EET-1220: CIRCUITS AND ELECTRONICS FOR AUTOMATION

Cuyahoga Community College

Viewing: EET-1220 : Circuits and Electronics for Automation

Board of Trustees:
January 2021

Academic Term:
Fall 2021

Subject Code
EET - Electrical/Electronic Engineer

Course Number:
1220

Title:
Circuits and Electronics for Automation

Catalog Description:
This course is designed for non-EET majors and provides a basic understanding of electricity and electronics as applied to manufacturing settings. Foundational topics include electrical safety, basic circuit fundamentals, electronic components, transformers, and machinery basics necessary for an understanding of modern automation systems used in industry.

Credit Hour(s):
3

Lecture Hour(s):
2

Lab Hour(s):
2

Other Hour(s):
0

Requisites

Prerequisite and Corequisite
MATH-0955 Beginning Algebra or concurrent enrollment; or departmental approval.

Outcomes

Course Outcome(s):
Apply knowledge of basic electric circuits, electrical/electronic components, and machinery basics to modern manufacturing settings.

Essential Learning Outcome Mapping:
Not Applicable: No Essential Learning Outcomes mapped. This course does not require application-level assignments that demonstrate mastery in any of the Essential Learning Outcomes.

Objective(s):
1. Describe the makeup of basic atomic structure.
2. List the characteristics of conductors and insulators.
3. Specify how wire sizes are categorized in the American Wire Gauge (AWG) system.
4. Specify the measurement units of electromotive force (EMF), electric current, and resistance.
5. Describe how voltage, current, and resistance is measured.
6. Explain how resistance opposes the flow of electric current.
7. Describe how characteristics of conductors affect their resistance.
8. Specify how resistor color coding provides various levels of resistance in an electric circuit.
9. Explain the relationship between voltage, current, and resistance in a circuit.

10. Describe Ohm's Law and how it can be used to solve electric circuit problems.
11. Apply Ohm's Law to solve electric circuit problems.
12. Practice conversion of very small and very large values of electrical quantities.
13. Discuss overload protection of electric circuits.
14. List various types of switches used in electric circuits.
15. Define the term "power".
16. Discus the relationship between Ohm's Law and Watt's Law.
17. Explain characteristics of series and parallel circuits.
18. Define Kirchoff's Voltage Law (KVL) and Kirchoff's Current Law (KCL).
19. Apply Kirchoff's Laws to simple series and parallel circuits.
20. Practice solving series and parallel circuit problems.
21. Explain how series-parallel or combination circuits are analyzed for basic electrical quantities.
22. Understand key characteristics of a bridge circuit.
23. State basic laws of magnetism.
24. Describe how electric current can produce magnetic fields.
25. Describe operation of a relay and why it is important to electrical applications.
26. List basic components and functionality of an electric motor.
27. Explain how a sine wave is generated.
28. Describe function of a capacitor in an electric circuit.
29. Define the unit for capacitance (Farad) and inductance (Henry).
30. Describe different types of capacitors and inductors.
31. Describe capacitive reactance and inductive reactance and its effect on an electric circuit.
32. Explain the characteristic of impedance in an electric circuit.
33. Describe how to combine capacitive reactance and inductive reactance in an electric circuit.
34. Explain why resonance is important in electronic communications applications.
35. Describe the basic operation of a transformer.
36. List three losses of a transformer.
37. Explain how transformers are constructed.
38. Discuss why turns ratio is important to transformer operation.
39. Explain why transformers are used for power transformers.
40. Explain the function of an autotransformer.
41. Define amplification.
42. Discuss formation of N-Type and P-Type material.
43. Explain how the diode is used in various circuits.
44. Explain operation of half-wave and full-wave rectifier circuits.
45. Describe function and operation of the transistor.
46. Discuss operation of SCR, Triac, Diac, and UJT Devices.
47. Describe an integrated circuit (IC).
48. Describe performance of an operational amplifier (op-amp).
49. List various digital logic gates and their function.
50. Explain configuration of a basic computer system.

Course Outcome(s):

Apply the basic concepts of analog and digital circuits to modern automation systems used in industry today.

Essential Learning Outcome Mapping:

Not Applicable: No Essential Learning Outcomes mapped. This course does not require application-level assignments that demonstrate mastery in any of the Essential Learning Outcomes.

Objective(s):

1. Understand the basic purpose and function of DC drives.
2. Understand the basic purpose and function of AC drives.
3. Describe Programmable Logic Controller (PLC) components, wiring, programming, and maintenance.
4. Explain the purpose of various sensors used in automated processes.
5. Explain the role of Human-Machine Interface (HMI) equipment in modern manufacturing settings.

Course Outcome(s):

Utilize sound electrical safety practices in an industrial setting.

Essential Learning Outcome Mapping:

Not Applicable: No Essential Learning Outcomes mapped. This course does not require application-level assignments that demonstrate mastery in any of the Essential Learning Outcomes.

Objective(s):

1. List general safe industrial work practices.
2. Describe how to safely work with electrical tools and equipment.
3. Explain safety rules that are especially related to electrical maintenance including arc flash precautions.
4. Describe the role OSHA plays in the workplace.
5. Discuss the importance of lockout/tagout.

Methods of Evaluation:

1. Tests
2. Quizzes
3. Laboratory Reports
4. Homework
5. Projects

Course Content Outline:

1. Safety
   a. Importance of Safety
   b. Safe Work Practices
   c. Safe Use of Tools and Equipment
   d. Special Safety Rules for Electrical Maintenance (Arc Flash Hazards)
   e. Lockout/Tagout
   f. OSHA
2. Fundamentals of Electricity
   a. Atomic Structure
   b. Conductors and Insulators
   c. Wire Sizes
   d. Electric Circuit Basics (Volts, Amperes, Ohms)
   e. Resistance and Conductor Size
   f. Resistor Color Codes
3. Meters
   a. Basic Electrical Measurements
   b. Analog and Digital Meters
   c. Meter Connections
   d. Meter Safety and Precautions
4. Ohm's Law
   a. Simple DC Circuit
   b. Overload Protection
   c. Circuits and Switches
5. Power
   a. Watt's Law
   b. Horsepower
6. Series Circuits
   a. Series Circuits Characteristics
   b. Resistors in Series
   c. Voltage Drop
   d. Applications
7. Parallel Circuits
   a. Parallel Circuit Characteristics
   b. Resistors in Parallel
   c. Applications

8. Series-Parallel (Combination) Circuits
    a. Series-Parallel (Combination) Circuit Characteristics
    b. Equivalent Resistance
    c. Bridge Circuits
9. Magnetism
    a. Laws of Magnetism
    b. Electricity and Magnetism
    c. Relays
    d. Solenoid Switches
    e. Hall Effect Devices
10. Alternating Current (AC) Principles
    a. Uses of AC
    b. Sinusoidal Waveforms
    c. Frequency
    d. Period
    e. Average Values
    f. Effective Values
    g. Peak-to-Peak Values
11. Capacitance
    a. Capacitors
    b. The Capacitive Circuit
    c. The Farad
    d. Working Voltage
    e. Labeling Capacitors
    f. Factors that Determine Capacitance
    g. Types of Capacitors
    h. RC Time Constants
    i. Capacitive Reactance
    j. Impedance
12. Inductance
    a. Circuit Inductance
    b. Self-Inductance
    c. The Henry
    d. Labeling Inductors
    e. Inductive Kick
    f. Inductive Reactance
    g. Impedance
    h. Combining X_L and X_C in a Circuit
    i. Resonance
13. Transformers
    a. Transformer Operation
    b. Lenz's Law
    c. Transformer Losses
    d. Transformer Construction
    e. Turns Ratio
    f. Power Transmission
    g. Autotransformer
14. Semiconductors and Integrated Circuits (ICs)
    a. Transistor History
    b. Amplification
    c. Diodes
    d. Rectification
    e. Transistors
    f. Special Semiconductor Devices
    g. Integrated Circuit (IC) Use
    h. Digital and Linear Integrated Circuits
    i. Computers
15. Motors and Motor Controls

   a. Motor Components and Function
   b. DC Motors
   c. AC Motors
   d. Basic Motor Controls
   e. Specifying Motors for Manufacturing Applications
16. Sensors and DC/AC Drives
   a. Sensors
   b. DC Drives
   c. AC Drives
17. Programmable Logic Controllers (PLCs)
   a. PLC Components and Wiring
   b. Programming
   c. Maintenance
18. Human-Machine Interface (HMI)
   a. Industrial Communication Networks
   b. Human-Machine Interfaces (HMIs)

Resources

Gerrish, Howard H., William E. Dugger Jr., and Ken DeLucca. *Electricity*. 11th ed. Goodheart-Wilcox, 2020.

Matt, Stephen R. *Electricity and Basic Electronics*. 8th ed. Goodheart-Wilcox, 2013.

Floyd, Thomas L. and David M. Buchla. *Electronics Fundamentals: Circuits, Devices & Applications*. 8th ed. Prentice Hall, 2010.

Bailee, Shawn A. and Gary R. Shearer. *Industrial Maintenance and Mechatronics*. 1st ed. Goodheart-Wilcox, 2020.

Brumbach, Michael E. and Jeffrey A. Clade. *Industrial Maintenance*. 2nd ed. Cengage, 2013.

Top of page
Key: 1622