WESTERN IOWA TECH COMMUNITY COLLEGE

Course Syllabus

Electrical Technician – Level 2

Course Title: Electrical Technician – Level
Total Hours:56
Meeting time/ location :TBA
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COURSE DESCRIPTION AND PREREQUISITES/COREQUISITES:
The Electrical Maintenance Certificate combines the disciplines of Industrial Safety, Electrical Concepts, Blueprint Reading, Motor Controls, Industrial Wiring, and Programmable Logic Controllers. Each of the levels contains portions of each of these disciplines to present a holistic and competency driven approach to the mastering of the skills necessary for an Electrical Maintenance Technician. Each level is designed to be delivered in such a way that the student attends the levels in a sequential order to ensure a complete understanding of the material. This training can be transcribed into college credit. Test outs are available to ensure the students are prepared for each level prior to registering for the training.

COURSE OBJECTIVES

The course will provide information which should enable the student to:

1.   Define series and parallel circuits
2.   Describe the voltage characteristics in series and parallel circuits
3.   Define current and give its units of measurement
4.   Describe the function of two types of ammeters and give their schematic symbol
5.   Describe how to use an ammeter to measure current
6.   Describe the current characteristics in series and parallel circuits
7.   Describe two methods of measuring continuity
8.   Describe the resistance characteristics in series and parallel circuits
9.   Define resistance and give its units of measurement
10. Describe the function of two types of ohmmeters and give their schematic symbol
11. Describe how to use an ohmmeter to measure resistance
12. State the formula for calculating series resistance and give an application
13. State Ohm's Law, explain its importance and give an application
14. State Kirchhoff's voltage law for a series circuit and give an application
15. Define power and give its units of measurement
16. State a formula for calculating the total power used in an electrical circuit
17. State Kirchhoff's Current Law and give an application
18. State a formula for calculating total parallel resistance
19. Describe the operation of two types of circuit breakers and give their schematic
20. Describe the operation of a fuse and give its schematic symbol
21. Describe the function of two types of circuit protection and give an application of
22. Define electromagnetism and give an application
23. Describe the functions of four electromagnetic devices
24. Define inductance and give its units of measurement
25. Describe the operation of an inductor and give its schematic symbol
26. Describe the effect of an inductor in a DC circuit and give an application
27. Describe the effect of an inductor in an AC circuit and give an application
28. State the formulas for calculating total series inductance and inductive reactance
29. State the formulas for calculating total parallel inductance and inductive
30. Define capacitance and give its units of measurement
31. Describe the operation of a capacitor and give its schematic symbol
32. Describe the functions of three types of capacitors

33. Describe the effect of a capacitor in a DC circuit and give an application
34. Describe the effect of a capacitor in an AC circuit and give an application
35. State the formulas for calculating total series capacitance and capacitive
36. State the formulas for calculating total parallel capacitance and capacitive
37. Describe the function of capacitor and inductors in electric power supplies
38. Describe the function of an RC timing circuit in a time-delay relay
39. Describe the function of a fluorescent light fixture
40. Define a series-parallel circuit
41. Describe a method for identifying the series and parallel sections of a circuit
42. List the seven steps for solving a combination circuit
43. Describe how switches are used in combination circuits and give an application
44. Describe the function of a variable resistor and give an application
45. Describe the function of a voltage divider and give an application
46. Describe the operation of three types of voltage dividers
47. Describe the three basic steps for troubleshooting an open circuit
48. Describe the four steps for troubleshooting a short circuit
49. Explain the effect of a short circuit
50. Describe the function of three types of electrical control systems and give an application of each
51. Describe the three steps of a control process
52. Describe the function of an indicator lamp and give an application
53. Describe the operation of a pushbutton switch and give its schematic symbol
54. Describe the operation of a selector switch and give its schematic symbol
55. Describe the function of a ladder diagram
56. Describe the function of four components of a ladder diagram
57. Describe six rules of drawing a ladder diagram
58. Describe how to determine the operation of a circuit given a ladder
59. Describe the operation of NAND logic and give an application
60. Describe the operation of OR logic and give an application
61. Describe the operation of NOT logic and give an application
62. List six elements of control logic
63. Describe the operation of AND logic and give an application
64. Describe the function of a push-to-test pilot light and give an application
65. Describe the operation of a push-to-test pilot light and give its schematic symbol
66. Describe the operation of memory logic and give an application
67. Describe the operation of a magnetic motor starter
68. Describe the operation of a two-wire motor control circuit and give an application
69. Describe the operation of a three-wire motor control circuit and give an
70. Describe the function of a control relay and give an application
71. Describe the operation of a control relay and give its schematic symbol
72. Describe the operation of two types of control relays and give an application of each
73. Describe how detached symbology is used to show a control relay on a ladder diagram
74. Describe how to test the windings of a 3-phase motor with a digital multimeter
75. Describe how to test a manual switch
76. Describe how to test a control relay
77. Describe how to test a motor contactor
78. Describe how to test an overload relay
79. Describe two levels of troubleshooting and give an application of each
80. Describe the three methods of testing a component and give an application of each
81. Describe how to test an indicator lamp
82. Describe the SLC 500"s memory organization
83. Describe the operation of the SLC 500's Input and Output Data Tables
84. Describe the function of seven types of processor files
85. Describe three advantages of PLC software
86. Describe how an input device can reference multiple input instructions
87. Describe how the input device logic affects input instruction logic
88. Describe how a PLC controls multiple outputs at the same time
89. Describe two methods by which a PLC output can control a motor
90. Describe how to draw a PLC output diagram for a motor application
91. Describe how input instructions can be controlled by output instructions
92. Describe the function and operation of PLC seal-in logic
93. Describe the function and operation of a program interlock and give an

94. Describe how a program interlock is used for safety
95. Describe the function of project documentation and give an application
96. Describe how to interface a PLC to a machine controller
97. Describe five features used to select a PLC discrete output module
98. Describe the effect of leakage current on AC output module operation
99. Explain how to interface to a discrete electronic sensor with NPN or PNP output
   100. Describe four features used to select a PLC discrete input module
   101. Define event-driven sequencing
   102. Describe the operation of a reciprocating actuator PLC program
   103. Describe the operation of a basic multiple actuator sequence program
   104. Describe the operation of a continuous cycle reciprocating program
   105. Describe the function of an internal output instruction and give an application
106. Understand how the lack of lockout/tagout causes industrial accidents
107. Recognize the basic concepts of lockot/tagout
108. Determine the hazards of uncontrolled energy
109. Acknowledge the importance of lockout/tagout
110. Understand the hazards of power tools
111. Use power tools safely
112. Inspect tools for safe operation and verify machine/tool guards are in place
113. Recognize a safe vs. unsafe tool use practices
114. Determine proper safety equipment for working with specific power tools
115. Identify power sources for tools. (hydraulic, electrical, powder actuated, etc)
116. Explain how workers are vulnerable to electrical injuries
117. Identify electrical hazards
118. Recognize benefits of proper wiring
119. Work safely with electrical components
120. Describe OSHA's electrical standards and laws
121. Identify different electrical warning symbols

CONTENT OUTLINE:
1. RESISTANCE MEASUREMENT
2. CURRENT MEASUREMENT
3. INTRODUCTION TO SERIES AND PARALLEL CIRCUITS
4. CIRCUIT PROTECTION DEVICES
5. POWER IN PARALLEL CIRCUITS
6. POWER IN SERIES CIRCUITS
7. ELECTROMAGNETISM
8. INDUCTANCE
9. CAPACITANCE
10. CHARACTERISTICS OF CAPACITANCE
11. INDUCTOR AND CAPACITOR APPLICATIONS
12. CHARACTERISTICS
13. LIGHTING CIRCUITS
14. VOLTAGE DIVIDERS
15. TROUBLESHOOTING
16. ELECTRICAL CONTROL SYSTEM BASICS
17. LADDER DIAGRAM BASICS
18. LOGIC ELEMENTS 1
19. LOGIC ELEMENTS 2
20. CONTROL RELAYS
21. MAGNETIC MOTOR STARTERS
22. TWO-WIRE CONTROL
23. THREE-WIRE START/STOP CONTROL
24. INTRODUCTION TO TROUBLESHOOTING
25. CONTROL COMPONENT TROUBLESHOOTING
26. MOTOR STARTER TROUBLESHOOTING
27. POWER COMPONENT TROUBLESHOOTING
28. PLC MEMORY ORGANIZATION
29. PLC PROGRAMMING SOFTWARE
30. PLC PROGRAM ANALYSIS
31. MOTOR CONTROL BASICS

32. SEAL-IN PROGRAM LOGIC
33. INTERLOCK FUNCTIONS
34. DOCUMENTATION AND ADVANCED EDITING
35. BASIC INPUT INTERFACING
36. BASIC OUTPUT INTERFACING
37. ELECTRONIC DEVICE INTERFACING
38. ELECTRICAL DRAWINGSAND PLANS
39. ELECTRICAL AND ELECTRONIC SYSTEMS

COMPETENCIES:
1. Voltage characteristics of series and parallel circuits
2. Use a DMM to measure voltage drops in series and parallel circuits
3. Test the continuity of wires using a DMM
4. Characteristics in series and parallel circuits
5. Use a DMM to measure the resistance of a component
6. Measure the resistance in series and parallel circuits
7. Current measurement simulation
8. Use a DMM to measure the electrical current
9. Use a DMM to measure current in series and parallel circuits
10. Calculate series resistance given each load's resistance
11. Use Ohm's Law to calculate voltage, current, and resistance in a series circuit
12. Verification of Kirchhoff's Voltage Law
13. Test and reset a circuit breaker
14. Calculate the main line current in a parallel circuit
15. Calculate the total parallel resistance
16. Calculate the total power used in a parallel circuit
17. Operate a circuit using a fuse
18. Test and replace a fuse
19. Operate a circuit using a circuit breaker
20. Calculate the total power used by a series circuit
21. Test an electromagnetic field
22. Electromagnetic device operation
23. Connect and operate a relay in a circuit
24. Effect of inductance in a DC circuit
25. Effect of inductive reactance in an AC circuit
26. Calculate the total load on an AC circuit with inductors
27. Discharge a capacitor
28. Test a capacitor with a DMM
29. Calculate the time to charge and discharge a capacitor
30. Effect of a capacitor in an AC circuit
31. Calculate the total load on an AC circuit with capacitors
32. Measure the voltage across a charged capacitor
33. Effect of a capacitor in a DC circuit
34. Trace the current path in a combination circuit
35. Solve a combination circuit
36. Connect and operate a basic lighting circuit
37. Connect and operate a ceiling fan circuit
38. Rheostat operation
39. Connect and operate a rheostat as a light dimmer
40. Locate an open circuit
41. Locate a short circuit
42. Voltage divider network operation
43. Design a voltage divider network
44. Connect and operate a voltage divider network
45. Connect and operate a basic electrical control circuit which uses a pushbutton switch
46. Connect and operate a basic electric control circuit using a selector switch
47. Draw a ladder diagram of a control circuit
48. Determine the operation of a control circuit given a ladder diagram
49. Connect and operate a control circuit given a ladder diagram
50. Connect and operate an AND logic circuit
51. Connect and operate an OR logic circuit
52. Connect and operate a NOT logic circuit

53. Connect and operate a NOR logic circuit
54. Connect and operate a NAND logic circuit
55. Design a multiple start/stop pushbutton station control circuit
56. Connect and operate a control relay in a circuit
57. Connect and operate a memory logic circuit
58. Connect and operate a three-wire control circuit with a push-to-test pilot light
59. Connect and operate a two-wire motor control circuit
60. Connect and operate a three-wire motor control circuit
61. Design a multiple operator station three-wire control circuit
62. Identification of the basic components of a magnetic motor contactor
63. Connect and operate a magnetic motor starter connected to a three-phase motor
64. Test an indicator lamp
65. Test a manual switch
66. Test a control relay
67. Test a motor contactor
68. Test an overload relay
69. Test the windings of a 3-phase motor with a digital multimeter
70. Test the windings of a control transformer with a digital multimeter
71. View the status of the SLC 500"s Input and Output Data Tables
72. Create a PLC project using PLC software
73. Configure the 1/0 for a PLC project using PLC software
74. Enter a basic PLC program using PLC software
75. Save a PLC program to disk using PLC software
76. Edit a PLC program using PLC software
77. Generate and print out a ladder logic report using PLC software
78. Control of multiple outputs
79. Operation of input instructions controlled by output instructions
80. Design a PLC program to jog two motors
81. Operation of a seal-in motor control program
82. Design a PLC program to control the start/stop of two motors application
83. Operation of a reversing motor control program
84. Design a PLC program to interlock two motors
85. Design a PLC program that uses a safety interlock to control the operation of a
86. View project documentation and use it to operate a PLC program
87. Document a PLC program file
88. Connect and test a limit switch to a discrete input module
89. Connect and test the operation of a PLC input module to a robot output module
90. Connect and test the operation of a PLC discrete output module to a robot input module
91. Develop an interface wiring diagram to interface a PLC to a machine controller
92. Connect and test the operation of an electronic sensor to a PLC input module
93. Connect and test the operation of a solenoid valve to a PLC output
94. Connect and test the operation of a motor starter to a PLC
95. Design a reciprocating actuator sequence PLC program
96. Operation of single-cycle actuator reciprocation PLC program
97. Operation of continuous cycle actuator reciprocating program
98. Operation of a clamp and drill sequence
99. Design a continuous cycle clamp and drill sequence PLC program

Course Grading Methods:

QUIZZES
OBJECTIVE TESTS
HANDS ON ASSESSMENTS
FINAL TEST

REVIEWS OR QUIZZES NOT TURNED IN ON TIME WILL BE GIVEN "0" MISSED PRACTICAL TESTS AND
    FINAL EXAM CAN BE MADE UP ONLY BY THE APPROVAL OF THE INSTRUCTOR.

FINAL EXAM - TBA

ATTENDANCE:

Students are expected to attend all sessions of classes for which they are enrolled. Absences do not excuse the student from meeting the course requirements. The student must take the initiative in making up any missed work. Each instructor will provide policies concerning course attendance."

ACADEMIC HONESTY:

Students are responsible for their own learning and development. They have a responsibility to be an active learner by attending class, completing class and laboratory assignments, and preparing in advance of the scheduled class session. Students are expected to understand and maintain high standards of academic honesty. Examples of academic dishonesty include, but are not limited to, the following:

- Cheating
- Plagiarism
- Fabrication
- Dual Submission
- Facilitating Academic Dishonesty

COMPUTER CONDUCT:

College computer systems are provided by WITCC for use by students, faculty, and staff for the purpose of furthering the educational mission of the College. This includes course work, college-related educational endeavors, and business operations. Each user is expected to follow established computer conduct policies and not to interfere with or disrupt the orderly processes of WITCC resources. Users accept the responsibility for utilizing services in ways that are ethical, that demonstrate academic integrity and respect for others who share this resource. Users must follow all existing federal, state, and local laws as they relate to computer conduct.

AMERICANS WITH DISABILITIES ACT (A):

Persons with documented disabilities may request reasonable accommodations through Disability Services, located in the Admissions & Advising Center, A300, or at (712) 274-8733, Ext. 3216.

DISCRIMINATION:

Western Iowa Tech Community College does not discriminate on the basis of race, creed, color, gender, national origin, religion, age, disability, sexual orientation, gender identity, veteran status or any other protected basis as defined in Iowa or federal law as amended from time to time in its educational programs, activities, admission procedures or employment practices. Individuals who believe they have been discriminated against may file a complaint through the College's Grievance or Complaint Procedures. Complaint or Grievance Forms and Procedures may be obtained from the WITCC Human Resources Department, Dr. Robert H. Kiser Building, Room A242, (712) 274-6400, Ext. 1220.

SAFETY AND SECURITY:

WITCC has produced videos regarding safety features and procedures that can be taken by students, staff and faculty. These videos have been posted on the myWIT homepage under the "Safety" tab and may be viewed at any time. An Emergency Response Guide along with Tornado, Fire and Secure Your Area posters have been placed in each classroom and work space area which list specific precautions that should be taken. If you have any questions or concerns, please call the Safety/Security Supervisor at 712-274-8733, extension 3210. If you have an emergency situation at the Sioux City campus, call 1316 or 911 from any telephone on campus immediately. For the outlying campuses call 911 immediately.

As a comprehensive community college, our mission is to provide quality education and to economically enhance the communities we serve.