



COURSE SYBALLUS

ELPT1341 - Motor Control

Catalog Description: The course covers the fundamental concepts of basic electric motor control. These concepts include how to interpret the logic of a schematic diagram, how to properly connect a circuit using a schematic diagram, and how to troubleshoot a control circuit. Lecture Hrs = 2, Lab Hrs = 2

Prerequisite(s): ELPT 1311

Semester Credit Hours: 3

Lecture Hours per Week: 2

Lab Hours per Week: 2

Contact Hours per Semester: 48

State Approval Code: 4603010000

Course Subject/Catalog Number: ELPT 1341

Course Title: Motor Control

Course Rationale:

This course provides the student training to understand the operational theory of AC and DC motor control systems utilized in industry.

Instructional Goals and Purposes:

The purpose of this course is to provide students with basic skills useful in installing, maintaining, and troubleshooting real-life motor control systems.

Learning Objectives:

1. Be able to demonstrate proper safety techniques in the use of electricity and chemicals
2. Be able to identify electrical symbols and create schematic diagrams
3. Describe how motors are protected from overloads
4. Describe and demonstrate how relay, contactors and motor starters control motors
5. Describe and demonstrate how transformers are used in motor control circuits
6. Describe and demonstrate how to forward/reverse electric motors
7. Describe and demonstrate how to jog/inch motors
8. Describe and demonstrate how to use timing relays for controlling complex motor control applications
9. Describe and demonstrate how to implement a sequence control operation
10. Describe what sensing devices are and how they are used in conjunction to motor control, including pressure, float, flow, limit, and temperature types.

11. Describe what proximity detector are
12. Describe how to install motor control systems
13. Describe the operation of Direct Current motors
14. Describe the operation of Alternating Current motors
15. Describe how to install motors
16. Describe the basics of Programmable Logic Controller as a means of motor control

Specific Course Objectives (includes SCANS):

1. Be able to demonstrate proper safety techniques in the use of electricity and chemicals
 - a. Identify basic safety rules. (1A-i, 1A-ii, 1A-iv, 1B-iii, 1B-iv, 1C-i, 1C-iv, 2A-I, 2A-iii, 2B-I, 2C-i, 2C-ii, 2C-iii, 2D-ii, 2D-iii, 2E-ii)
 - b. Describe the effects of electric current on the body
 - c. Discuss the origin and responsibilities of OSHA
 - d. Discuss material safety data sheets
 - e. Discuss lockout and tagout procedures
2. Be able to identify electrical symbols and create schematic diagrams. (1A-i, 1A-ii, 1A-iv, 1B-iii, 1B-iv, 1C-i, 1C-iv, 2A-I, 2A-iii, 2B-I, 2C-i, 2C-ii, 2C-iii, 2D-ii, 2D-iii, 2E-ii)
 - a. Discuss symbols used in the drawing of schematic diagrams
 - b. Draw standard NEMA control symbols
 - c. Interpret the logic of simple ladder diagrams
 - d. Discuss the reading of large schematic diagrams
3. Describe how motors are protected from overloads. (1A-i, 1A-ii, 1A-iv, 1B-iii, 1B-iv, 1C-i, 1C-iv, 2A-I, 2A-iii, 2B-I, 2C-i, 2C-ii, 2C-iii, 2D-ii, 2D-iii, 2E-ii)
 - a. Discuss differences between fuses and overloads
 - b. List different types of overload relays
 - c. Describe how thermal overload relay operate
 - d. Describe how magnetic overload relay operate
 - e. Describe how dashpot overload relays operate
4. Describe and demonstrate how relay, contactors and motor starters control motors. (1A-i, 1A-ii, 1A-iv, 1B-iii, 1B-iv, 1C-i, 1C-iv, 2A-I, 2A-iii, 2B-I, 2C-i, 2C-ii, 2C-iii, 2D-ii, 2D-iii, 2E-ii)
 - a. Discuss the operation of magnetic type relay
 - b. Explain the difference between relays, contactors, and motor starters
 - c. Connect a relay to a circuit
 - d. Discuss the differences between DC and AC type relay and contactors
5. Describe and demonstrate how transformers are used in motor control circuits. (1A-i, 1A-ii, 1A-iv, 1B-iii, 1B-iv, 1C-i, 1C-iv, 2A-I, 2A-iii, 2B-I, 2C-i, 2C-ii, 2C-iii, 2D-ii, 2D-iii, 2E-ii)
 - a. Discuss the use of control transformers in a control circuit
 - b. Connect a control transformer for operation on a 120V system

6. Describe and demonstrate how to forward/reverse electric motors. (1A-i, 1A-ii, 1A-iv, 1B-iii, 1B-iv, 1C-i, 1C-iv, 2A-I, 2A-iii, 2B-I, 2C-i, 2C-ii, 2C-iii, 2D-ii, 2D-iii, 2E-ii)
 - a. Discuss cautions that must be observed in reversing circuits
 - b. Explain how to reverse a three phase motor
 - c. Discuss interlocking methods
 - d. Connect a forward-reverse motor control circuit
7. Describe and demonstrate how to jog/inch motors. (1A-i, 1A-ii, 1A-iv, 1B-iii, 1B-iv, 1C-i, 1C-iv, 2A-I, 2A-iii, 2B-I, 2C-i, 2C-ii, 2C-iii, 2D-ii, 2D-iii, 2E-ii)
 - a. Define the term jogging
 - b. State the purpose of jogging
 - c. State difference between jogging and inching
 - d. Connect a jogging circuit
8. Describe and demonstrate how to use timing relays for controlling complex motor control applications. (1A-i, 1A-ii, 1A-iv, 1B-iii, 1B-iv, 1C-i, 1C-iv, 2A-I, 2A-iii, 2B-I, 2C-i, 2C-ii, 2C-iii, 2D-ii, 2D-iii, 2E-ii)
 - a. Identify the primary types of timing relays
 - b. Explain the basic steps in the operation of the common timing relays
 - c. List the factors that affect the selection of a timing relay for a particular use
 - d. Draw simple circuit diagrams using timing relays
 - e. Identify on- and off-delay timing wiring symbols
9. Describe and demonstrate how to implement a sequence control operation. (1A-i, 1A-ii, 1A-iv, 1B-iii, 1B-iv, 1C-i, 1C-iv, 2A-I, 2A-iii, 2B-I, 2C-i, 2C-ii, 2C-iii, 2D-ii, 2D-iii, 2E-ii)
 - a. State the purpose for starting motors in a predetermined sequence
 - b. Read and interpret sequence control schematics
 - c. Convert a sequence control schematic into a wiring diagram
 - d. Connect a sequence control circuit
10. Describe what sensing devices are and how they are used in conjunction to motor control, including pressure, float, flow, limit, and temperature types. (1A-i, 1A-ii, 1A-iv, 1B-iii, 1B-iv, 1C-i, 1C-iv, 2A-I, 2A-iii, 2B-I, 2C-i, 2C-ii, 2C-iii, 2D-ii, 2D-iii, 2E-ii)
 - a. Explain the operation and connection of sensing switches
 - b. Explain how to make connection of various sensing switches for instrumentation purposes
11. Describe what proximity detector are. (1A-i, 1A-ii, 1A-iv, 1B-iii, 1B-iv, 1C-i, 1C-iv, 2A-I, 2A-iii, 2B-I, 2C-i, 2C-ii, 2C-iii, 2D-ii, 2D-iii, 2E-ii)
 - a. Describe the Hall effect and discuss how Hall effect devices are used.
 - b. Describe the operation of proximity detectors
 - c. Discuss the different types of proximity detectors
 - d. Describe the operation of photodetector and their use
12. Describe how to install motor control systems. (1A-i, 1A-ii, 1A-iv, 1B-iii, 1B-iv, 1C-i, 1C-iv, 2A-I, 2A-iii, 2B-I, 2C-i, 2C-ii, 2C-iii, 2D-ii, 2D-iii, 2E-ii)
 - a. Discuss methods of installing a control system
 - b. Discuss how to use wire numbers to troubleshoot a control circuit
 - c. Describe advantages of using terminal strips for connecting a circuit

13. Describe the operation of Direct Current motors. (1A-i, 1A-ii, 1A-iv, 1B-iii, 1B-iv, 1C-i, 1C-iv, 2A-I, 2A-iii, 2B-I, 2C-i, 2C-ii, 2C-iii, 2D-ii, 2D-iii, 2E-ii)
 - a. Discuss the types of DC motors
 - b. Discuss methods of limiting in-rush current
 - c. Discuss methods of manual speed control for DC motors
 - d. Determine the direction of rotation of a DC motor
 - e. Discuss solid-state DC motor controls
14. Describe the operation of Alternating Current motors. (1A-i, 1A-ii, 1A-iv, 1B-iii, 1B-iv, 1C-i, 1C-iv, 2A-I, 2A-iii, 2B-I, 2C-i, 2C-ii, 2C-iii, 2D-ii, 2D-iii, 2E-ii)
 - a. Discuss the types of AC motors
 - b. Discuss how to control AC motors with variable frequency techniques
 - c. Discuss different methods of controlling frequency
 - d. Define the terms of ramping and volts per Hz
15. Describe how to install motors. (1A-i, 1A-ii, 1A-iv, 1B-iii, 1B-iv, 1C-i, 1C-iv, 2A-I, 2A-iii, 2B-I, 2C-i, 2C-ii, 2C-iii, 2D-ii, 2D-iii, 2E-ii)
 - a. Discuss how to determine full load current rating of different types of motors
 - b. Discuss how to size wiring for connecting motors
 - c. Discuss how to select the proper size of starter for a particular motor
16. Describe the basics of Programmable Logic Controller as a means of motor control. (1A-i, 1A-ii, 1A-iv, 1B-iii, 1B-iv, 1C-i, 1C-iv, 2A-I, 2A-iii, 2B-I, 2C-i, 2C-ii, 2C-iii, 2D-ii, 2D-iii, 2E-ii)
 - a. Discuss the principle parts of a PLC
 - b. Discuss differences between the I/O rack, CPU, and program loader
 - c. Discuss how the input and output modules work

Methods of Instruction/Course Format/Delivery:

Students will meet regularly for lecture over the material. Students will access this course via WebCT.

Students will be assigned a quiz each week to assess their understanding of each chapter. After the quizzes have been graded, the student will be able to review his or her quiz and will see a grade in My Grades link in the left banner. The student generally will have their work graded and posted within two days following the deadline. In addition, the student will be assigned certain problems from the end of each chapter to work manually. All lab assignments will be completed and turned in at the end of the semester in a lab notebook.

Students should use the Email within WebCT to communicate with the instructor. Using WebCT email gives the student access to the instructor and other classmates without having to remember or type email addresses – the student just selects a name from the list. If the student is not able to contact the instructor using email in WebCT, he or she may use the instructor's Panola College email address. The instructor will attempt to respond to all email within 24 hours. If the student makes an appointment with the instructor through email to take an exam, for example, the instructor will reply to the student's email – if the instructor does not reply, the student should send his or her email to the instructor again or attempt to call the instructor. Please, always include a subject line and the student's name and email.

Assessment:

The following items will be assigned during the semester and used to calculate the student's final grade:

- **QUIZZES**

After working through the chapter and completing the assigned problems, the student will take an online quiz over the chapter. The Quizzes generally contain 10-20 True/False, Multiple Choice questions. The student should save each answer as he or she proceed and then click Finish only when the student has completed the entire quiz. There will be approximately 14 quizzes and the instructor will drop the student's two lowest quizzes at the end of the semester.

- **LAB NOTEBOOK**

At the end of each chapter, there are step-by-step instructions for completing each experiment. During each experiment, the student is expected to wire circuits, make electrical measurements and complete performance sheets related to the experiments. On these sheets, the student will report on the theoretical and practical aspects underlying the experiment in addition to the student's tabulated results.

The student will compile a notebook containing the completed performance sheets along with the student's tabulated data. The notebook will be turned in at the end of the semester.

- **EXAM**

Three exams will be given during the semester and they will count 60 percent of the student's final grade. Any test that is missed by the student will be counted as a 0 unless prior arrangements have been made with the instructor. Each exam will cover approximately 5 chapters and will be administered online.

The student's grade will be determined by:

- Quizzes – 25%
- Lab Notebook – 15%
- Exams – 60%

Assignments are due as assigned and 10 points will be deducted for each day work is late. All of the student's grades including a mid-semester and final grade will be posted to My Grades in WebCT.

Textbook, Materials and Supplies:

- Text: *Understanding Motor Controls*, by Stephen L. Herman, ISBN 1-4018-9016-4
- Access to a computer and the Internet

Other:

- For testing services, use the following link:
<http://www.panola.edu/instruciton/dl/testing.htm>

Secretary of Labor's Commission on Achieving Necessary Skills (SCANS)

1. BASIC SKILL COMPETENCIES

A. Basic Skills

- i. **Reading:** Locate, understand and interpret written information in prose and in documents such as manuals, graphs and schedules.
- ii. **Writing:** Communicate thoughts, ideas, information and messages in writing, and create documents such as letters, directions, manuals, reports, graphs, and flow charts.
- iii. **Arithmetic & Mathematical Operations:** Perform basic computations and approach practical problems by choosing appropriately from a variety of mathematical techniques.
- iv. **Listening:** Receive, attend to, interpret, and respond to verbal messages and other cues.
- v. **Speaking:** Organize ideas and communicate orally.

B. Thinking Skills

- i. **Creative Thinking:** Generate new ideas.
- ii. **Decision Making:** Specify goals and constraints generate alternatives, consider risks and evaluate and choose the best alternative.
- iii. **Problem Solving:** Recognize problems and devise and implement plan of action.
- iv. **Visualize ("Seeing Things in the Mind's Eye"):** Organize and process symbols, pictures, graphs, objects, and other information.
- v. **Knowing how to learn:** use efficient learning techniques to acquire and apply new knowledge and skills
- vi. **Reasoning:** Discover a rule or principle underlying the relationship between two or more objects and apply it when solving a problem.

C. Personal Qualities

- i. **Responsibility:** Exert a high level of effort and persevere toward goal attainment.
- ii. **Self-Esteem:** Believe in one's own self-worth and maintain a positive view of oneself.
- iii. **Sociability:** Demonstrate understanding, friendliness, adaptability, empathy, and politeness in group settings.
- iv. **Self-Management:** Assess oneself, set personal goals, monitor progress, and exhibit self-control.
- v. **Integrity & Honesty:** Choose ethical courses of action.

2. WORKPLACE COMPETENCIES

A. Resources:

- i. **Time:** Select goal-relevant activities, rank them, allocate time, and prepare and follow schedules.
- ii. **Money:** Use or prepare budgets, make forecasts, keep records, and make adjustments to meet objectives.
- iii. **Material & Facilities:** Acquire, store, allocate, and use materials or space efficiently.
- iv. **Human Resources:** Assess skills and distribute work accordingly, evaluate performance and provide feedback.

B. Interpersonal Skills:

- i. **Participate as Member of a Team:** Contribute to group effort.
- ii. **Teach Others New Skills.**
- iii. **Serve Clients/ Customers:** Work to satisfy customers' expectations.
- iv. **Exercise Leadership:** Communicate ideas to justify position, persuade & convince others, responsibly challenge existing procedures & policies.
- v. **Negotiate:** Work toward agreements involving exchange of resources, resolve divergent interests.
- vi. **Work with Diversity:** Work well with men and women from diverse backgrounds.

C. Information:

- i. **Acquire and Evaluate Information.**
- ii. **Organize and Maintain Information.**
- iii. **Interpret and Communicate Information.**
- iv. **Use computers to process information.**

D. Systems:

- i. **Understand Systems:** Know how social, organizational and technological systems work and operate effectively with them.
- ii. **Monitor & Correct Performance:** Distinguish trends, predict impacts on system operations, and diagnose deviations in systems' performance.
- iii. **Improve or Design Systems:** Suggest modifications to existing systems and develop new or alternative systems to improve performance.

E. Technology

- i. **Select Technology:** Choose procedures, tools or equipment including computers and related technologies.
- ii. **Apply Technologies to Task:** Understand overall intent and proper procedures for setup and operation of equipment.
- iii. **Maintain and Troubleshoot Equipment:** Prevent, identify, or solve problems with equipment, including computers and other technologies.