

## **COURSE SYLLABUS**

<b>LAST REVIEW</b>	Fall 2022
<b>COURSE TITLE</b>	Electromechanical Systems
<b>COURSE NUMBER</b>	ELET 0101
<b>DIVISION</b>	Career and Technical Education
<b>DEPARTMENT</b>	ELET
<b>CIP CODE</b>	46.0302
<b>CREDIT HOURS</b>	3
<b>CONTACT HOURS/WEEK</b>	Class: 2      Lab: 2
<b>PREREQUISITES</b>	None

### **COURSE DESCRIPTION**

Upon successful completion of this course, the student should be able to identify electrical components and their relationships to the various repair and troubleshooting techniques. The materials in this course will prove useful to service technicians whose background in electricity is limited. The course includes material from basic electrical theory to troubleshooting complex electrical circuits. This course will provide practice in the application of electrical theory as well as in the interconnection of components of heating and cooling systems.

### **PROGRAM ALIGNMENT**

This course is part of a program aligned through the Kansas Board of Regents and Technical Education Authority. For more information, please visit:  
[https://kansasregents.org/workforce\\_development/program-alignment](https://kansasregents.org/workforce_development/program-alignment)

### **PROGRAM LEARNING OUTCOMES**

1. The Student will be able to identify workplace safety issues in accordance with OSHA standards.
2. Upon successful completion of this course, the student should be able to identify the job skills necessary to have a successful career in the Electrical Profession.
3. Inspect electrical circuit connections in accordance with the N.E.C. standards of compliance.

### **TEXTBOOKS**

<http://kckccbookstore.com/>

### **METHOD OF INSTRUCTION**

A variety of instructional methods may be used depending on content area. These include but are not limited to lecture, multimedia, cooperative/collaborative learning, labs and demonstrations, projects and presentations, speeches, debates, panels, conferencing, performances, and learning experiences outside the classroom. Methodology will be selected to best meet student needs.

## **COURSE OUTLINE**

- I. Basic Electricity
  - A. Explain the flow of electrons and how it is accomplished
  - B. Explain electrical potential, current flow, and resistance and how each is measured
  - C. Explain electrical power and how it is measured
  - D. Explain Ohm's law
  - E. Calculate the potential, current and resistance of an electrical circuit using Ohm's law
- II. Electric Circuits
  - A. Explain the characteristics of a series circuit
  - B. Explain the characteristics of a parallel circuit
  - C. Describe how parallel circuits are utilized as power circuits in the air-conditioning industry
  - D. Calculate the current, resistance and electromotive force in a series circuit
  - E. Calculate the current, resistance and electromotive force in a parallel circuit
  - F. Explain the operation of the basic analog meter
  - G. Describe the operation of an analog voltmeter
  - H. Describe the operation of an analog and a digital clamp-on ammeter
  - I. Describe the operation of an analog ohmmeter
  - J. Explain the operation of a digital volt-ohm meter
  - K. Material Safety Data Sheet (MSDS)
- III. Electric Symbols of Air Conditioning Wiring Diagrams
  - A. Identify the symbols of relays and contactors in heating, cooling, and refrigeration systems
  - B. Identify the symbols of switches and the types used in heating, cooling, and refrigeration systems
  - C. Read simple air conditioning schematic diagrams
  - D. Read advanced air conditioning schematic diagrams
- IV. Alternating Current, Power Distribution and Voltage Systems
  - A. Explain the basic difference between direct and alternating currents
  - B. Explain how alternating current is produced
  - C. Explain the difference between single-phase and three-phase power distribution systems
  - D. Explain inductance, reactance, and impedance

- V. Basic Electric Motors
  - A. Explain magnetism and the part it plays in the operation of electric motors
  - B. Explain torque and the purpose of different types of single-phase motors
  - C. Describe the operation, install, reverse the rotation, if possible, and diagnose problems in a shaded-pole motor
  - D. Describe the purpose of capacitors in the operation of a single-phase motor and be able to explain the difference between a starting and running capacitor
  - E. Explain the operation of split-phase and capacitor-start motors
  - F. Explain the operation of permanent split-capacitor motors
  - G. Explain the operation of capacitor-start-capacitor-run motors
- VI. Heating Control Devices
  - A. Explain the purpose of the electrical controls in warm air and hydronic heating applications that are necessary to safely operate and maintain the desired temperature in a conditioned space
  - B. Describe the pilot safety controls and methods of ignition of the burners in a gas furnace
  - C. Explain the operation of an electric furnace or electric resistance duct heater and the methods of control that are commonly used
  - D. Draw the wiring diagram of an electric
- VII. Air Conditioning Control Systems
  - A. Explain the electrical circuitry of a residential condensing unit
  - B. Make all electrical connections to install a condensing unit in a residential application
  - C. Make all electrical connections for a complete residential installation
  - D. Draw the control systems used in gas heat electric air-conditioning packaged units
- VIII. Control Systems: Circuits and Troubleshooting
  - A. Describe the control circuit used in residential applications
  - B. Draw the basic circuit of control systems used on light commercial and industrial applications
  - C. Describe the best troubleshooting procedures to use for a particular problem
  - D. Troubleshoot basic light commercial conditioned air control systems

### **COURSE LEARNING OUTCOMES AND COMPETENCIES**

Upon successful completion of this course, the student will:

- A. Explain the flow of electrons and how it is accomplished.
  - 1. Explain the electron theory and the cause of electrons flowing from their valence orbit.
  - 2. Explain how electrical resistance, voltage and current are measured.
  - 3. Explain how power is measured in a circuit.

4. Explain Ohm's Law and calculate resistance, current and voltage using Ohm's Law.
- B. Explain electrical potential, current flow, and resistance and how each is measured.
5. Explain the characteristics of a series circuit and parallel circuit.
  6. Calculate current, resistance and voltage in a series circuit and a parallel circuit.
  7. Explain how an analog meter operates.
  8. Explain how an analog voltmeter operates.
  9. Explain how an analog and a digital clamp-on ammeter operates.
  10. Explain the operation of an analog ohmmeter.
  11. Explain the operation of a digital volt-ohmmeter.
- C. Identify electric symbols of air conditioning wiring diagrams.
12. Identify symbols of relays, pressure switches and contactors in an air conditioning circuit.
  13. Identify switches used in heating, refrigeration, and air conditioning.
  14. Read and explain simple air conditioning diagrams.
  15. Explain advance air conditioning diagrams with pneumatic controls.
- D. Explain the difference between alternating current and direct current.
16. Explain how alternating current has a peak on the positive cycle and the negative cycle.
  17. Explain how direct current does not have a change from positive to negative.
  18. Explain how alternating power is produced at the generating station.
  19. Determine single phase power from three phase power by the number of conductors.
  20. Explain the elements in a circuit that causes inductance, reactance, and impedance.
- E. Explain the basic operation of electric motors.
21. Explain how magnetism plays a crucial role in the electric motor operation.
  22. Explain how the different characteristics of single-phase motors determine motor torque value.
  23. Explain the rotating field in a shaded pole motor and how to diagnose problems.
  24. Explain the operation of a single-phase capacitor start and capacitor run motor.
  25. Explain the operation of a single-phase split-phase capacitor motor.
  26. Explain the operation of a permanent split capacitor motor.
  27. Explain the operation of a capacitor start and capacitor run motor.
- F. Explain the operation and control of electrical heating devices.
28. Explain the purpose of electrical control devices and how they control the temperature of hydronic heating safely to maintain a desired temperature.
  29. Describe the pilot ignition and different methods of ignition on gas furnaces.

30. Explain the operation of an electric furnace or electric resistance duct heater and how the temperatures are controlled.
  31. Draw a wiring diagram of an electric furnace.
- G. Explain the electric circuit of an air conditioning control system.
32. Explain the electric circuit of the condensing unit.
  33. Make all electrical connections for the condensing unit.
  34. Complete all electrical connections on the furnace.
  35. Draw a diagram of the controls used in a gas fired furnace and electric air conditioner.
- H. Describe control circuits and troubleshooting in residential applications.
36. Describe the schematic functions of a control circuit.
  37. Draw the circuit for control systems on commercial and industrial applications.
  38. Describe the best procedures for troubleshooting by starting at the source of voltage.
  39. Troubleshoot light commercial air conditioning systems by checking the power supply and air distribution system.

### **ASSESSMENT OF COURSE LEARNING OUTCOMES AND COMPETENCIES**

Student progress is evaluated through both formative and summative assessment methods. Specific details may be found in the instructor's course information document.

### **COLLEGE POLICIES AND PROCEDURES**

*Student Handbook*

<https://www.kckcc.edu/files/docs/student-resources/student-handbook-and-code-of-conduct.pdf>

*College Catalog*

<https://www.kckcc.edu/academics/catalog/index.html>

*College Policies and Statements*

<https://www.kckcc.edu/about/policies-statements/index.html>

*Accessibility and Accommodations*

<https://www.kckcc.edu/academics/resources/student-accessibility-support-services/index.html>.