficiency advantage of an SCR-based motor-drive circuit versus a variable-resistance armature control circuit and measure the winding resistances of a dc motor (armature, shunt field winding, and a series field winding)**
17. **Demonstrate/Practice verbally justify these relative values and properly start and stop a dc motor using manually operated disconnect switches (proper starting and stopping must heed the adage of the field winding being "first On, last Off"**
18. **Demonstrate/Practice use an analog ammeter to demonstrate the inrush starting current problem of a dc motor that is started by the across- the-line method; and demonstrate the elimination of the inrush problem when a dc motor is started under reduced- voltage "soft-start" conditions and demonstrate the relationship between direction of shaft rotation and polarization of armature voltage for a dc motor**
19. **Demonstrate/Practice design, draw in ladder-logic format, wire and test a single-station, reversing motor control circuit, with directional indicator lights and design, draw in ladder-logic format, wire and test a two-station, nonreversing motor control circuit with indicator lights**
20. **Demonstrate/Practice design, draw in ladder-logic format, wire and test a two-station, reversing, Jog/Run motor control circuit, with directional indicator lights and design, draw in ladder-logic format, wire and test a two-motor, single-station time-delay motor control circuit**
21. **Demonstrate/Practice design, draw in ladder-logic format, wire and test a two-motor, two-station time-delay motor control circuit and wire and test a current-limiting starting circuit, with field-failure protection and overload protection and wire the circuit and display and explain the waveforms of an SCR power-control circuit for an incandescent lamp**
22. **Demonstrate/Practice wire the circuit and display and explain the waveforms of an SCR dc motor-drive**