

UNIT 1 ELECTRICAL SAFETY 3 Hour

Table of Contents/Objectives

1. Friend and Foe
2. Electricity and the Human Body
3. Hazards of Electricity
4. Effects of Voltage, Current and Resistance
5. Danger High Voltage
6. Lock Tag and Think
7. Safe Electrical Practices

Unit Summary

Review Quiz

Hands On Exercises

- Lab 1 Working Safely with Electricity
- Lab 2 Electrical Controls Trainer Familiarization

UNIT 2 CONTROL TRANSFORMERS 2 Hour

Table of Contents/Objectives

1. Alternating Current Power Systems
2. Voltage Measurements
3. Control Transformers
4. 480 Volt Primary Connections
5. 340 Volt Primary Connections
6. Transformer Protection and Grounding
7. Testing Control Transformers

Unit Summary

Review Quiz

Hands On Exercises

- Lab 3 Voltage Measurement
- Lab 4 Control Transformers

UNIT 3 OVERCURRENT PROTECTION 3.25 Hours

Table of Contents/Objectives

1. Overcurrent Protection
2. Overloads
3. Short Circuits
4. Overcurrent Protection Devices
5. Fuses
6. Non-Time Delay Fuses
7. Time Delay Fuses
8. Current Limiting Fuses
9. Fuse Classes
10. Testing Fuses
11. Replacing Fuses
12. Circuit Breakers
13. Thermal Circuit Breakers
14. Magnetic Circuit Breakers

Unit Summary

Review Quiz

Hands On Exercises

- Lab 5 Overcurrent Protection

UNIT 4 PUSHBUTTON STATIONS 3.5 Hours

Table of Contents/Objectives

1. Pushbutton Switches
2. Legend Plates
3. Contact Blocks
4. Operators
5. Color Coding of Operators
6. Pushbutton Units
7. Selector Switches
8. Two Position Selector Switch
9. Three Position Selector Switch
10. Pilot Lights

PILOT STATIONS *continued*

11. Full Voltage Pilot Lights
12. Transformer Pilot Lights
13. Push to Test Pilot Lights
14. Cluster Pilot Lights
15. Full and Miniature Size Devices
16. Testing Contact Blocks
17. Continuity Testers
18. Testing Pilot Light Units
19. Enclosures

Unit Summary

Review Quiz

Hands On Exercises

- Lab 6 Continuity Testers
- Lab 7 Pushbutton Controls
- Lab 8 Pilot Lights

UNIT 5 LIMIT SWITCHES 2.75 Hours

Table of Contents/Objectives

1. Limit Switches
2. Mechanical Limit Switches
3. Mechanical Limit Switch Adjustments
4. Mechanical Limit Switch Contacts
5. Proximity Switches
6. Inductive Proximity Switches
7. Capacitive Proximity Switches
8. Proximity Switch Outputs
9. Connecting Multiple Proximity Switches
10. Photoelectric Switches
11. Direct Mode
12. Retroreflective Mode
13. Diffuse Mode
14. Convergent Mode

LIMIT SWITCHES *continued*

1. Photoelectric Switch Outputs
2. Pressure Switches
3. Temperature Switches
4. Flow, Float and Foot Switches
5. Testing Limit Switches

Unit Summary

Review Quiz

Hands On Exercises

- Lab 9 Mechanical Limit Switches
- Lab 10 Proximity Switches
- Lab 11 Photoelectric Switches

UNIT 6 SOLENOIDS *2.5 Hours*

Table of Contents/Objectives

1. Solenoids
2. Solenoid Construction
3. Eddy Currents
4. Solenoid Operation
5. Inrush and Sealing Current
6. Shading Coil
7. Physical and Electrical Characteristics
8. Solenoid Valves
9. Single Actuator Valves
10. Double Actuator Valves
11. Troubleshooting Solenoids
12. Testing Solenoids

Unit Summary

Review Quiz

Hands On Exercises

- Lab 12 Solenoids

UNIT 7 RELAYS *3.5 Hours*

Table of Contents/Objectives

1. An Electrically Operator Switch
2. Relay Construction
3. Relay Operation
4. Relay Applications
5. Control Relay Coils
6. Control Relay Contacts
7. Control Relay Configurations
8. Control Relay Terminal Identification
9. Electrical Interlock Circuit
10. Latching Relays
11. Time Delay Relays
12. Plug-In Relays
13. Solid State Relays
14. Troubleshooting Relay Circuits

Unit Summary

Review Quiz

Hands On Exercises

- Lab 13 Control Relays
- Lab 14 Latching Relays
- Lab 15 Time Delay Relays
- Lab 16 Plug In Relays

UNIT 8 TIMERS & COUNTERS *2.5 Hours*

Table of Contents/Objectives

15. Timer Applications
1. Elapsed Time Indicators
2. Reset Timers
3. Reset Timer Operation
4. Reset Timer Contacts
5. Pushbutton Reset Timers
6. Repeat Cycle Timers

TIMERS & COUNTERS *continued*

8. Counter Applications
9. Reset Counters
10. Reset Counter Operation
11. Reset Counter Contacts

Unit Summary

Review Quiz

Hands On Exercises

- Lab 17 Timers

UNIT 9 THREE PHASE MOTORS *3.5 Hours*

Table of Contents/Objectives

1. Three Phase AC Motors
2. Principles of Rotating Electrical Machinery
3. Rotating Magnetic Field
4. Torque
5. Horsepower
6. Induction Motor
7. Repulsion Motor
8. Motor Speed and Slip
9. Motor Frame Sizes
10. Motor Enclosures
11. Squirrel Cage Induction Motors
12. Single Voltage Connections
13. Dual Voltage Connections
14. Multi-Speed Motors
15. Direction of Rotation
16. AC Repulsion Motors
17. Wound Rotor Motors
18. Synchronous Motors
19. Troubleshooting AC Motors
20. Motor Nameplate Information

THREE PHASE MOTORS *Continued*

21. Voltage Measurements
22. Current Measurements
23. Ventilation
24. Lubrication
25. Vibration

Unit Summary

Review Quiz

Hands On Exercises

- Lab 18 Three Phase Motors

UNIT 10 CONTACTORS & MOTOR STARTERS *5 Hours*

Table of Contents/Objectives

1. Contactors
2. Contactor Sizes
3. Contact Arcing
4. Contactor Applications
5. Overload Relays
6. Melting Alloy Overload Relays
7. Overload Heater Selection
8. Bimetallic, Magnetic and Solid State OL Relays
9. Full Voltage Motor Starters
10. Reversing Motor Starters
11. Reduced Voltage Motor Starters
12. Primary Resistor Motor Starters
13. Autotransformer Motor Starters
14. Wye-Delta Motor Starters
15. Part Winding Motor Starters
16. Combination Motor Starters
17. IEC Devices
18. Troubleshooting Motor Starters
19. Checking the Control Circuit in a Starter

CONTACTORS & MOTOR STARTERS *continued*

21. Testing Overload Relay Contacts
22. Checking the Power Circuit in a Starter
23. Testing Contactor and Heaters
24. Testing Motor Windings

Unit Summary

Review Quiz

Hands On Exercises

- Lab 19 Non-Reversing Motor Starter
Lab 20 Reversing Motor Starter

UNIT 11 LADDER LOGIC & ELECTRICAL DRAWINGS *12 Hours*

Table of Contents/Objectives

1. Electrical Symbols
2. Electrical Drawings
3. Wiring Diagrams
4. Ladder Diagrams
5. Conductor Identification
6. IEC Component Symbols
7. IEC Terminal Identification
8. Ladder Logic
9. AND Ladder Logic
10. OR Ladder Logic
11. NOT Ladder Logic
12. NOR Ladder Logic
13. Two Wire Control
14. Three Wire Controls
15. Ladder Logic Control Circuits
16. Multiple Pushbutton Ladder Logic
17. Manual-Off-Automatic Ladder logic
18. Sequencing Ladder Logic
19. Electrical interlocks
20. Master Control Relay Ladder Logic

LADDER LOGIC & ELECTRICAL DRAWINGS *continued*

Unit Summary

Review Quiz

Hands On Exercises

- Lab 21 Wiring Diagrams
Lab 22 Ladder Diagrams
Lab 23 Two Wire Control
Lab 24 Multiple Pushbuttons
Lab 25 Man-Off-Automatic Operation
Lab 26 Manual Sequencing
Lab 27 Automatic Sequencing
Lab 28 Electrical Interlocks

UNIT 12 JOGGING & PLUGGING *2.5 Hours*

Table of Contents/Objectives

1. Jogging
2. Selector Switch Jogging
3. Control Relay Jogging
4. Jogging a Reversing Starter
5. Plugging Speed Switches
6. Speed Switches
7. Plugging Circuits
8. Anti-Plugging

Unit Summary

Review Quiz

Hands On Exercises

- Lab 29 Jogging
Lab 30 Drill Station